BOOK OF DATA
FOR
TEACHERS
OF
CHEMISTRY

Department of Science, Health and Physical Education
National Institute of Education
Maharagama

2010

First Edition 2010

TO THE CHEMISTRY TEACHER

This "Book of Data for Teachers of Chemistry" has been compiled to ease your burden in searching for data at the stage of planning lessons.

The data contained in this book will provide you with material for the

- preparation and presentation of your lessons.
- planning and developing exercises, assignments and projects for your students.
- preparation of visual aids - graphs and charts - to be displayed in the classroom.

The material could also be used to motivate your students to further their interest in chemistry.

I am confident that the use of this book will contribute to better teaching and learning of chemistry in Sri Lanka.

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National Institute of Education,
Maharagama.
2010

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1. RELATIVE ATOMIC MASSES OF ELEMENTS

Name	Symbol	Atomic number	Relative Atomic mass
Actinium	Ac	89	(227)
Aluminium	Al	13	26.9815
Americium	Am	95	(243)
Antimony	Sb	51	121.75
Argon	Ar	18	39.948
Arsenic	As	33	74.9216
Astatine	At	85	(210)
Barium	Ba	56	137.34
Berkelium	Bk	97	(249)
Beryllium	Be	4	9.0122
Bismuth	Bi	83	208.980
Boron	B	5	10.81 ± 0.003*
Bromine	Br	35	79.909 ± 0.002**
Cadmium	Cd	48	112.40
Caesium	Cs	55	132.905
Calcium	Ca	20	40.08
Californium	Cf	98	(251)
Carbon	C	6	12.0115 ± 0.00005*
Cerium	Ce	58	140.12
Chlorine	Cl	17	35.453
Chromium	Cr	24	51.996
Cobalt	Co	27	58.9332
Copper	Cu	29	63.54
Curium	Cm	96	(247)
Dysprosium	Dy	66	162.50
Einsteinium	Es	99	(254)
Erbium	Er	68	167.26
Europium	Eu	63	151.96
Fermium	Fm	100	(253)
Fluorine	F	9	18.994
Francium	Fr	87	(223)
Gadolinium	Gd	64	157.25
Gallium	Ga	31	69.72
Germanium	Ge	32	79.59
Gold	Au	79	196.967
Hafnium	Hf	72	178.49
Helium	He	2	4.0026
Holmium	Ho	67	164.930
Hydrogen	H	1	1.00797

RELATIVE ATOMIC MASSES OF ELEMENTS (Contd.)

Name	Symbol	Atomic number	Relative Atomic mass
Indium	In	49	114.82
Iodine	I	53	126.9044
Iridium	Ir	77	192.20
Iron	Fe	26	55.857±0.003**
Krypton	Kr	36	83.80
Lanthanum	La	57	138.92
Lawrencium	Lw	103	(257)
Lead	Pb	82	207.19
Lithium	Li	3	6.959
Lutetium	Lu	71	174.970
Magnesium	Mg	12	24.312
Manganese	Mn	25	54.9380
Mendelevium	Md	101	(256)
Mercury	Hg	80	200.59
Molybdenum	Mo	42	95.94
Neodymium	Nd	60	144.24
Neon	Ne	10	20.138
Neptunium	Np	93	(237)
Nickel	Ni	28	58.71
Niobium	Nb	41	92.906
Nitrogen	N	7	14.0067
Nobelium	No	102	(254)
Osmium	Os	76	190.2
Oxygen	O	8	15.9994
Palladium	Pd	46	106.4
Phosphorus	P	15	30.9738
Platinum	Pt	78	195.09
Plutonium	Pu	94	(242)
Polonium	Po	84	(210)
Potassium	K	19	39.102
Praseodymium	Pr	59	140.92
Promethium	Pm	61	(145)
Protactinium	Pa	91	(231)
Radium	Ra	88	(226)
Radon	Rn	86	(222)
Rhenium	Re	75	186.20
Rhodium	Rh	45	102.905
Rubidium	Rb	37	85.47
Ruthenium	Ru	44	101.07

RELATIVE ATOMIC MASSES OF ELEMENTS (Contd.)

Name	Symbol	Atomic number	Relative Atomic mass
Samarium	Sm	62	150.35
Scandium	Sc	21	44.956
Selenium	Se	34	78.96
Silicon	Si	14	28.086
Silver	Ag	47	107.870±0.003***
Sodium	Na	11	22.9898
Strontium	Sr	38	87.62
Sulphur	S	16	32.064±0.003*
Tantalum	Ta	73	180.948
Technetium	Tc	43	(99)
Tellurium	Te	52	127.60
Terbium	Tb	65	158.924
Thallium	TI	81	204.37
Thorium	Th	90	232.038
Thulium	Tm	69	168.934
Tin	Sn	50	118.69
Titanium	Ti	22	47.90
Tungsten	W	74	183.85
Uranium	U	92	238.03
Vanadium	V	23	50.942
Xenon	Xe	54	131.30
Ytterbium	Yb	70	173.04
Yttrium	Y	39	88.905
Zinc	Zn	30	65.37
Zirconium	Zr	40	91.22

Several of the more recently discovered elements are only known to exist as unstable isotopes. For these elements the mass of the most stable isotopes is given in parenthesis.

* These elements have variable atomic masses because of natural variations is isotopic composition.
* The values for these elements are believed to have experimental uncertainties as indicated.

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2. SPECTRA OF ATOMIC HYDROGEN (Wavelength in nm)

Lyman series *Ultra-violet, nm*	*Balmer series* *Visible, nm*
92.3	656.3
92.6	486.1
93.1	434.0
93.8	410.2
95.0	397.0
97.3	388.9
102.6	383.5
121.6	

Series limits for the ultra-violet spectra of the alkali metals

Element	*Series limit, cm^{-1}*
Lithium	43,480
Sodium	41,450
Potassium	35,010
Rubidium	33,680
Caesium	31,410

3. ELECTRO MAGNETIC SPECTRUM

Wavelength **cm**

10^{4}	10^{3}	10^{2}	10	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}
Radio Waves					Micro wave	Far IR	IR	Near IR	Visible	UV	Vacuum UV		Xrays	Gamma rays →

Wavelength	km 0.01													
	m 10	1												
	cm	100				10^{-2}								
			10^{4}			10^{2}				10^{-2}				
	nm					10^{5}			10^{3}	10				
	^{0}A								10^{4}	100		1		10^{-2}

Frequency	Hz	$3x10^{8}$	$3x10^{10}$	$3x10^{12}$	μm	$3x10^{14}$	$3x10^{16}$		$3x10^{18}$		$3x10^{20}$			
	kHz	$3x10^{5}$	$3x10^{7}$	$3x10^{9}$										
	MHz	300	$3x10^{4}$	$3x10^{6}$										
	cm^{-1}	0.01	1	100		10^{4}	10^{6}		10^{8}		10^{10}			

Low energy
Long wavelen
Low frequenc

High energy
Short wavelength
High frequency

F ɔectrum.

4. PHYSICAL PROPERTIES OF ELEMENTS

Z	Symbol	Rel.At. Mass	Density gcm^{-3}(20 ^{0}C)	At.Vol. $cm^3\ mol^{-1}$	Sp.Ht. $Jg^{-1}K^{-1}$	M.Pt. ^{0}C	B.Pt. ^{0}C	Ht. Fusion $kJ\ mol^{-1}$	Ht.Vap. $kJ\ mol^{-1}$ `	Covalent Radii nm	Van der waal Radii nm	Ionic Radii nm
1	2	3	4	5	6	7	8	9	10	11	12	13
1	H	1	0.071	14.1	14.42	-259	-253	0.06	.45	.03	.12	(-1).208
2	He	4	0.125	31.8	5.23	-270	-268.9	0.02	.084	-	-	-
3	Li	6.94	0.53	13.1	3.30	180	1330	3.30	138.0	.123	.155	.068
4	Be	9	11.84	04.9	1.88	1283	3000	10.0	310.0	.090	.112	.035
5	B	10.8	2.34	04.3	1.63	2030	2550	22	536.0	.082	.098	.023
6	C	12	2.25	5.4	0.69	3600	4800	-	718.0	.077	.091	.061
7	N	14	0.81	17.3	1.03	-210	-196	0.4	2.8	.075	.15	.17
8	O	16	1.14	14.0	0.91	-218	-183	0.22	3.4	.073	.14	.14
9	F	19	1.15	17.1	0.75	-220	-188	0.8	3.135	.072	.135	.136
10	Ne	20.2	1.20	16.8	-	249	-245	0.33	1.67	.071	.131	.112
11	Na	23	0.97	23.7	1.23	97.8	890	2.6	93	.156	.19	.095
12	Mg	24.3	1.74	14.0	1.02	651	1100	9.00	128	.136	.16	.066
13	Al	27	2.70	10.0	0.90	660	2500	10.7	290	.12	.14	.051
14	Si	28.1	2.42	16.6	0.68	1410	3265	46.5	397	.117	.13	.042
15	P	31	2.34	14.1	0.74	44	280	0.6	12.8	.11	.128	.212
16	S	32	2.07	15.5	0.73	113	445	1.2	10	.103	.127	.184
17	Cl	35.5	2.00	18.7	0.48	-103	- 35	3.2	10	.099	-	0.181
18	Ar	39.95	1.66	24.0	0.52	-189	-186	1.12	6.7	.098	.174	-
19	K	39.1	0.87	45.0	0.74	63	766	2.3	79	.203	.235	.133
20	Ca	40	1.55	26.0	1.25	840	1500	8.7	161	.174	.197	.099
21	Sc	45.0	3.0	15.0	0.56	1540	2400	16.0	305	0.144	0.162	0.081
22	Ti	47.9	4.5	10.6	0.52	1680	3277	15.5	429	0.132	0.147	(+2).09
23	V	50.9	6.0	8.3	0.5	1910	3376	17.6	458	0.122	0.134	(+3).074
24	Cr	52.0	7.2	7.2	0.46	1900	2642	14.0	347	0.118	0.13	(+3).069
25	Mn	54.9	7.4	7.4	0.48	1250	2041	14.6	220	0.117	0.135	(+2).08
26	Fe	55.9	7.86	7.1	0.46	1535	3000	15.4	350	0.117	0.126	(+2).074
27	Co	58.9	8.9	6.6	0.41	1495	2900	15.0	382	0.116	0.125	(+2).072
28	Ni	58.7	8.93	6.6	0.44	1450	2837	17.6	372	0.115	0.124	(+2).069
29	Cu	63.5	8.93	7.1	0.38	1083	2582	13.0	305	0.117	0.128	(+2).069

4. PHYSICAL PROPERTIES OF ELEMENTS (Contd.)

Z	Symbol	Rel.At. Mass	Density gcm^{-3}(20 ^{0}C)	At.Vol. $cm^3\ mol^{-1}$	Sp.Ht. $Jg^{-1}K^{-1}$	M.Pt. ^{0}C	B.Pt. ^{0}C	Ht. Fusion $kJ\ mol^{-1}$	Ht.Vap. $kJ\ mol^{-1}$ `	Covalent Radii nm	Van der waal Radii nm	Ionic Radii nm
1	2	3	4	5	6	7	8	9	10	11	12	13
30	Zn	65.4	7.1	9.2	0.38	420	908	7.4	115	0.125	0.138	.074
31	Ga	69.7	5.9	11.8	0.33	30	2237	5.6	256	0.125	0.138	(+1).113
32	Ge	72.6	5.46	13.3	0.31	937	2837	31.8	330	0.122	0.137	(+2).093
33	As	74.9	5.72	13.1	0.34	613	Subl	27.7	32	0.121	0.139	(-3).222
34	Se	79.0	4.8	16.5	0.35	220	685	5.4	27	0.117	0.200	(-2).195
35	Br	79.9	3.12	25.6	0.29	-7.2	58.5	5.4	15	0.114	0.195	.195
36	Kr	83.8	3.00	32.3	-	-157	-153	1.6	9.2	0.112	0.189	-
37	Rb	85.5	1.53	55.7	0.33	39	700	2.3	75	0.316	0.248	.147
38	Sr	87.6	2.6	33.7	0.33	800	1400	9.0	140	0.191	0.215	.112
39	Y	88.9	4.47	19.9	0.30	1500	3227	17.0	393	0.162	_	-
40	Zr	91.2	6.44	14.2	0.33	1952	4377	17.0	581	0.145	_	-
41	Nb	92.9	8.57	10.8	0.27	2500	4927	11.0	283	0.134	_	(+5).069
42	Mo	95.9	10.2	9.4	0.28	2620	4800	28.0	540	0.13	_	(+6).062
43	Tc	99.0	11.5	8.6	-	2140	4627	23.0	577	0.127	_	(+7).056
44	Rn	101.1	12.4	8.4	0.24	2425	4111	25.5	567	0.125	_	(+4).067
45	Rh	102.9	12.44	8.3	0.25	1960	3960	21.0	495	0.125	_	(+3).056
46	Pd	106.4	12.2	8.8	0.24	1550	3127	16.7	392	0.128	_	(+2).08
47	Ag	107.9	10.5	10.3	0.23	961	2227	11.2	255	0.134	.144	.126
48	Cd	112.4	8.65	13.1	0.23	321	765	6.2	100	0.144	.15	.097
49	In	114.8	7.3	15.7	0.24	157	2000	3.3	225	0.144	_	(+3).08
50	Sn	118.7	7.3	16.3	0.23	232	2300	7.2	290	0.14	.162	(+2).112
51	Sb	121.8	6.6	18.2	0.20	630	1380	20.0	195	0.141	.22	(+5).076
52	Te	127.6	6.25	20.5	0.20	450	1390	17.5	50	0.137	.22	(+4).07
53	I	126.9	4.9	25.7	0.22	113	184	8.0	21	0.133	.215	(-1).216
54	Xe	131.3	-	42.9	-	-112	- 108	2.2	12.54	0.131	.21	_
55	Cs	132.9	1.87	71.0	0.20	28	685	2.1	66	0.235	.267	.167

4. PHYSICAL PROPERTIES OF ELEMENTS (Contd.)

Z	Symbol	Rel.At. Mass	Density g cm^{-3}(20 ^{0}C)	At.Vol. cm^3 mol^{-1}	Sp.Ht. J $g^{-1}K^{-1}$	M.Pt. ^{0}C	B.Pt. ^{0}C	Ht.Fusion kJ mol^{-1}	Ht.Vap. kJ mol^{-1}	Covalent Radii nm	Vanderwall Radii nm	Ionic Radii nm
1	2	3	4	5	6	7	8	9	10	11	12	13
56	Ba	137.3	3.5	39.2	0.28	725	1140	7.6	150	0.198	.222	.134
58.	Pt	195.1	21.4	9.1	0.13	1770	4300	20	510	0.13	.139	(+2).096
79.	Au	197.0	19.3	10.2	0.14	1063	2600	13	325	0.134	.146(M)	.137
80.	Hg	200.6	13.6	14.7	0.14	-39	357	2.3	58	0.147	.157(M)	.112
82.	Pb	207.2	11.3	18.3	0.13	327	1750	5	179	0.154	.175(M)	(+2).12
83.	Bi	209	9.8	21.4	0.13	271	1560	1.9	151.32	.148	.17	(+5).074
85.	At	210	-	-	-	-	-	-	-	.145	.176	(+7).062
86.	Rn	222	-	50.5	-	72	-62	2.93	16.30	-	.25	-
87.	Fr	223	-	-	-	27	677	2.09	63.54	-	-	.18
88.	Ra	226	-	45	-	700	1527	8.36	136.69	-	-	.14

M = Metallic radius

5. PHYSICAL CONSTANTS

Universal gas constant	(R)	$8.314\ J\ mol^{-1}\ K^{-1}$
Velocity of light	(C)	$2.997 \times 10^{8}\ m\ s^{-1}$
Avogadro constant	(L)	$6.022 \times 10^{23}\ mol^{-1}$
Faraday constant	(F)	$96490\ C\ mol^{-1}$
Mass of an electron	(m_e)	$9.1096 \times 10^{-28}\ g$
Charge of an electron	(e)	$1.6022 \times 10^{-19}\ C$
Mass of a proton	(m_p)	$1.6726 \times 10^{-24}\ g$
Mass of a neutron	(m_n)	$1.6749 \times 10^{-24}\ g$
Atmospheric pressure		$101\ 325\ N\ m^{-2}$

6. ELECTRO NEGATIVITY VALUES OF SOME ELEMENTS (PAULING'S SCALE)

						H
						2.1
Li	**Be**	**B**	**C**	**N**	**O**	**F**
1.0	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
Na	**Mg**	**Al**	**Si**	**P**	**S**	**Cl**
0.9	**1.2**	**1.5**	**1.8**	**2.1**	**2.5**	**3.0**
K	**Ca**	**Ga**	**Ge**	**As**	**Se**	**Br**
0.8	**1.0**	**1.6**	**1.8**	**2.0**	**2.4**	**2.8**
Rb	**Sr**	**In**	**Sn**	**Sb**	**Te**	**I**
0.8	**1.0**	**1.7**	**1.8**	**1.9**	**2.1**	**2.5**
Cs	**Ba**	**Tl**	**Pb**	**Bi**	**Po**	**At**
0.7	**0.9**	**1.8**	**1.9**	**1.9**	**2.0**	**2.2**

7. FIRST IONIZATION ENERGIES OF THE ELEMENTS

(a) First Ionization Energies $\Delta H/kJmol^{-1}$ at 298K

									H 1310								He 2370
Li 519	Be 900											B 799	C 1090	N 1400	O 1310	F 1680	Ne 2080
Na 494	Mg 736											Al 577	Si 786	P 1060	S 1000	Cl 1260	Ar 1520
K 418	Ca 590	Sc 632	Ti 661	V 648	Cr 653	Mn 716	Fe 762	Co 757	Ni 736	Cu 745	Zn 908	Ga 577	Ge 762	As 966	Se 941	Br 1140	Kr 1350
Rb 402	Sr 548	Y 636	Zr 669	Nb 653	Mo 694	Tc 699	Ru 724	Rh 745	Pd 803	Ag 732	Cd 866	In 556	Sn 707	Sb 833	Te 870	I 1010	Xe 1170
Cs 376	Ba 502	La 540	Hf 531	Ta 577	W 770	Re 762	Os 841	Ir 887	Pt 866	Au 891	Hg 1010	Tl 590	Pb 716	Bi 774	Po 812	At	Rn 1040
Fr 318	Ra 510	Ac 669															
		Ce 665	Pr 556	Nd	Pm 607	Sm 556	Eu 540	Gd 548	Tb 594	Dy 648	Ho 657	Er	Tm	Yb 598	Lu 481		
		Th 674	Pa	U 385	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

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8. SUCCESSIVE I. E.'S OF ELEMENTS in KJ mol^{-1}

Atomic number	Element	1st	2nd	3rd	4th	5th	6th	7th	8th
1	H	1310							
2	He	2370	5250						
3	Li	519	7300	11800					
4	Be	900	1760	14800	21000				
5	B	799	2420	3660	25000	32800			
6	C	1090	2350	4610	6220	37800	47000		
7	N	1400	2860	4590	7480	9440	53200	64300	
8	O	1310	3390	5320	7450	11000	13300	71000	84100
9	F	1680	3370	6040	8410	11000	15100	17900	91600
10	Ne	2080	3950	6150	9290	12100	15200	20000	23000
11	Na	494	4560	6940	9540	13400	16600	20100	25500
12	Mg	736	1450	7740	10500	13600	18000	21700	25600
13	Al	577	1820	2740	11600	14800	18400	23400	27500
14	Si	786	1580	3230	4360	16000	20000	23600	29100
15	P	1060	1900	2920	4960	6280	21200	25900	30500
16	S	1000	2260	3390	4540	6990	8490	27100	31700
17	Cl	1260	2300	3850	5150	6540	9330	11000	33600
18	Ar	1520	2660	3950	5770	7240	8790	12000	13800
19	K	418	3070	4600	5860	7990	9620	11400	14900
20	Ca	590	1150	4940	6480	8120	10700	12300	14600
21	Sc	632	1240	2390	7110	8870	10700	13600	15300
22	Ti	661	1310	2720	4170	9620	11600	13600	17000
23	V	648	1370	2870	4600	6280	12400	14600	16700
24	Cr	653	1590	2990	4770	7070	8700	16600	17700
25	Mn	716	1510	3250	5190	7360	9750	11500	18800
26	Fe	762	1560	2960	5400	7620	10100	12800	14600
27	Co	757	1640	3230	5100	7910	10500	13300	16400
28	Ni	736	1750	3390	5400	7620	10900	13800	17000
29	Cu	745	1960	3550	5690	7990	10500	14300	17500
30	Zn	908	1730	3828	5980	8280	11000	13900	18100
31	Ga	577	1980	2960	6190	8700	11400	14400	17700
32	Ge	762	1540	3300	4390	8950	11900	14900	18200
33	As	966	1950	2730	4850	6020	12300	15400	18900
34	Se	941	2080	3090	4140	7030	7870	16000	19500
35	Br	1140	2080	3460	4850	5770	8370	10000	20300
36	Kr	1350	2370	3560	5020	6370			
37	Rb	402	2650	3850	5110	6850			
38	Sr	548	1060	4120	5440	6940			
39	Y	636	1180	1980					
40	Zr	669	1270	2220	3310	8000	9600	11000	14000
41	Nb	653	1380	2430	3690	4850	10000	12000	14000
42	Mo	694	1560	2620	4480	5400	7100	12000	15000

8. SUCCESSIVE I. E.'S OF ELEMENTS in KJ mol^{-1} (Contd.)

Atomic number	Element	1st	2nd	3rd	4th	5th	6th	7th	8th
43	Tc	699	1470	2800	4100	5900	7500	9200	15000
44	Ru	724	1620	2740	4500	6300	7900	9600	11000
45	Rh	745	1740	3000	4400	6300	8400	10000	12000
46	Pd	803	1870	3180	4730	6300	8800	10000	13000
47	Ag	732	2070	3360	5000	6700	8400	11000	13000
48	Cd	866	1630	3620					
49	In	556	1820	2700	5230				
50	Sn	707	1410	2940	3930	7780			
51	Sb	833	1590	2440	4270	5360			
52	Te	870	1800	3010	3680	5860			
53	I	1010	1840	2040	4030				
54	Xe	1170	2050	3100					
55	Cs	376	2420						
56	Ba	502	966	3390					
57	La	540	1100	1850					
72	Hf	531	1440	2010	3010				
73	Ta	577	1560	2150	3190	4350			
74	W	770	1710	2330	3420	4600	5900		
75	Re	762	1600	2500	3600	5000	6300	7500	
76	Os	841	1630	2400	3800	5000	6700	8000	9600
77	Ir	887	1550	2600	3800	5400	7100	8400	10000
78	Pt	866	1870	2750	3970	5400	7200	8800	10500
79	Au	891	1980	2940	4200	5400	7100	9200	11000
80	Hg	1010	1810	3300					
81	Tl	590	1970	2870	4900				
82	Pb	716	1450	3080	4080	6700			
83	Bi	774	1610	2460	4350	5400			
84	Po	812							
85	At								
86	Rn	1040	1930	2890	4250	5310			
87	Fr	381							
88	Ra	510	979						
89	Ac	669	1170						
90	Th	674	1110	1930	2760				
91	Pa								
92	U	385							

9. SUCCESSIVE I. E.'S OF CALCIUM AND SODIUM

Number of electrons removed	Ionization Energy of calcium kJ mol^{-1}	Ionization Energy of sodium kJ mol^{-1}
1	590	496
2	1145	4578
3	4912	6792
4	6474	9576
5	8145	13440
6	10496	16674
7	12320	20166
8	14207	25578
9	18192	29022
10	20385	141540
11	57048	159600
12	63333	
13	70052	
14	78792	
15	86367	
16	94000	
17	104900	
18	111600	
19	494790	
20	527759	

10. STANDARD ENTHALPIES OF COMBUSTION, ΔH^0_c AND STANDARD ENTHALPIES OF FORMATION, ΔH^0_f

	Physical state	Standard Enthalpy of Combustion ΔH^0_c kJ mol^{-1}	Standard Enthalpy of Formation ΔH^0_f kJ mol^{-1}
HYDROCARBONS			
Alkanes			
Methane	(g)	- 889	- 75
Ethane	(g)	-1565	- 85
Propane	(g)	-2228	- 104
n-butane	(g)	-2888	- 146
n-pentane	(*l*)	-3523	- 174
n-hexane	(*l*)	-4159	- 200
n-heptane	(*l*)	-4807	- 225
n-octane	(*l*)	-5445	- 237
Alkenes			
ethene	(g)	-1362	+ 54
propene	(g)	-2058	+ 21
Alkynes			
ethyne	(g)	-1310	+ 228
propyne	(g)	-1953	+ 186
Benzene compounds			
Benzene	(*l*)	-3284	+ 49
Toluene	(*l*)	-3923	+ 50.1
Ethylbenzene	(*l*)	-4436	- 11.7
ALDEHYDES			
Methanal	(*l*)	- 552	- 116
Ethanal	(*l*)	-1172	- 167
Propanal	(*l*)	-1823	- 206
KETONES			
Propanone	(*l*)	-1792	- 249
Butanone	(*l*)	-2446	- 272
Pentan-3-one	(*l*)	-3089	- 310
ACIDS			
Methanoic	(*l*)	- 271	- 411
Ethanoic	(*l*)	- 879	- 490
Propanoic (propionic)	(*l*)	-1582	- 511
Butanoic (butyric)	(*l*)	-2175	- 543
Oxalic	(s)	- 246	- 700

10. STANDARD ENTHALPIES OF COMBUSTION, ΔH^0_c AND STANDARD ENTHALPIES OF FORMATION ΔH^0_f (Contd.)

	Physical state	Standard Enthalpy of Combustion ΔH^0_c kJ mol^{-1}	Standard Enthalpy of Formation ΔH^0_f kJ mol^{-1}
ALCOHOLS			
Methanol	(*l*)	- 729	-239
Ethanol	(*l*)	-1372	-279
Propan-l-ol	(*l*)	-2022	-302
Butan-l-ol	(*l*)	-2680	-333
Pentan-l-ol	(*l*)	-3330	-360
Hexan-l-ol	(*l*)	-3985	-386
Heptan-l-ol	(*l*)	-4630	-413
Octan-l-ol	(*l*)	-5287	-435
Propan-2-ol	(*l*)	-1994	-312

Standard enthalpy of formation of selected compounds
(kJ mol^{-1} at 25^{0}C and 1 atm; g = gas, *l* = liquid, s = solid, aq = aqueous)

Compound	ΔH^0_f (kJ mol^{-1})	Compound	ΔH^0_f (kJ mol^{-1})
AgBr(s)	- 100.4	Fe_3O_4(s)	-1118
$BaCl_2$(s)	- 858.6	HI(g)	26.5
$BaCl_2.2H_2O$(s)	-1461	H_2O(g)	-241.8
CH_4(g)	- 74.81	H_2O(*l*)	-285.8
C_2H_6(g)	- 84.68	H_2O_2(g)	-136.3
C_3H_8(g)	-103.8	H_2SO_4(*l*)	-814.0
n-C_4H_{10}(g)	-124.7	$NaHCO_3$(s)	-947.7
C_6H_6(g)	82.93	Na_2CO_3(s)	-1131
C_6H_6(*l*)	49.03	NH_3(g)	-46.19
CO(g)	-110.5	O_3(g)	442
CO_2(g)	-393.5	SO_2(g)	-296.8
Fe_2O_3(s)	-824.2	SO_3(g)	-395.7

11. STANDARD ENTHALPIES OF ATOMIZATION OF ELEMENTS ΔH^{θ}_{Atom}

Elements	kJ mol^{-1}
Aluminium	326.4
Antimony	263.6
Arsenic	288.7
Barium	174.4
Beryllium	327.4
Bismuth	207.1
Boron	553.0
Bromine	224.2
Cadmium	12.1
Caesium	78.2
Calcium	177.4
Carbon (graphite)	714.0
Carbon (diamond)	713.0
Chlorine	242.0
Chromium	397.5
Cobalt	424.0
Copper	339.3
Fluorine	158.2
Gold	368.2
Hydrogen	436.0
Iodine	213.4
Iron	417.5
Lead	195.8
Lithium	160.7
Magnesium	147.7
Manganese	279.0
Mercury	61.1
Nickel	428
Nitrogen	946
Oxygen	498.8
Phosphorous (white)	316.3
Phosphorous (red)	333.8
Potassium	89.6
Radium	161.9
Rubidium	82.0
Silicon	443
Silver	286.2
Sodium	107.5
Strontium	163.6
Sulphur	274.5
Tin	301.2
Zinc	130.5

12. ELECTRON AFFINITIES OF SOME ELEMENTS

$X(g) + e \rightarrow X^{-1}(g) \Delta H$ = Electron Affinity

X(g)	Electron Affinity kJ mol^{-1}
H	-75
O	-139
O^-	+794
S	-231
S^-	+567
F	-351
Cl	-349
Br	-344
I	-318

13. AVERAGE BOND ENTHALPIES AT 298 K

Bond	ΔH/kJ mol^{-1}		Bond	ΔH/kJ mol^{-1}
H-H	436		C-H	412
D-D	442	N≡N	Si-H	318
C-C	348		N-H	388
C=C	612		P-H	322
	837		O-H	463
C-C (benzene)	518		S-H	338
Si-Si	176		F-H	562
N-N	163		Cl-H	431
N=N	409		Br-H	366
	944		I-H	299
P-P	112			
O-O	146		C-O	360
O=O	496		C=O	743
S-S	264		C-N	305
F-F	158		C=N	613
Cl-Cl	242			890
Br-Br	193		C-F	489
I-I	151		C-Cl	338
H-Se	305		C-Br	276
H-Te	238		C-I	238
O-Si	464			
O=S	523			

14. ENTHALPIES OF HYDRATION OF SOME IONS AND IONIC RADII

Ion	Enthalpy of hydration kJ/mol^{-1}	Ionic Radius nm
Li^+	-499	0.06
Na^+	-399	0.095
K^+	-305	0.133
Rb^+	-290	0.148
Mg^{2+}	-1891	0.065
Ca^{2+}	-1562	0.099
Cu^{2+}	-2101	0.069
Zn^{2+}	-2045	0.074
Al^{3+}	-4613	0.050
F^-	-457	0.136
Cl^-	-381	0.181
Br^-	-351	0.195
I^-	-307	0.216
Cs^+	-251	0.169
Sr^{2+}	-1415	0.113
Ba^{2+}	-1275	0.135
Fe^{2+}	-1890	0.076
Fe^{3+}	-4340	0.064
Cr^{3+}	-4350	0.069

15. LATTICE ENERGIES OF ALKALI METAL HALIDES in kJ mol^{-1}

Elements	Fluoride	Chloride	Bromide	Iodide
Lithium	1008	836	794	731
Sodium	895	769	735	689
Potassium	798	697	668	634
Rubidium	764	676	647	609
Caesium	731	638	613	584

16. LATTICE ENERGIES OF SOME COMPOUNDS

Lattice energies	
Compounds	kJ mol^{-1}
AgCl	916
AgBr	908
AgI	865
ZnS	3615
MgCl	753
$MgCl_2$	2502
$MgCl_3$	5440

17. STANDARD ENTHALPIES OF FORMATION OF SOME COMPOUNDS OF GROUP I ELEMENTS

X	X_2O kJ/mol	XOH kJ/mol	XF kJ/mol	XCl kJ/mol	XBr kJ/mol	XI kJ/mol
Lithium Li	-596	-486	-612	-408	-351	-271
Sodium Na	-416	-426	-573	-411	-360	-288
Potassium K	-362	-423	-569	-435	-393	-328
Rubidium Rb	-330	-420	-548	-428	-389	-329
Caesium Cs	-318	-418	-531	-433	-395	-337

18. STANDARD ENTHALPIES OF FORMATION OF SOME COMPOUNDS OF GROUP II ELEMENTS

X	XO kJ/mol	$X(OH)_2$ kJ/mol	XF_2 kJ/mol	XCl_2 kJ/mol	XBr_2 kJ/mol	XI_2 kJ/mol	XCO_3 kJ/mol
Beryllium Be	-599	-904	-1009	-493	-370	-212	
Magnesium Mg	-603	-922	-1121	-642	-518	-360	-1113
Calcium Ca	-636	-984	-1215	-795	-675	-535	-1207
Strontium Sr	-590	-953	-1215	-828	-716	-567	-1218
Barium Ba	-557	-945	-1200	-860	-755	-602	-1219

19. MELTING AND BOILING POINTS OF HYDRIDES OF GROUP IV, V, VI, VII ELEMENTS AND INERT GASES

Compound	M.P. ^{0}C	B.P. ^{0}C
CH_4	-183	-162
SiH_4	-185	-112
GeH_4	-165	- 90
SnH_4	-150	- 52
NH_3	- 78	- 33
PH_3	-134	- 88
AsH_3	-116	- 55
SbH_3	- 88	- 17
OH_2	0	100
SH_2	- 85	- 60
SeH_2	- 66	- 41
TeH_2	- 48	- 2
HF	- 83	- 19
HCl	-114	- 85
HBr	- 86	- 66
HI	- 51	- 35
Ne	-249	-246
Ar	-189	-186
Kr	-157	-153
Xe	-112	-108

20. PROPERTIES OF ELEMENTS OF THE 3RD ROW OF THE PERIODIC TABLE

Properties	Na	Mg	Al	Si	P	S	Cl
Nature of the Element	metal	metal	metal	non-metal	non-metal	non-metal	non-metal
Melting point	98	651	660	1416	44	119	-10.1
Boiling point	892	1107	2467	2355	280	445	-34.5
Electronegativity	1.0	1.25	1.45	1.74	2.05	2.45	2.85
1st I.E.	495	738	577	787	1060	100	1255
Electron affinity	21	- 67	26	135	60	196	-348
Atomic volume cm^3/mole	23.7	14.0	10	12	17	15.4	22.7
Formulae of chlorides	NaCl	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_3 PCl_5	SCl_2 SCl_4	Cl_2
Bond Type	Ionic	Ionic	–	Covalency	Increases	→	Covalent
Formulae of oxides	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_3	SO_3	Cl_2O_7
Valency	1	2	3	4	5	6	7
Bonding	Ionic	Ionic	Covalency	Increases	→	Covalent	Covalent
Formulae of hydride	NaH	MgH_2	AlH_3	SiH_4	PH_3	SH_2	ClH
Bonding	Ionic	-	-	Covalency	Increases →	Covalent	Covalent

21. PROPERTIES OF THE OXIDES, CHLORIDES AND HYDROXIDES OF THE ELEMENTS OF ROWS 2 AND 3 OF PERIODIC TABLE

OXIDES OF THE ELEMENTS OF ROW 2 AND 3

Row 2	Li_2O	BeO	B_2O_3	CO_2	N_2O_5	O_2	F_2O
	s	s	s	g	s	g	g
Melting point/^{0}C	>1690	2550	450	-55 (5 atm)	30	-218	-223
ΔH_f per mol 'O'	-660	-610	-427	-200	-8	0	-20
Structure	← Ionic →		Giant Covalen lattice	← Molecular structure →			
Action of water	Basic	Weakly amphoteric	Weakly acidic	← Acidic →		Neutral	Strongly acidic

General increase in acidic properties →

Row 3	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7
	s	s	s	s	s	l	g
Melting point/^{0}C	1280 sub	2850	2080	1610	580	17	-90
ΔH_f per mol 'O'	-410	-600	-560	-455	(>1 atm) -300	-147	+38
Structure	← Ionic →		Giant Covalent lattice		Polymeric ← Molecular structure →		
Action of water ←	Basic		No action →		← Strongly acidic →		

General increase in acidic properties →

CHLORIDES OF THE ELEMENTS OF ROWS 2 AND 3

Row 2	LiCl	$BeCl_2$	BCl_3	CCl_4	NCl_3	OCl_2	FCl
	s	s	*l*	*l*	*l*	g	g
Melting point/^{o}C	607	407	-107	-23	< - 43	-20	-
	-410	-255	-140	-26	+76	+40	-55
Structure	Ionic	Polymeric	←		Molecular structure	→	
Action of water	Dissolution $Li^+(aq)$ $Cl^-(aq)$	Hydrolysis acidic solution	←		Insoluble →	Weakly acidic	Strongly acidic

PROPERTIES OF THE OXIDES, CHLORIDES AND HYUDROXIDES OF THE ELEMENTS OF ROWS 2 AND 3 OF PERIODIC TABLE (Contd.)

Row 3	NaCl	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_5	SCl_2	Cl_2
	s	*s*	*s*	*l*	*s*	*l*	g
Melting point/°C	800	714	180 sub	-70	162 sub	-78	-101
ΔH_f per mol 'Cl'	-412	-320	-233	-160	-92	-10	0
Structure	←	Ionic	→	←	Molecular	→	
Action of water		Dissociation	←	Hydrolysis	←	acidic solution	

HYDRIDES OF THE ELEMENTS OF ROWS 2 AND 3

Row 2	LiH	BeH_2	B_2H_6	CH_4	NH_3	OH_2	FH_2
	s	s	g	g	g	*l*	*l*
Melting point/°C	680	dec. 125	-165	-182	-78	0	-83
ΔH_f per mol 'H'	-90	-	+6	-18	-15	-143	-270
Structure	Ionic	←	Polymeric	→	←	Molecular	→
Action of water	-	Basic; H_2 evolved	Weakly acidic	Insoluble	Basic	-	Acidic

Increasingly (+) ve charge on hydrogen

→ Increasingly acidic

Row 3	NaH	MgH_2	AlH_3	SiH_4	PH_3	SH_2	ClH
	s	s	s	g	g	g	g
Melting point/°C	dec. 800	dec. 290	-	-185	-133	-85	-115
ΔH_f per mol 'H'	-56	-38	+42	-15	+2	-10	-92
Structure	Ionic	Polymeric			←	Molecular structure	→
Action of water		Basic; H_2 evolved		Insoluble	soluble neutral	acidic	acidic

Increasingly (+) ve charge on hydrogen

→ Increasingly acidic

22. DECOMPOSITION TEMPERATURES (^{0}C) OF SOME CARBONATES OF s-BLOCK ELEMENTS

Group I	Decomposition Temperature/^{0}C	Group II	Decomposition Temperature/^{0}C
Lithium	1267	Beryllium	97
Sodium	V. high	Magnesium	197
Potassium	V. high	Calcium	897
Rubidium	V. high	Strontium	1277
Caesium	V. high	Barium	1357

23. MELTING AND BOILING POINTS OF ORGANIC COMPOUNDS

Name	Melting Point ^{0}C	Boiling Point ^{0}C
ALKANES		
methane	**-182.0**	**-160.0**
ethane	**-183.2**	**- 88.0**
propane	**-187.8**	**- 41.4**
butane	**-135.0**	**0.8**
2-methylpropane	**-159.4**	**- 10.9**
pentane	**-129.0**	**37.8**
2-methylbutane	**-158.0**	**28.0**
2, 2-dimethylpropane	**- 15.9**	**10.0**
hexane	**- 94.0**	**69.0**
2-methylpentane	**-153.4**	**60.2**
2, 2-dimethylbutane	**- 98.2**	**49.7**
2, 3-dimethylbutane	**-128.0**	**57.9**
heptane	**- 90.6**	**98.4**
octane	**- 56.8**	**125.7**
2, 2, 4-trimethylpentane	**-107.4**	**99.2**
cyclohexane	**6.5**	**80.7**

23. MELTING AND BOILING POINTS OF ORGANIC COMPOUNDS (Contd.)

Name	Melting Point ^{0}C	Boiling Point ^{0}C
ALKENES		
ethene	-169.1	- 103.7
propene	-184.9	- 47.7
but-1-ene	-185.3	- 6.2
but-2-ene	-138.7	- 3.7
2-methylprop-1-ene	-139.0	- 6.9
pent-1-ene	-165.2	29.9
cyclohexene	-103.7	83.3
buta-1, 3-diene	-136.3	10.3
isoprene	-146.0	34.1
ALKYNES		
ethyne	- 81.5	sub.
propyne	-102.7	-23.2
but-2-yne	- 32.2	27.0
ALKYL HALIDES		
chloromethane	- 97.7	-23.7
dichloromethane	- 96.7	40.2
trichloromethane	- 63.5	61.2
tetrachloromethane	- 22.9	76.8
bromomethane	- 93.6	3.5
dibromomethane	- 52.7	97.0
tribromomethane	8.3	149.6
ALCOHOLS		
methanol	- 97.6	64.6
ethanol	-114.5	78.5
propan-l-ol	-126.5	97.1
propan-2-ol	- 89.5	82.4
butan-1-ol	- 89.5	117.2
butan-2-ol	- 89.0	99.5
2-methylpropan-2-ol	25.0	82.5
2-methylpropan-1-ol	-108.0	108.0
pentan-l-ol (Amyl)	- 78.8	138.2
pentan-2-ol		119.8
pentan-3-ol		116.1

23. MELTING AND BOILING POINTS OF ORGANIC COMPOUNDS (Contd.)

Name	Melting Point ^{0}C	Boiling Point ^{0}C
2-methylbutan-1-ol		128.0
3-methylbutan-1-ol	-117.2	132.0
3-methylbutan-2-ol	17.0	112.9
2-methylbutan-2-ol	- 8.6	101.9
2, 2-dimethypropan-1-ol	52.0	113.0
glycerol	18.2	290.0
ETHERS		
demethyl ether	-141.5	- 24.8
methyl ethyl ether		7.0
diethyl ether	-116.3	34.5
methyl-n-butyl ether	-115.5	70.3
ethylene oxide	-111.7	10.7
ALDEHYDES		
methanal	- 92.0	- 21.0
ethanal	-123.5	20.2
propanal	- 80.5	47.9
butanal	- 99.0	74.7
2-methyl proponal	- 65.9	64.2
KETONES		
acetone	- 94.81	56.1
butanone	- 86.9	79.5
pentan-3-one	- 39.9	102.0
pentan-2-one	- 77.8	102.4
3-methylbutan-2-one	- 92.0	95.0
pentan-2-one	- 56.9	127.2
4-methylpentan-2-one	- 84.7	117.0
AMINES		
methylamine	- 92.5	- 6.0
ethylamine	- 80.6	16.6
propylamine	- 83.0	49.0
butylamine	- 50.0	77.8
triethylamine	- 114.7	89.4

23. MELTING AND BOILING POINTS OF ORGANIC COMPOUNDS (Contd.)

Name	Melting Point ^{0}C	Boiling Point ^{0}C
ACIDS		
methanoic acid	8.4	100.8
ethanoic acid	16.6	117.8
propanoic acid	- 20.8	140.8
butanoic acid	- 5.5	164.0
2-methylpropanoic acid	- 46.1	154.7
chloroacetic acid	63.0	189.4
dichloroacetic acid	9.7	194.4
trichloroacetic acid	58.0	196.0
ACID DERIVATIVES		
methanamide	2.6	193.0
ethanoic anhydride	- 73.0	140.0
ethanoyl chloride	- 112.0	51.0
ethanamide	81.0	221.0
urea	132.7	decomposes
ESTERS		
ethyl methanoate	- 79.4	54.2
methyl ethanoate	98.7	57.3
ethyl ethanoate	- 83.6	77.2
iso-butyl ethanoate	- 98.9	118.0
AROMATIC		
benzene	5.5	80.1
toluene	- 95.0	110.6
aniline	- 6.1	184.4
chlorobenzene	- 45.2	132.4
nitrobenzene	5.7	210.9
benzaldehyde	- 26.0	179.1
benzoic acid	122.4	250.0
phenol	40.9	181.8
benzyl alcohol	- 15.2	205.4
o-xylene	- 25.2	144.4
m-xylene	- 47.9	139.1
p-xylene	13.3	138.4
napthalene	80.2	218.4

24. DISSOCIATION CONSTANTS OF SOME ACIDS AT 298 K

Acids	K_a
Methanoic acid	1.8×10^{-4}
Ethanaoic acid	1.8×10^{-5}
Propanoic acid	1.32×10^{-5}
Butanoic acid	1.51×10^{-5}
Mono fluoro ethanoic acid	2.19×10^{-3}
Mono chloro ethanoic acid	1.4×10^{-3}
Mono bromo ethanoic acid	1.35×10^{-3}
Mono iodo ethanoic acid	7.41×10^{-4}
Di chloro ethanoic acid	5.7×10^{-2}
Tri chloro ethanoic acid	2.2×10^{-1}
Benzoic acid	6.7×10^{-5}
Phenol	1.3×10^{-10}
4-Nitro phenol	6.4×10^{-8}
2, 4-Dinitro phenol	1.0×10^{-4}
2,4, 6-trinitro phenol	1.6×10^{-1}
Carbonic acid	4.6×10^{-7}
Bicarbonate ion	4.4×10^{-11}
Hydrofluoric acid	3.53×10^{-4}
Bi sulphate ion	1.26×10^{-2}
Hydrogen sulphide 1	9.1×10^{-8}
Hydrogen sulphide 2	1.1×10^{-12}
Phosphoric acid 1	7.52×10^{-3}
Phosphoric acid 2	6.23×10^{-8}
Phosphoric acid 3	2.2×10^{-13}
Nitrous acid	4.6×10^{-4}
Hypochlorous acid	2.95×10^{-8}
Sulphurous acid 1	1.54×10^{-2}
Sulphurous acid 2	1.02×10^{-7}

25. DISSOCIATION CONTANTS OF SOME BASES AT 298K

Base	K_b
Ammonia	1.77×10^{-5}
CH_3NH_2	4.2×10^{-4}
$(CH_3)_2NH$	5.9×10^{-4}
$(CH_3)_3N$	6.3×10^{-5}
N_2H_4	3.0×10^{-6}
$C_2H_5NH_2$	5.62×10^{-4}
$(C_2H_5)_2NH$	9.55×10^{-4}
$C_6H_5NH_2$	3.80×10^{-16}

26. IONIC PRODUCT OF WATER AT DIFFERENT TEMPERATURES

Temperature ^0C	$K_w(mol^2\ dm^{-6})$
0	0.11×10^{-14}
10	0.30×10^{-14}
20	0.68×10^{-14}
25	1.00×10^{-14}
50	5.47×10^{-14}
100	51.30×10^{-14}

27. SOLUBILITY PRODUCTS AT 25 ^{0}C

Name	Formula	Solubility Product
aluminium hydroxide	$Al(OH)_3$	$1x10^{-33}$
barium carbonate	$BaCO_3$	$5x10^{-9}$
barium chromate	$BaCrO_4$	$1x10^{-10}$
barium sulphate	$BaSO_4$	$1x10^{-10}$
beryllium hydroxide	$Be(OH)_2$	$3x10^{-18}$
bismuth suphide	Bi_2S_3	$1x10^{-97}$
cadmium hydroxide	$Cd(OH)_2$	$4x10^{-15}$
cadmium sulphide	CdS	$8x10^{-27}$
calcium carbonate	$CaCO_3$	$3x10^{-9}$
calcium hydroxide	$Ca(OH)_2$	$4x10^{-6}$
calcium fluoride	CaF_2	$3x10^{-11}$
calcium oxalate	CaC_2O_4	$2x10^{-9}$
calcium sulphate	$CaSO_4$	$9x10^{-6}$
chromium(II) hydroxide	$Cr(OH)_2$	$1x10^{-17}$
chromium(III) hydroxide	$Cr(OH)_3$	$1x10^{-33}$
cobalt(II) hydroxide	$Co(OH)_2$	$6x10^{-15}$
cobolt(III) hydroxide	$Co(OH)_3$	$3x10^{-41}$
cobalt(I) sulphide	CoS	$4x10^{-21}$
copper(I) bromide	$CuBr$	$5x10^{-9}$
copper(I) chloride	$CuCl$	$2x10^{-7}$
copper(II) hydroxide	$Cu(OH)_2$	$2x10^{-19}$
copper(I) iodide	CuI	$1x10^{-12}$
copper(II) sulphide	CuS	$4x10^{-36}$
copper(I) thiocynate	$CuSCN$	$1x10^{-14}$
gallium hydroxide	$Ga(OH)_3$	$8x10^{-40}$
iron(II) hydroxide	$Fe(OH)_2$	$8x10^{-16}$
iron(III) hydroxide	$Fe(OH)_3$	$4x10^{-40}$
iron(II) sulphide	FeS	$5x10^{-18}$
lead carbonate	$PbCO_3$	$6x10^{-14}$
lead chloride	$PbCl_2$	$2x10^{-5}$
lead hydroxide	$Pb(OH)_2$	$8x10^{-16}$
lead sulphate	$PbSO_4$	$2x10^{-8}$
lead sulphide	PbS	$7x10^{-28}$

27. SOLUBILITY PRODUCTS AT 25 ^{0}C (Contd.)

Name	Formula	Solubility Product
magnesium carbonate	$MgCO_3$	$3x10^{-8}$
magnesium hydroxide	$Mg(OH)_2$	$1x10^{-11}$
manganese(II) hydroxide	$Mn(OH)_2$	$2x10^{-13}$
manganese(II) sulphide	MnS	$3x10^{-10}$
mercury(I) chloride	Hg_2Cl	$1x10^{-18}$
mercury(I) hydroxide	$Hg_2(OH)_2$	$2x10^{-24}$
mercury(II) hydroxide	$Hg(OH)_2$	$4x10^{-26}$
mercury(I) sulphate	Hg_2SO_4	$7x10^{-7}$
mercury(II) sulphide	HgS	$1x10^{-52}$
nickel hydroxide	$Ni(OH)_2$	$2x10^{-15}$
silver acetate	CH_3COOAg	$3x10^{-3}$
silver bromide	AgBr	$5x10^{-13}$
silver carbonate	Ag_2CO_3	$8x10^{-12}$
silver chloride	AgCl	$2x10^{-10}$
silver chromate	Ag_2CrO_4	$2x10^{-12}$
silver cyanide	AgCN	$1x10^{-16}$
silver hydroxide	AgOH	$2x10^{-8}$
silver iodide	AgI	$8x10^{-17}$
silver sulphide	AgS	$6x10^{-50}$
silver thiocyanate	AgSCN	$1x10^{-12}$
strontium carbonate	$SrCO_3$	$1x10^{-10}$
strontium sulphate	$SrSO_4$	$3x10^{-7}$
tin(II) hydroxide	$Sn(OH)_2$	$8x10^{-29}$
tin(II) sulphide	SnS	$1x10^{-26}$

28. ACID-BASE INDICATORS

Name	Concentration of solution	Colour	pH range	pK_a=-log K_a
Thymol blue	0.1% in water	red-yellow	1.2-2.8	1.7
Methyl yellow	0.1% in 90% alc.	red-yellow	2.9-4.0	-
Methyl orange	0.1% in water	red-yellow	3.1-4.4	3.7
Methyl red	0.1% in water	red-yellow	4.4-6.2	5.1
Bromothymol blue	0.1% in water	yellow-blue	6.0-7.6	7.0
Phenol red	0.1% in water	yellow-red	6.8-8.4	7.9
Thymol blue	0.1% in water	yellow-blue	8.0-9.6	8.9
Phenolphthalein	0.1% in 70% alc.	colourless-red	8.3-10.0	9.6
Alizarin yellow	0.1% in water	yellow-lilac	10.1-12.0	-

29. VARIATION OF pH IN AN ACID-BASE TITRATION

Addition of 0.1 mol dm^{-3} NaOH to 25 ml 0.1 mol dm^{-3} HCl							
Volume of base added (cm^3)	0.0	5.0	10.0	15.0	20.0	24.0	24.2
pH	1	1.2	1.4	1.6	2.0	2.7	3.0
Volume of base added (cm^3)	24.4	24.8	24.90	24.95	25.0	25.1	25.2
pH	4.0	4.6	5.0	5.2	7	9.8	10.6
Volume of base added (cm^3)	25.4	25.6	25.8	26.0	30.0	35.0	
pH	10.9	11.2	11.3	11.4	11.9	12.2	

30. SELECTED CONSTANT BOILING-POINT (AZEOTROPIC) BINARY MIXTURES

1. Minimum boiling-point systems

A	B	Mole% A	Wt % A	bp/K
H_2O	C_2H_5OH	10.6	4.43	351.4
H_2O	$(C_2H_{5)2}O$	5.6	1.26	357.4
H_2O	C_6H_6	44.4	15.6	342.6
CH_3OH	$(CH_3)_2CO$	20.0	12.2	328.9
CH_3OH	C_6H_6	61.4	39.5	331.5
CH_3CO_2H	C_6H_6	97.5	96.8	353.3
C_2H_5OH	C_6H_6	44.8	32.4	341.4
C_2H_5OH	C_6H_{12}	33.2	21.4	331.9

2. Maximum boiling-point systems

A	B	Mole% A	Wt % A	bp/K
H_2O	HF	65.4	62.9	384.6
H_2O	HCl	88.9	79.8	381.8
H_2O	HBr	83.1	96.7	399.2
H_2O	HI	84.3	43.1	400.2
H_2O	$HClO_4$	32.0	32.0	476.2
H_2O	HNO_3(735 Torr)	62.2	7.79	393.7
H_2O	HCO_2H	43.3	15.6	380.3
HCl	$(CH_3)_2O$	65.0	59.5	271.7
$CHCl_3$	$(CH_3)_2CO$	65.5	79.6	378.6
HCO_2H	$(C_2H_{5)2}CO$	48.0	33.0	337.7
C_6H_5OH	$C_6H_5CH_2OH$	8.0	7.04	479.2
C_6H_5OH	C_6H_5CHO	54.0	51.0	458.8

31. COMPOSITION AND BOILING POINTS OF AN IDEAL MIXTURE OF LIQUIDS A AND B

Boiling Points ^{0}C	Liquid Phase A % (moles)	Vapour Phase A % (moles)
80	0	0
85	18	1.8
90	33	6.6
95	45	13.5
100	56.5	22.6
105	66	33
110	74.5	44.7
115	82	57.4
120	89	71.2
125	95	85.5
130	100	100

32. SATURATED VAPOUR PRESSURE OF WATER

Temperature ^{0}C	S.V.P. mm Hg	Temperature ^{0}C	S.V.P. mm Hg
10	9.2	39	52.4
11	9.8	40	55.3
12	10.5	41	58.3
13	11.2	42	61.5
14	12.0	43	64.8
15	12.8	44	68.3
16	13.6	45	71.9
17	14.5	46	75.7
18	15.5	47	79.6
19	16.5	48	83.7
20	17.5	49	88.0
21	18.7	50	92.5
22	19.8	51	97.2
23	21.1	52	102.1
24	22.4	53	107.2
25	23.8	54	112.5
26	25.2	55	118.0
27	26.7	56	123.8
28	28.3	57	129.8
29	30.0	58	136.1
30	31.8	59	142.6
31	33.7	60	149.2
32	35.7		
33	37.7		
34	39.9		
35	42.2		
36	44.6		
37	47.1		
38	49.7		

34. STANDARD REDUCTION (ELECTRODE) POTENTIALS

Half reaction	E(V)
$Li^{+}_{(aq)} + e^{-} \rightarrow Li_{(s)}$	- 3.04
$Cs^{+}_{(aq)} + e^{-} \rightarrow Cs_{(s)}$	- 2.95
$Rb^{+}_{(aq)} + e^{-} \rightarrow Rb_{(s)}$	- 2.93
$K^{+}_{(aq)} + e^{-} \rightarrow K_{(s)}$	- 2.92
$Ba^{2+}_{(aq)} + 2e^{-} \rightarrow Ba_{(s)}$	- 2.90
$Sr^{2+}_{(aq)} + 2e^{-} \rightarrow Sr_{(s)}$	- 2.89
$Ca^{2+}_{(aq)} + 2e^{-} \rightarrow Ca_{(s)}$	- 2.87
$Na_{(aq)} + 2e^{-} \rightarrow Na_{(s)}$	- 2.71
$Mg^{2+}_{(aq)} + 2e^{-} \rightarrow Mg_{(s)}$	- 2.37
$Al^{3+}_{(aq)} + 3e^{-} \rightarrow Al_{(s)}$	- 1.66
$Mn^{2+}_{(aq)} + 2e^{-} \rightarrow Mn_{(s)}$	- 1.18
$2H_2O_{(l)} + 2e^{-} \rightarrow H_2(g) + 2OH^{-}_{(aq)}$	- 0.8
$Zn^{2+}_{(aq)} + 2e^{-} \rightarrow Zn_{(s)}$	- 0.76
$Cr^{3+}_{(aq)} + 3e^{-} \rightarrow Cr_{(s)}$	- 0.74
$Fe^{2+}_{(aq)} + 2e^{-} \rightarrow Fe_{(s)}$	- 0.44
$2H^{+}(10^{-7}\ M) + 2e^{-} \rightarrow H_{2(g)}$	- 0.414 *
$Cr^{3+}_{(aq)} + e^{-} \rightarrow Cr^{2+}_{(s)}$	- 0.41
$Co^{2+}_{(aq)} + 2e^{-} \rightarrow Co_{(s)}$	- 0.28
$Ni^{2+}_{(aq)} + 2e^{-} \rightarrow Ni_{(s)}$	- 0.25
$Sn^{2+}_{(aq)} + 2e^{-} \rightarrow Sn_{(s)}$	- 0.14
$Pb^{2+}_{(aq)} + 2e^{-} \rightarrow Pb_{(s)}$	- 0.13
$2H^{2+}_{(aq)} + 2e^{-} \rightarrow H_{2(g)}$	0.00
$Sn^{4+}_{(aq)} + 2e^{-} \rightarrow Sn^{2+}_{(s)}$	+ 0.15
$Cu^{3+}_{(aq)} + e^{-} \rightarrow Cu^{+}_{(s)}$	+ 0.15
$Cu^{2+}_{(aq)} + 2e^{-} \rightarrow Cu_{(s)}$	+ 0.34
$Cu^{+}_{(aq)} + e^{-} \rightarrow Cu_{(s)}$	+ 0.52
$I_{2(s)} + 2e^{-} \rightarrow 2I^{-}_{(aq)}$	+ 0.54
$O_{2(g)} + 2H^{+} + 2e^{-} \rightarrow H_2O_{2(aq)}$	+ 0.68
$Fe^{3+}_{(aq)} + e^{-} \rightarrow Fe^{2+}_{(aq)}$	+ 0.77
$NO_3^{-}{}_{(aq)} + 2H^{+} + e^{-} \rightarrow NO_{2(g)} + H_2O_{(l)}$	+ 0.78
$Ag^{+}_{(aq)} + e^{-} \rightarrow Ag_{(s)}$	+ 0.80
$\frac{1}{2}O_{2(g)} + 2H^{+}(10^{-7}\ M) + 2e^{-} + H_2O_{(l)} \rightarrow$	+ 0.815 *
$NO_3^{-}{}_{(aq)} + 4H^{+}_{(g)} + 3e^{-} \rightarrow NO_{(g)} + H_2O_{(l)}$	+ 0.96
$Br_{2(l)} + 2e^{-} \rightarrow 2Br^{-}_{(aq)}$	+ 1.07
$\frac{1}{2}O_2(g) + 2H^{+} + 2e^{-} \rightarrow H_2O_{(l)}$	+ 1.23
$4H^{+2}_{(aq)} + MnO_{2(aq)} + 2e^{-} \rightarrow Mn^{2+} + 2H_2O_{(l)}$	+ 1.28
$Cr_2O_7^{2-}{}_{(aq)} + 14H^{+}_{(aq)} + 6e^{-} \rightarrow 2Cr^{3+} + 7H_2O_{(l)}$	+ 1.33
$Cl_{2(g)} + 2e^{-} \rightarrow 2Cl^{-}_{(aq)}$	+ 1.36
$Au^{3+}_{(aq)} + 3e^{-} \rightarrow Au_{(s)}$	+ 1.50
$MnO_4^{-}{}_{(aq)} + 8H^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+ 1.52
$H_2O_2 + 2H^{+} + 2e^{-} \rightarrow 2H_2O_{(l)}$	+ 1.77
$F_{2(g)} + 2e^{-} \rightarrow 2F^{-}_{(aq)}$	+ 2.87

Very weak oxidizing agents

Very strong reducing agents

Oxidizing strength decreasing

Oxidizing strength decreasing

Very strong oxidizing agents

Very weak reducing agents

34. COMPOSITION OF THE ELEMENTS OF THE EARTH CRUST (BY WEIGHT)

Oxygen	**46.71%**
Silicon	**27.60%**
Aluminium	**8.07%**
Iron	**5.05%**
Calcium	**3.65%**
Sodium	**2.75%**
Potassium	**2.58%**
Magnesium	**2.08%**
Other elements	**1.14%**

COMPOSITION OF THE ELEMENTS OF THE EARTH AS A WHOLE (BY WEIGHT)

Iron	**36.9%**
Oxygen	**29.3%**
Silicon	**14.9%**
Magnesium	**7.4%**
Nickel	**3.0%**
Calcium	**3.0%**
Aluminium	**2.4%**
Sulphur	**0.9%**
Titanium	**0.6%**
Sodium	**0.6%**
Other elements	**1.0%**

35. MINEROLOGICAL COMPOSITIONS OF THE EARTH'S CRUST

Feldspar	**59.5%**
Horn Blende	
Pyroxene	**16.8%**
(Complex Silicate)	
Quartz	**12.0%**
Mica	**3.8%**
Other elements	**7.9%**

36. COMPOSITION OF DRY AIR

Dry gas	By volume	By weight
He	1 volume in 200,000 volumes	-
Ne	1 volume in 65,000 volumes	-
N_2	78.03%	75.53%
Ar	0.94%	1.27%
O_2	20.99%	23.16%
Kr	1 volume in 1,000,000 volumes	-
Xe	1 volume in 11,000,000	-
CO_2	0.03%	0.033%

The following gases are found in very small quantities O_3, N_2O, CH_4, CO. In an industrial environment there would be traces of H_2S and SO_2.

37. COMPOSITION OF SEA WATER

Total percentage of dissolved salt in sea water = 3.5 (w/w)
Density of sea water = 1.008 g/*ml*

	Percentage of each compound in dissolved salt (w/w)	Percentage of each compound in sea water (w/w)
NaCl	78.04	2.731×10^{-2}
$MgCl_2$	9.21	3.225×10^{-3}
$MgSO_4$	6.53	2.286×10^{-3}
$CaSO_4$	3.48	1.218×10^{-3}
KCl	2.11	7.385×10^{-4}
$CaCO_3$	0.33	1.155×10^{-4}
$MgBr_2$	0.25	8.750×10^{-5}

The total ion concentration in sea water (mol/dm^{-3})

Na	4.705×10^{-3}
Mg^{2+}	10.134×10^{-4}
Ca^{2+}	10.192×10^{-5}
K^+	9.99×10^{-5}
Cl^-	5.49×10^{-3}
SO_4^{2-}	2.82×10^{-4}
CO_3^{2-}	1.164×10^{-5}
Br^-	9.586×10^{-6}

38. MINERAL RESOURCES OF SRI LANKA

Type	Chemical formula	Location	Utilization
Oxides		**Iron Minerals**	
Limonite	$Fe_2O_3.2H_2O$	Ratnapura, Galle	Iron
Geothite	$Fe_2O_3.H_2O$	Matara	and
Magnetite	Fe_3O_4	Panerendawa,	Steel
	$CuFeS_2.Fe_3O_4$	Wilagedera, Seruwila	
		Alkaline Earth Minerals	
Carbonates			
Limestone	$CaCO_3$	K.K.S., Puttalam Ambalangoda, Hungama.	Cement & Building Ceramics
Dolomite	$CaCO_3.MgCO_3$	Kandy, Matale, Badulla Habarana, Ratnapura.	Fertilizer & source of magnesia
Magnesite	$MgCO_3$	Wellawaya, Randeniya.	Refractory's furnace linings
		Beach Minerals	
Oxides			
Ilmenite	$FeO.TiO_2$	Pulmoddai and Southern coast	Titanium metal and pigments
Rutile	TiO_2	Pulmoddai and Southern coast	Refractory
Baddeleyite	ZrO_2	Pulmoddai and South coast	Refractory
Silicates			
Zircon	$ZrSiO_4$	Pulmoddai and Southern coast	Ceramics and refractories
Sillimanite	$Al_2O_3.SiO_2$	Pulmoddai and Southern coast	Ceramics and refractories
Garnet	$Fe_3Al_2(SiO_4)_3$	Hambantota, Kirinda	Abrasive and paving floors
Phosphate			
Phosphate	$ThO_2(Ce\ La\ Y)PO_4$	Pulmoddai, Kaikawala	Source of thorium, rare earths and phosphates

38. MINERAL RESOURCES OF SRI LANKA (Contd.)

Type	Chemical formula	Location	Utilization
		Carbon Minerals	
Graphite	C	Bogala, Kolongaha Kahatagaha	Manufacture of electrodes, crucibles, lubricants.
Peat	Hydrocarbons (H and C)	Muthurajawela	Fuel and used in agriculture.
		Radioactive Minerals	
Oxides			
Thorianite	$U_3O_2.ThO_2$	Bambarabotuwa, Kaikawela	Nuclear energy Source of Th and U.
Phosphate			
Monazite	ThO_2(Ce La Y)PO_4	Pulmoddai, Kaikawela	Source of Thorium and Rare Earths.
		Phosphorus Minerals	
Phosphates			
Apatite	$Ca_5(PO_4)_3F$, Cl	Eppawala	Phosphorus compounds and fertilizer.
		Mica Minerals	
Silicates			
Phlogopite	$K_2O.6MgO.Al_2O_3$ $.6SiO_2.2H_2O$	Wariyapola	Insulator for electricity filler for paints and plastics etc.
Muscovite	K_2O-$3Al_2O_3$-$6SiO_2$ $-2H_2O$	Badulla, Haldumulla	Insulator for electricity, filler for paints and plastic etc.
Biotite	K_2O_6(Mg.Fe)O.Al_2O_3 $6SiO_2$ $2H_2O$	Madampe, Maskeliya	Insulator for electricity, filler for paints and plastic etc.

MINERAL RESOURCES OF SRI LANKA (Contd.)

Type	Chemical formula	Location	Utilization
		Copper Minerals	
Sulphides			
Copperpyrites associated with Magnetite	$CuFeS_2$	Seruwila	Source of copper
		Silica Minerals	
Oxides			
Quarts	SiO_2	Opanaike, Pelmedulla	Ceramics and glass
Silica Sands	SiO_2	Rattota, Madampe, Nattandiya, Trincomalee, Jaffna	Industry
Silicates			
Felspar	$K_2O.Al_2O_3.6SiO_2$	Talagoda, Koslanda	Ceremics and glass Industry
Cordierite	$2MgO.Al_2O_3.5SiO_2$	Gampaha & Avissawella	Ceremic industry.
Serpentinite	$Mg_6Si_4O_{10}(OH)_8$	Uda Walawe	Used for fertilizer (fused magnesium phosphate)
Allanite	$(CaFe)_2(AlFeCe)_3(SiO_4)_4(OH)$	Rattota	Source of thorium and rare earths
		Clay Minerals	
Kaolin or China Clay & Ball Clay		Boralesgamuwa, Meetiyagoda,	Used in the ceremics industry.
Kaolinite	$Al_2O_3.2SiO_2.2H_2O$	Dediyawala.	
Montmorillonite	$(MgCa)O.Al_2O_3.5SiO_2.6H_2O$		
Pipe Clay	$(MgCa)O.Al_2O_3.5SiO_2 6H_2O$	Dry Zone areas	Manufacture of clay products and cement.
Brick & Tile Clay	$(MgCa)O.Al_2O_3.5SiO_2.6H_2O$		
Clay for Cement	$(MgCa)O.Al_2O_3.5SiO_2.6H_2O$	Puttalam & Murunkan	

GEM MINERAL (IMPORTANT VARIETIES)

Mineral	Chemical Formula	Varieties
Corundum	Al_2O_3	Sapphire, Ruby Star, Sapphire, Star Ruby, Yellow, White & Orange Sapphire.
Chrysoberyl	$BeO.Al_2O_3$	Alexandrite, Cat's eye.
Beryl	$3BeO.Al_2O_3.6SiO_2$	Emerald, Aquamarine.
Topaz	$Al_2(FOH)_3.SiO_4$	White & Yellow Topaz. Blue, Green, Violet and Red Topaz.
Tourmaline	Complex Boro Silicate	Black, Pink, Blue tourmaline.
Garnet		
Pyrope	$MgAl_2(SiO_4)_3$	Deep red to black.
Alamandine	$Fe_3Al_2(SiO_3)_4$	Deep crimson to violet.
Grossularite	$Ca_3Al_2(SiO_4)_3$	Yellow to brown.
Spinel	$MgO.Al_2O_3$	Deep red, green, violet spinel.
Zircon	$ZrSiO_4$	Hyacinth, red, orange, brown and yellow zircon.
Quartz	SiO_2	Rock crystal, amethyst, rose quartz, smokey quartz, citrine, cat's eye quartz.
Felspar	$KAISiO_3O_8$	Moonstone, amazon stone.
Cordierite	$(MgFe)_2Al_2Si_5O_8$	Iolite.

39. SOME OF THE MAJOR CONSTITUENTS IN SELECTED ESSENTIAL OILS (in percentage)

Cinnamon	Leaf oil	Bark oil	Root bark oil
Eugenol	70-80	8-10	5
Cinnamic aldehyde	6-10	75	4
Benzyl benzoate	3	1	0.4
Caryiphyllene	2	1.5	trace
Linalool	2	3	1
1:8 - Cineole	0.2	2	6
Camphor	trace	trace	65

Citronella oil	
Geraniol	20
Citronellol	10
Limonene	10
Camphene	8
Borneol	7
Citronellal	6
Geranyl formate	5
Methyl iso eugenol	4
Caryophyllene	3
Pinene	3

Pepper oil	
Caryophyllene	25

Nutmeg oil	
α Pinene	30
β Pinene	20
Sabinene	15
Limonene	10

Lemon grass	
Citral A and B (Geranial, normal)	65

39. SOME OF THE MAJOR CONSTITUENTS IN SELECTED ESSENTIAL OILS (in percentage) (Contd.)

Cardamon oil	Leaf oil
Terpenyl accetate	30
1:8 Cineole	05
Sabinnene	03
Linalool	03

Clove oil	
Eugenol	90
Caryophyllene	
Pinene	

Eucalyptus	
1:8 Cineole	80

40. Selected Thermodynamic Data

Substance and State	ΔH^0_f (kJ/mol)	ΔG^0_f (kJ/mol)	S^0 (J/k mol)
Aluminum			
Al(s)	0	0	28
Al_2O_3(s)	-1676	-1582	51
$Al(OH)_3$(s)	-1277		
$AlCl_3$(s)	-704	-629	111
Barium			
Ba(s)	0	0	67
$BaCO_3$(s)	-1219	-1139	112
BaO(s)	-582	-552	70
$Ba(OH)_2$(s)	-946		
BaSO4(s)	-1465	-1353	132
Beryllium			
Be(s)	0	0	10
BeO(s)	-599	-569	14
$Be(OH)_2$(s)	-904	-815	47
Bromine			
Br_2(l)	0	0	10
Br_2(g)	31	3	245
Br_2(aq)	-3	4	130
Br^-(aq)	-121	-104	82
HBr(g)	-36	-53	199
Cadmium			
Cd(s)	0	0	52
CdO(s)	-258	-228	55
Cd(OH)2(s)	-561	-474	96
Cds(s)	-162	-156	65
$CdSO_4$(s)	-935	-823	123
Calcium			
Ca(s)	0	0	41
CaC_2(s)	-63	-68	70
$CaCO_3$(s)	-1207	-1129	93
CaO(s)	-635	-604	40
$Ca(OH)_2$(s)	-987	-899	83
$Ca_3(PO_4)_2$(s)	-4126	3890	241
$CaSO_4$(s)	-1433	-1320	107
$CaSiO_3$(s)	-1630	-1550	84
Carbon			
C(s) (graphite)	0	0	6
C(s) (diamond)	2	3	2
CO(g)	-110.5	-137	198
CO_2(g)	-393.5	-394	214
CH_4(g)	-75	-51	186
CH_3OH(g)	-201	-163	240
CH_3OH(l)	-239	-166	127
H_2CO_3(g)	-201	-163	240
HCOOH(g)	-363	-351	249
HCN(g)	135.1	125	202
C_2H_2(g)	227	209	201
C_2H_4(g)	52	68	219
CH_3CHO(g)	-166	209	250
C_2H_6(g)	-84.7	-32.9	229.9
C_3H_6(g)	20.9	62.7	266.9
C_2H_8(g)	-104	24	270
C_2H_4O(g)	-53	-13	242
CH_2=CHCN*(l)*	152	190	274
CH_3COOH(l)	-484	-389	160
$C_6H_{12}O_6$(s)	-1275	-911	212
Chlorine			
Cl_2(g)	0	0	223
Cl_2(aq)	-23	7	121
Cl^-(aq)	-167	-131	57
HCl(g)	-92	-95	187
Chromium			
Cr(s)	0	0	24
Cr_2O_3(s)	-1128	-1047	81
CrO_3(s)	-579	-502	72
Copper			
Cu	0	0	33
$CuCO_3$	-595	-518	88
Cu_2O	-170	-148	93
CuO	-156	-128	43
$Cu(OH)_2$(s)	-450	-372	108
CuS(s)	-49	-49	67
Fluorine			
F_2(g)	0	0	203
F^-(aq)	-333	-279	14
HF(g)	-271	-273	174
Hydrogen			
H_2(g)	0	0	131
H(g)	271	203	115
H^+(aq)	0	0	0
OH-(aq)	-230	-157	-11
H_2O(l)	-286	-237	70
H_2O(g)	-242	-229	189

Substance	ΔH°_{f} (kJ/mol)	ΔG°_{f} (kJ/mol)	S° (J/kmol)
Iodine			
I_2(s)	0	0	116
I_2(g)	62	19	261
I_2(aq)	23	16	137
I^-(aq)	-55	-52	106
Iron			
Fe(s)	0	0	27
Fe_3C(s)	21	15	108
$Fe_{0.95}O$(s) (wustite)	-264	-240	59
FeO	-272	-255	61
Fe_3O_4(s) (magnetic)	-1117	-1013	146
Fe_2O_3(s) (hematic)	-826	- 740	90
FeS(s)	-95	-97	67
FeS_2(s)	-178	- 166	53
$FeSO_4$(s)	-929	- 825	121
Lead			
Pb(s)	0	0	65
PbO_2(s)	-277	-217	69
PbS(s)	-100	-99	91
$PbSO_4$(s)	-920	- 813	149
Magnesium			
Mg(s)	0	0	33
$MgCO_3$(s)	-1113	-1029	66
MgO(s)	-602	-569	27
$Mg(OH)_2$(s)	-925	-834	64
Manganese			
Mn(s)	0	0	32
MnO(s)	-385	-363	60
Mn_3O_4(s)	-1387	-1280	149
Mn_2O_3(s)	-971	-893	110
MnO_2(s)	-521	-466	53
MnO_4^-aq)	-543	-449	190
Mercury			
Hg(l)	0	0	76
Hg_2Cl_2(s)	-265	-211	196
$HgCl_2$(s)	-230	-184	144
HgO(s)	- 90	-59	70
HgS(s)	-58	-49	78
Nickel			
Ni(s)	0	0	30
$NiCl_2$(s)	-316	-272	107
NiO(s)	-241	-213	38
$Ni(OH)_2$(s)	-538	-453	79
NiS(s)	-93	-90	53

Substance	ΔH°_{f} (kJ/mol)	ΔG°_{f} (kJ/mol)	S° (J/kmol)
Nitrogen			
N_2(g)	0	0	192
NH_3 (g)	-46	-16.6	193
NH_3(aq)	-80	-27	111
NH_4+(aq)	-132	-79	113
NO(aq)	90	87	211
NO_2(g)	34	52	240
N_2O(g)	82	104	220
N_2O_4(g)	10	98	304
N_2O_4(l)	-20	97	209
N_2O_5(s)	-42	134	178
$N_2H_3CH_3$(l)	54	180	166
HNO_3(aq)	-207	-111	146
HNO_3(l)	-174	-81	156
NH_4ClO_4(s)	-295	-89	186
Oxygen			
O_2(g)	0	0	205
O(g)	249	232	161
O_3(g)	143	163	239
Phosphorus			
P(s) (White)	0	0	41
P(s) (red)	-18	-12	23
P(s) (black)	-39	-33	23
P_4(g)	59	24	280
PF5(g)	-1578	-1509	296
PH_3(g)	5	13	210
H_3PO_4(s)	-1279	-1119	110
H_3PO_4(l)	-1267	-	-
H_3PO_4(aq)	-1288	-1143	158
P_4O_{10}(s)	-3110	-2698	229
Potassium			
K(s)	0	0	64
KCl(s)	-436	-408	83
$KClO_3$(s)	-391	-290	143
$KClO_4$(s)	-433	-304	151
K_2O(s)	-361	-322	98
K_2O_2(s)	-496	-430	113
KO_2(s)	-283	-238	117
KOH(s)	-425	-379	79
KOH(aq)	-481	-440	9.20
Silicon			
SiO_2(s)(quartz)	-911	-856	42
Silver			
Ag(s)	0	0	43
Ag^+(aq)	105	77	73
AgBr(s)	-100	-97	107
AgCN(s)	146	164	87
AgCl(s)	-127	-110	96
Ag_2CrO_4(s)	-712	-622	217
AgI(s)	-62	-66	115
Ag_2O(s)	-31	-11	122
Ag_2S(s)	-32	-40	146

Substance and State	ΔH°_f (kJ/mol)	ΔG°_f (kJ/mol)	S° (J/kmol)
Sodium			
Na(s)	0	0	51
Na^+(aq)	-240	-262	59
NaBr(s)	-360	-347	84
Na_2CO_3(s)	-1131	-1048	136
$NaHCO_3$(s)	-948	-852	102
NaCl(s)	-411	-384	72
NaH(s)	-56	-33	40
NaI(s)	-288	-282	91
$NaNO_2$(s)	-359	-	-
$NaNO_3$(s)	-467	-366	116
Na_2O(s)	-416	-377	73
Na_2O_2(s)	-515	-451	95
NaOH(s)	-427	-381	64
NaOH(aq)	-470	-419	50
Sulphur			
S(s) (rhombic)	0	0	32
S(s) (monoclinic)	0.3	0.1	33
S^{2-}(aq)	33	86	-15
S_8(g)	102	50	431
SF_6(g)	-1209	-1105	292
H_2S(g)	-21	-34	206
SO_2(g)	-297	-300	248
SO_3(g)	-396	-371	257
SO_4^{2-}(aq)	-909	-745	20
H_2SO_4(l)	-814	-690	157
H_2SO_4(aq)	-909	-745	20
Tin			
Sn(s)(white)	0	0	52
Sn(s)(gray)	-2	0.1	44
SnO(s)	-285	-257	56
SnO_2(s)	-581	-520	52
$Sn(OH)_2$(s)	-561	-492	155
Titanium			
$TiCl_4$(g)	-763	-727	355
TiO_2(s)	-945	-890	50
Uranium			
U(s)	0	0	50
UF_6(s)	-2137	-2008	228
UF_6(g)	-2113	-2029	380
UO_2(s)	-1084	-1029	78
U_3O_8(s)	-3575	-3393	282
UO_3(s)	-1230	-1150	99
Xenon			
Xe(g)	0	0	170
XeF_2(g)	-108	-48	254
XeF_4(s)	-251	-121	146
XeF_6(g)	-294		
XeO_3(s)	402		

Substance and State	ΔH°_f (kJ/mol)	ΔG°_f (kJ/mol)	S° (J/kmol)
Zinc			
Zn(s)	0	0	42
ZnO(s)	-348	-318	44
$Zn(OH)_2$(s)	-642		
ZnS(s) (wurtzite)	-193		
ZnS(s) (zinc blende)	-206	-201	58
$ZnSO_4$(s)	-983	-874	120

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