1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.70	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226.0)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 (269)	111 (272)	112 (272)	113 (282)	114 (287)	115 (288)	116 (289)		118 (293)

* 58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
** 90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (244)	94 **Pu** (242)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

$g = 9.807$ m·s^{-2}

$c = 2.998 \times 10^8$ m·s^{-1}

$R = 0.08206$ L·atm·mol^{-1}·K^{-1}

$R = 8.314$ J·mol^{-1}·K^{-1}

$h = 6.626 \times 10^{-34}$ J·s

$N_A = 6.022 \times 10^{23}$ mol^{-1}

$F = 9.6485 \times 10^4$ C·mol^{-1}

$m_e = 9.109 \times 10^{-31}$ kg

$0.0\ ^{\circ}C = 273.15$ K

$1 \text{Å} = 10^{-10}$ m

1 cal = 4.184 J

1 atm = 760 torr = 101.3 kPa

$1\ eV = 1.602 \times 10^{-19}$ J

$1\ V = 1$ J·C^{-1}

$1\ A = 1$ C·s^{-1}

Average Bond Energies, kJ mol^{-1}, at 25 °C

H – H	436	C – C	347
H – C	414	C = C	611
H – N	389	C ≡ C	837
H – O	464	C – N	305
H – Cl	431	C = N	615
H – F	565	C ≡ N	891
C – O	360	N = O	590
C = O	736	CO_2	799
N – N	163	O – O	142
N = N	418	O = O	498
N ≡ N	946	C – Cl	339
N – O	222	Cl – Cl	243

Water Vapour Pressure[a], kPa

0 °C	0.6113
10 °C	1.228
25 °C	3.169
40 °C	7.381

[a]CRC handbook

Ionization Constants at 25 °C

	K_a
Acetic acid	1.8×10^{-5}
Chloroacetic acid	1.4×10^{-3}
Formic acid	1.8×10^{-4}
Hydrocyanic acid	6.2×10^{-10}
Hydrofluoric acid	6.6×10^{-4}
Hypobromous acid	2.5×10^{-9}
Hypochlorous acid	2.9×10^{-8}
Iodic acid	1.6×10^{-1}
Nitrous acid	7.2×10^{-4}

	K_b
Ammonia	1.8×10^{-5}
Diethylamine	6.9×10^{-4}
Ethylamine	4.3×10^{-4}
Hydroxylamine	9.1×10^{-9}
Methylamine	4.2×10^{-4}
Pyridine	1.5×10^{-9}
Trimethylamine	6.3×10^{-5}

	K_w
Water	1.0×10^{-14}

Solubility Product Constants, K_{sp}, at 25 °C

AgBr	5.0×10^{-13}
AgCl	1.8×10^{-10}
AgI	8.5×10^{-17}
Ag_2CO_3	8.5×10^{-12}
$Al(OH)_3$	2.0×10^{-32}
$BaCO_3$	5.1×10^{-9}
$BaSO_4$	1.1×10^{-10}
CaF_2	4.9×10^{-11}
$Ca_3(PO_4)_2$	2.0×10^{-29}
CdS	2.0×10^{-28}
$MgCO_3$	1.0×10^{-5}
$PbCl_2$	1.6×10^{-5}
$PbCO_3$	7.4×10^{-14}
PbI_2	7.1×10^{-9}

Standard Reduction Potentials, E° (V) at 25 °C

F_2 (g) + 2 e- → 2 F$^-$ (aq)	+2.866
H_2O_2 (aq) + 2 H$^+$ (aq) + 2 e- → 2 H_2O (l)	+1.763
MnO_4^- (aq) + 8H$^+$ (aq) + 5e- → Mn^{2+}(aq) + 4H_2O (l)	+1.51
Cl_2 (g) + 2 e- → 2 Cl$^-$ (aq)	+1.358
O_2 (g) + 4 H$^+$ (aq) + 4 e- → 2 H_2O (l)	+1.229
Br_2 (l) + 2 e- → 2 Br- (aq)	+1.065
NO_3^- (aq) + 4 H$^+$ (aq) + 3 e- → NO (g) + 2 H_2O (l)	+0.956
Hg^{2+} (aq) + 2 e- → Hg (s)	+0.851
Ag$^+$ (aq) + e- → Ag (s)	+0.800
Fe^{3+} (aq) + e- → Fe^{2+} (aq)	+0.771
I_2 (s) + 2 e- → 2 I$^-$ (aq)	+0.535
Cu$^+$ (aq) + e- → Cu (s)	+0.521
Cu^{2+} (aq) + 2 e- → Cu (s)	+0.340
SO_4^{2-} (aq) + 4H$^+$ (aq) + 2 e- → 2 H_2O (l) + SO_2 (g)	+0.170
Cu^{2+} (aq) + e- → Cu$^+$ (aq)	+0.159
Sn^{4+} (aq) + 2 e- → Sn^{2+} (aq)	+0.154
2 H$^+$ (aq) + 2 e- → H_2 (g)	0.000
Pb^{2+} (aq) + 2 e- → Pb (s)	-0.125
Sn^{2+} (aq) + 2 e- → Sn (s)	-0.137
Ni^{2+} (aq) + 2 e- → Ni (s)	-0.257
Cr^{3+} (aq) + e- → Cr^{2+} (aq)	-0.424
Fe^{2+} (aq) + 2 e- → Fe (s)	-0.440
Zn^{2+} (aq) + 2 e- → Zn (s)	-0.763
2 H_2O (l) + 2 e- → H_2 (g) + 2 OH$^-$ (aq)	-0.828
Al^{3+} (aq) + 3 e- → Al (s)	-1.676
Mg^{2+} (aq) + 2 e- → Mg (s)	-2.356
Na$^+$ (aq) + e- → Na (s)	-2.713
Ca^{2+} (aq) + 2 e- → Ca (s)	-2.840
K$^+$ (aq) + e- → K (s)	-2.924
Li$^+$ (aq) + e- → Li (s)	-3.040

Thermodynamic Properties of Substances at 298.15 K

	ΔH_f^o, kJ mol^{-1}	ΔG_f^o, kJ mol^{-1}	S^o, J mol^{-1} K^{-1}		ΔH_f^o, kJ mol^{-1}	ΔG_f^o, kJ mol^{-1}	S^o, J mol^{-1} K^{-1}
Al (s)	0	0	28.33	HF (g)	-271.1	-273.2	173.8
AlCl$_3$ (s)	-704.2	-628.8	110.7	H$_2$O (g)	-241.8	-228.6	188.8
Al$_2$O$_3$ (s)	-1676	-1582	50.92	H$_2$O (l)	-285.8	-237.1	69.91
Br (g)	111.9	82.40	175.0	I (g)	106.8	70.25	180.8
Br$^-$ (aq)	-121.6	-104.0	82.4	I$_2$ (g)	62.44	19.33	260.7
Ca (s)	0	0	41.42	K$^+$ (aq)	-252.4	-283.3	102.5
CaCl$_2$ (s)	-795.8	-748.1	104.6	KCl (s)	-436.7	-409.1	82.59
CaO (s)	-635.1	-604.0	39.75	N (g)	472.7	455.6	153.3
C (diamond)	1.90	2.90	2.38	N$_2$ (g)	0	0	191.6
C (graphite)	0	0	5.74	Na$^+$ (aq)	-240.1	-261.9	59.0
CCl$_4$ (l)	-135.4	-65.21	216.4	NaCl (s)	-411.2	-384.1	72.13
CH$_2$CH$_2$ (g)	52.26	68.15	219.6	Na$_2$CO$_3$ (s)	-1131	-1044	135.0
CH$_3$OH (l)	-238.7	-168.5	160.7	NH$_3$ (g)	-46.11	-16.45	192.5
CH$_3$CH$_2$OH (l)	-277.7	-174.8	160.7	NH$_4^+$ (aq)	-132.5	-79.31	113.4
CH$_3$CH$_3$ (g)	-84.68	-32.82	229.6	NO (g)	90.25	86.55	210.8
CH$_3$COOH (l)	-484.5	-389.9	159.8	NO$_2$ (g)	33.18	51.31	240.1
CH$_4$ (g)	-74.81	-50.72	186.3	N$_2$O (g)	82.05	104.2	219.9
CO (g)	-110.5	-137.2	197.7	N$_2$O$_4$ (g)	9.16	97.89	304.3
CO$_2$ (g)	-393.5	-394.4	213.7	O (g)	249.2	231.7	161.1
Cl (g)	121.7	105.7	165.2	O$_2$ (g)	0	0	205.1
Cl$^-$ (g)	-167.2	-131.2	56.5	O$_3$ (g)	142.7	163.2	238.9
F (g)	78.99	61.91	158.8	OH$^-$ (aq)	-230.0	-157.2	-10.75
F$^-$ (aq)	-332.6	-278.8	-13.8	PCl$_3$ (g)	-287.0	-267.8	311.8
H (g)	218.0	203.2	114.7	PCl$_5$ (g)	-374.9	-305.0	364.6
H$_2$ (g)	0	0	130.7	S (g)	278.8	238.3	167.8
HBr (g)	-36.40	-53.45	198.7	SF$_6$ (g)	-1209	-1105	291.8
HCl (g)	-92.31	-95.30	186.9	SiO$_2$ (s)	-910.9	-856.6	41.84

$$PV = nRT \qquad E = h\nu \qquad \nu = c/\lambda$$

Electronegativities of the Elements

$$\lambda = \frac{h}{mv} \qquad \chi_1 = \frac{n_1}{n_{tot}} = \frac{P_1}{P_{tot}} \qquad u_{rms} = \sqrt{\frac{3RT}{M}}$$

$$E_n = -2.178 \times 10^{-18}\left(\frac{Z^2}{n^2}\right) \qquad P = \frac{nRT}{V-nb} - \frac{an^2}{V^2} \qquad (KE)_{avg} = \frac{3RT}{2N_A}$$

$$\text{Rate} = k[A]^m[B]^n \qquad 2d\sin\theta = n\lambda \qquad M_{tot} = \chi_1 M_1 + \chi_2 M_2 + \dots$$

$$k = A\,e^{\frac{-Ea}{RT}} \qquad k = Z_0\,p\,e^{\frac{-Ea}{RT}} \qquad t_{1/2} = \frac{[A]_o}{2k} \qquad t_{1/2} = \frac{\ln 2}{k} \qquad t_{1/2} = \frac{1}{k[A]_o}$$

$$q = C\Delta T \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{Ea}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \qquad [A] = [A]_o - kt \qquad \ln[A] = \ln[A]_o - kt \qquad \frac{1}{[A]} = \frac{1}{[A]_o} + kt$$

$$w = -P\Delta V \qquad G = H - TS \qquad H = E + PV \qquad \Delta G = \Delta G^o + RT\ln Q \qquad \Delta S_{surr} = -\frac{\Delta H_{sys}}{T}$$

$$\Delta G^o = \Delta H^o - T\Delta S^o \qquad \Delta G^o = \sum n_p \Delta G_f^o(p) - \sum n_r \Delta G_f^o(r) \qquad \Delta H^o = \sum n_r D_r - \sum n_p D_p \qquad \Delta H^o = \sum n_p \Delta H_f^o(p) - \sum n_r \Delta H_f^o(r)$$

$$\Delta G^o = -RT\ln K \qquad \Delta S^o = \sum n_p S^o(p) - \sum n_r S^o(r) \qquad \log K = \frac{nE^o}{0.0592} \qquad E = E^o - \frac{RT}{nF}\ln Q \qquad E = E^o - \frac{0.0592}{n}\log Q$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]} \qquad \ln\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \qquad E_{cell} = E_{cathode} - E_{anode} \qquad \Delta G^o = -nFE^o$$

$$K_a \cdot K_b = K_w \qquad K_b = \frac{[BH^+][OH^-]}{[B]} \qquad K_a = \frac{[A^-][H_3O^+]}{[HA]} \qquad \Delta G = -nFE$$
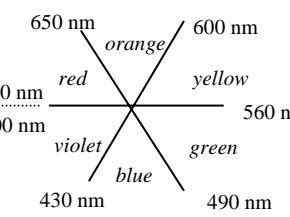
$$K_{sp} = [A^+]^a[B^-]^b \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Spectrochemical Series :
CN$^-$ > NO$_2^-$ > en > NH$_3$ > H$_2$O > OH$^-$ > F$^-$ > Cl$^-$ > Br$^-$ > I$^-$