

**CHEMISTRY DATA SHEET**  
Revised February 2008

Draft

## FORMULA

$$\text{Number of moles} \quad n = \frac{m}{M} \quad \frac{\text{(mass)}}{\text{(molar mass)}}$$

$$\text{Number of moles of solute} \quad n = cV$$

$$\text{Number of moles of a gas at STP} \quad n = \frac{V}{22.41}$$

$$\text{Ideal gas law} \quad PV = nRT$$

$$\text{Parts per million} \quad \text{ppm} = \frac{\text{mass of solute (mg)}}{\text{mass of solution (kg)}}$$

$$\text{pH of a solution} \quad \text{pH} = -\log [\text{H}^+]$$

$$\text{Density} \quad \rho = \frac{\text{mass of sample}}{\text{volume of sample}}$$

## Units

**Volumes** are given in the units of litres (L), or millilitres (mL)

**Temperatures** are given in the units of degrees Celsius (°C) or Kelvin (K).

It may be assumed that  $0.0^{\circ}\text{C} = 273.1 \text{ K}$

**Energy changes** are given in the SI unit kilojoule (kJ)

**Pressures** are given in the SI unit kilopascal (kPa) and in atmospheres.

**Solution concentrations** are given in the unit moles per litre ( $\text{mol L}^{-1}$ )

## Constants

Universal Gas Constant,  $R = 8.315 \text{ J K}^{-1} \text{ mol}^{-1}$

Avogadro Constant,  $N = 6.022 \times 10^{23} \text{ mol}^{-1}$

Volume of 1.000 mol of an ideal gas at  $0.0^{\circ}\text{C}$  and 101.3 kPa is 22.41 L

S.T.P. is  $0.0^{\circ}\text{C}$  and 101.3 kPa

Equilibrium Constant for Water at  $25^{\circ}\text{C}$   $K_w = 1 \times 10^{-14}$

## Solubility rules for ionic solids in water

### Soluble in water

Soluble	Exceptions	
	Insoluble	Slightly soluble
Most chlorides	AgCl,	PbCl <sub>2</sub>
Most bromides	AgBr,	PbBr <sub>2</sub>
Most iodides	AgI, PbI <sub>2</sub>	
All nitrates	No exceptions	
All ethanoates		
Most sulfates	SrSO <sub>4</sub> , BaSO <sub>4</sub> , PbSO <sub>4</sub>	CaSO <sub>4</sub> , Ag <sub>2</sub> SO <sub>4</sub>

### Insoluble in water

Insoluble	Exceptions	
	Soluble	Slightly soluble
Most hydroxides	NaOH, KOH, Ba(OH) <sub>2</sub> (NH <sub>4</sub> OH and AgOH do not exist)	Ca(OH) <sub>2</sub> , Sr(OH) <sub>2</sub>
Most carbonates	Na <sub>2</sub> CO <sub>3</sub> , K <sub>2</sub> CO <sub>3</sub> , (NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>	
Most phosphates	Na <sub>3</sub> PO <sub>4</sub> , K <sub>3</sub> PO <sub>4</sub> , (NH <sub>4</sub> ) <sub>3</sub> PO <sub>4</sub>	
Most sulfides	Na <sub>2</sub> S, K <sub>2</sub> S, (NH <sub>4</sub> ) <sub>2</sub> S	

Soluble = more than 0.1 mole dissolves per litre

Slightly soluble = between 0.01 and 0.1 mole dissolves per litre

Insoluble = less than 0.01 mole dissolves per litre

### Colour of species in aqueous solution

Cation	Colour	Cation	Colour
$\text{Al}^{3+}$	colourless	$\text{Mn}^{2+}$	very pale pink
$\text{NH}_4^+$	colourless	$\text{Ni}^{2+}$	green
$\text{Ba}^{2+}$	colourless	$\text{Ag}^+$	colourless
$\text{Ca}^{2+}$	colourless	$\text{Na}^+$	colourless
$\text{Cr}^{3+}$	deep green	$\text{Sr}^{2+}$	colourless
$\text{Co}^{2+}$	pink	$\text{Sn}^{2+}$	colourless
$\text{Cu}^{2+}$	blue	$\text{Zn}^{2+}$	colourless
$\text{Fe}^{2+}$	pale green		
$\text{Fe}^{3+}$	brown		
$\text{K}^+$	colourless		
$\text{Pb}^{2+}$	colourless		
$\text{Mg}^{2+}$	colourless		

Anion	Colour
$\text{Br}^-$	colourless
$\text{Cl}^-$	colourless
$\text{CrO}_4^{2-}$	yellow
$\text{Cr}_2\text{O}_7^{2-}$	orange
$\text{I}^-$	colourless
$\text{MnO}_4^-$	deep purple
$\text{PO}_4^{3-}$	colourless
$\text{S}^{2-}$	colourless
-	

Halogen	Colour
$\text{Cl}_{2(\text{aq})}$	pale yellow
$\text{Br}_{2(\text{aq})}$	orange
$\text{I}_{2(\text{aq})}$	brown
<b>Halogen in organic solvent</b>	
Halogen	Colour
$\text{Br}_2$	red
$\text{I}_2$	purple

### Standard Reduction Potentials at 25°C

Half-reaction	$E^\circ$ (volts)
$F_2(g) + 2 e^- \rightleftharpoons 2 F^-(aq)$	+ 2.87
$H_2O_2(aq) + 2 H^+(aq) + 2 e^- \rightleftharpoons 2 H_2O(l)$	+ 1.78
$PbO_2(s) + SO_4^{2-}(aq) + 4 H^+(aq) + 2 e^- \rightleftharpoons PbSO_4(s) + 2 H_2O(l)$	+ 1.69
$2 HClO(aq) + 2 H^+(aq) + 2 e^- \rightleftharpoons Cl_2(g) + 2 H_2O(l)$	+ 1.61
$MnO_4^-(aq) + 8 H^+(aq) + 5 e^- \rightleftharpoons Mn^{2+}(aq) + 4 H_2O(l)$	+ 1.51
$Au^{3+}(aq) + 3 e^- \rightleftharpoons Au(s)$	+ 1.50
$HClO(aq) + H^+(aq) + 2 e^- \rightleftharpoons Cl^-(aq) + H_2O(l)$	+ 1.48
$PbO_2(s) + 4 H^+(aq) + 2 e^- \rightleftharpoons Pb^{2+}(aq) + 2 H_2O(l)$	+ 1.46
$Cl_2(g) + 2 e^- \rightleftharpoons 2 Cl^-(aq)$	+ 1.36
$Cr_2O_7^{2-}(aq) + 14 H^+(aq) + 6 e^- \rightleftharpoons 2 Cr^{3+}(aq) + 7 H_2O(l)$	+ 1.23
$O_2(g) + 4 H^+(aq) + 4 e^- \rightleftharpoons 2 H_2O(l)$	+ 1.23
$Br_2(l) + 2 e^- \rightleftharpoons 2 Br^-(aq)$	+ 1.07
$NO_3^-(aq) + 4 H^+(aq) + 3 e^- \rightleftharpoons NO(g) + 2 H_2O(l)$	+ 0.96
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+ 0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+ 0.77
$O_2(g) + 2 H^+(aq) + 2 e^- \rightleftharpoons H_2O_2(aq)$	+ 0.68
$I_2(s) + 2 e^- \rightleftharpoons 2 I^-(aq)$	+ 0.54
$O_2(g) + 2 H_2O(l) + 4 e^- \rightleftharpoons 4 OH^-(aq)$	+ 0.40
$Cu^{2+}(aq) + 2 e^- \rightleftharpoons Cu(s)$	+ 0.34
$S(s) + 2 H^+(aq) + 2 e^- \rightleftharpoons H_2S(aq)$	+ 0.14
$2 H^+(aq) + 2 e^- \rightleftharpoons H_2(g)$	0 exactly
$Pb^{2+}(aq) + 2 e^- \rightleftharpoons Pb(s)$	- 0.13
$Sn^{2+}(aq) + 2 e^- \rightleftharpoons Sn(s)$	- 0.14
$Ni^{2+}(aq) + 2 e^- \rightleftharpoons Ni(s)$	- 0.26
$Co^{2+}(aq) + 2 e^- \rightleftharpoons Co(s)$	- 0.28
$PbSO_4(s) + 2 e^- \rightleftharpoons Pb(s) + SO_4^{2-}(aq)$	- 0.36
$Cd^{2+}(aq) + 2 e^- \rightleftharpoons Cd(s)$	- 0.40
$2 CO_2(g) + 2 H^+(aq) + 2 e^- \rightleftharpoons HOCCOOH(aq)$	- 0.43
$Fe^{2+}(aq) + 2 e^- \rightleftharpoons Fe(s)$	- 0.44
$Cr^{3+}(aq) + 3 e^- \rightleftharpoons Cr(s)$	- 0.73
$Zn^{2+}(aq) + 2 e^- \rightleftharpoons Zn(s)$	- 0.76
$2 H_2O(l) + 2 e^- \rightleftharpoons H_2(g) + 2 OH^-(aq)$	- 0.83
$Mn^{2+}(aq) + 2 e^- \rightleftharpoons Mn(s)$	- 1.18
$Al^{3+}(aq) + 3 e^- \rightleftharpoons Al(s)$	- 1.66
$Mg^{2+}(aq) + 2 e^- \rightleftharpoons Mg(s)$	- 2.37
$Na^+(aq) + e^- \rightleftharpoons Na(s)$	- 2.71
$Ca^{2+}(aq) + 2 e^- \rightleftharpoons Ca(s)$	- 2.76
$Sr^{2+}(aq) + 2 e^- \rightleftharpoons Sr(s)$	- 2.89
$Ba^{2+}(aq) + 2 e^- \rightleftharpoons Ba(s)$	- 2.91
$K^+(aq) + e^- \rightleftharpoons K(s)$	- 2.93

# Periodic Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	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	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	85 At	86 Rn
	87 Fr	88 Ra 226.0	89 **Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt									

\* Lanthanide Series

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm	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
-------------------	-------------------	-------------------	----------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------

\*\* Actinide Series

90 Th 232.0	91 Pa	92 U 238.0	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr
-------------------	----------	------------------	----------	----------	----------	----------	----------	----------	----------	-----------	-----------	-----------	-----------

6	← Atomic Number
C	← Symbol
12.	← Atomic Mass
01	