DATA SHEET
Some Useful Constants and Formulae

Fundamental Constants and Conversion Factors

Atomic mass unit (u)	$1.660\,539 \times 10^{-27}$ kg	Kelvin temperature scale	0 K = -273.15 °C
Avogadro's number (N_A)	$6.022\,141 \times 10^{23}$ mol^{-1}	K_w (at 25 °C)	10^{-14}
Boltzmann constant (k_B)	$1.380\,649 \times 10^{-23}$ J·K^{-1}	Planck's constant (h)	$6.626\,070 \times 10^{-34}$ J·Hz^{-1}
Charge of electron	$-1.602\,176 \times 10^{-19}$ C	Speed of light in vacuum (c)	2.997 925 x 10^8 m·s^{-1}
Faraday's constant (F)	96 485 C·mol^{-1}	Volume conversion	1000 L = 1 m^3
Ideal gas constant (R)	8.314 462 J·mol^{-1}·K^{-1}	Pressure conversions	1 bar = 100 kPa
	8.314 462 m^3·Pa·mol^{-1}·K^{-1}		1 atm = 1.01325 bar

Formulae

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad PV = nRT$$

$$S = k_B \ln \Omega \qquad \Delta S = \frac{q_{rev}}{T} \qquad \Delta_r G = \Delta_r H - T\Delta_r S$$

$$\Delta_r G = \Delta_r G^\circ + RT \ln Q \qquad \Delta_r G^\circ = -RT \ln K \qquad \ln\left(\frac{K_2}{K_1}\right) = \frac{\Delta_r H^o}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$P_A = X_A P_A^o \qquad [A] = k_H P_A \qquad X = \frac{n}{\sum n} \qquad \Delta_r G = -\upsilon_e F E \qquad E = E^\circ - \frac{RT}{\upsilon_e F} \ln Q$$

$$pH = -\log a_{H^+} \qquad pK_a = -\log K_a \qquad pK_b = -\log K_b \qquad K_w = K_a \cdot K_b \qquad pH = pK_a + \log\left(\frac{a_{A^-}}{a_{HA}}\right)$$

$$\Delta H^0_{rxn} = \sum(\Delta H^0_f(products) - \sum(\Delta H^0_f(reactants) \qquad \Delta S^0_{rxn} = \sum(S^0(products) - \sum(S^0(reactants)$$

$$\Delta G^0_{rxn} = \sum(\Delta G^0_f(products) - \sum(\Delta G^0_f(reactants)$$

Activities

Solid	$a = 1$
Pure liquid	$a = 1$
Ideal Solvent	$a = X$
Ideal Solute	$a = \frac{c}{c^\circ}$
Ideal Gas	$a = \frac{P}{P^\circ}$

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CHEM 2000 Standard Periodic Table

1												13	14	15	16	17	18
1.0079 **H** 1	2																4.0026 **He** 2
6.941 **Li** 3	9.0122 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.0067 **N** 7	15.9994 **O** 8	18.9984 **F** 9	20.1797 **Ne** 10
22.9898 **Na** 11	24.3050 **Mg** 12	3	4	5	6	7	8	9	10	11	12	26.9815 **Al** 13	28.0855 **Si** 14	30.9738 **P** 15	32.066 **S** 16	35.4527 **Cl** 17	39.948 **Ar** 18
39.0983 **K** 19	40.078 **Ca** 20	44.9559 **Sc** 21	47.88 **Ti** 22	50.9415 **V** 23	51.9961 **Cr** 24	54.9380 **Mn** 25	55.847 **Fe** 26	58.9332 **Co** 27	58.693 **Ni** 28	63.546 **Cu** 29	65.39 **Zn** 30	69.723 **Ga** 31	72.61 **Ge** 32	74.9216 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
85.4678 **Rb** 37	87.62 **Sr** 38	88.9059 **Y** 39	91.224 **Zr** 40	92.9064 **Nb** 41	95.94 **Mo** 42	(98) **Tc** 43	101.07 **Ru** 44	102.906 **Rh** 45	106.42 **Pd** 46	107.868 **Ag** 47	112.411 **Cd** 48	114.82 **In** 49	118.710 **Sn** 50	121.757 **Sb** 51	127.60 **Te** 52	126.905 **I** 53	131.29 **Xe** 54
132.905 **Cs** 55	137.327 **Ba** 56	**La-Lu**	178.49 **Hf** 72	180.948 **Ta** 73	183.85 **W** 74	186.207 **Re** 75	190.2 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.967 **Au** 79	200.59 **Hg** 80	204.383 **Tl** 81	207.19 **Pb** 82	208.980 **Bi** 83	(210) **Po** 84	(210) **At** 85	(222) **Rn** 86
(223) **Fr** 87	226.025 **Ra** 88	**Ac-Lr**	(265) **Rf** 104	(268) **Db** 105	(271) **Sg** 106	(270) **Bh** 107	(277) **Hs** 108	(276) **Mt** 109	(281) **Ds** 110	(280) **Rg** 111	(285) **Cn** 112	(284) **Nh** 113	(289) **Fl** 114	(288) **Mc** 115	(293) **Lv** 116	(294) **Ts** 117	(294) **Og** 118

138.906 **La** 57	140.115 **Ce** 58	140.908 **Pr** 59	144.24 **Nd** 60	(145) **Pm** 61	150.36 **Sm** 62	151.965 **Eu** 63	157.25 **Gd** 64	158.925 **Tb** 65	162.50 **Dy** 66	164.930 **Ho** 67	167.26 **Er** 68	168.934 **Tm** 69	173.04 **Yb** 70	174.967 **Lu** 71
227.028 **Ac** 89	232.038 **Th** 90	231.036 **Pa** 91	238.029 **U** 92	237.048 **Np** 93	(240) **Pu** 94	(243) **Am** 95	(247) **Cm** 96	(247) **Bk** 97	(251) **Cf** 98	(252) **Es** 99	(257) **Fm** 100	(258) **Md** 101	(259) **No** 102	(262) **Lr** 103

Developed by Prof. R. T. Boeré (updated 2016)

Degrees of Unsaturation for Organic Compounds

$$DU = \frac{2C + 2 + N - X - H}{2}$$

Some Useful Thermodynamic Properties

	Standard Free Energy of Formation $(\Delta_f G°)$
$Al(OH)_{3(s)}$	$-1284.56\frac{kJ}{mol}$
$Al_2O_{3(s)}$	$-1656.86\frac{kJ}{mol}$
$Al_2SiO_{5(s)}$	$-2443.87\frac{kJ}{mol}$
$CO_{2(g)}$	$-395.39\frac{kJ}{mol}$
$H_2O_{(g)}$	$-228.60\frac{kJ}{mol}$
$LiOH_{(s)}$	$-438.90\frac{kJ}{mol}$
$SiO_{2(s)}$	$-855.88\frac{kJ}{mol}$

Half-Reaction	Standard Reduction Potential $(E°)$
$O_{3(g)} + H_2O_{(l)} + 2\,e^- \rightarrow O_{2(g)} + 2\,OH^-_{(aq)}$	$+1.246\,V$
$O_{2(g)} + 2\,H_2O_{(l)} + 4\,e^- \rightarrow 4\,OH^-_{(aq)}$	$+0.401\,V$
$LiOH_{(aq)} + e^- \rightarrow Li_{(s)} + OH^-_{(aq)}$	$-3.045\,V$