

## Conversions/Constants: (\* exact)

### Length:

1 in. = 2.54 cm\*  
 1 mi = 5280 ft\*  
 1 mi = 1.609344 km\*  
 1 m = 1.094 yd  
 1 yd = 3 ft\*  
 1 ft = 12 in.\*  
 Angstrom =  $\text{\AA} = 10^{-10} \text{ m}^*$

### Mass:

1 kg = 2.20462 lb  
 1 lb = 453.59 g  
 1 lb = 16 oz  
 1 oz = 28.3495 g\*  
 1 ton = 2000 lbs  
 1 amu =  $1.66053873 \times 10^{-24} \text{ g}$   
 1 carat = 0.2 g\*

### Volume:

1 L = 1.056688 qt  
 1 gal = 4 qt  
 1 gal = 3.78541 L  
 1 mL =  $1 \text{ cm}^3$   
 1 fl oz = 0.02957 L  
 1 qt = 32 fl oz

### Radioactivity:

1 becquerel =  $2.7 \times 10^{-11} \text{ curie}^*$

### Pressure:

1 atm = 760 mmHg\*  
 1 atm = 760 torr\*  
 1 atm = 14.69595 psi  
 1 atm = 101325 pascal\*  
 1 atm = 1.01325 bar\*  
 1 bar =  $10^5 \text{ pascal}^*$

### Energy:

1 J = 0.239 cal  
 1 J =  $1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$   
 101.3 J = 1 L·atm  
 1 cal = 4.184 J\*  
 1 cal = 0.003968320 Btu  
 1 cal = 0.0413205 L·atm  
 $C = A \cdot s$   
 $J = C \cdot V$   
 $J = \text{kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$

### SI prefixes:

mega (M)	=	$10^6$
kilo (k)	=	$10^3$
deca (da)	=	$10^1$
deci (d)	=	$10^{-1}$
centi (c)	=	$10^{-2}$
milli (m)	=	$10^{-3}$
micro ( $\mu$ )	=	$10^{-6}$
nano (n)	=	$10^{-9}$
pico (p)	=	$10^{-12}$

### Constants:

$R = 0.08206 \text{ L atm/mol K}$   
 $8.314510 \text{ J/mol K}$   
 $N_a = 6.022137 \times 10^{23} \text{ mol}^{-1}$   
 $h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$   
 $k = 1.389658 \times 10^{-23} \text{ J} \cdot \text{K}^{-1}$   
 $F = 9.649 \times 10^4 \text{ C/mol}$   
 $\mathfrak{R} = 1.097373 \times 10^7 \text{ m}^{-1}$   
 $K_w = 1.0 \times 10^{-14} (25 \text{ }^\circ\text{C})$   
 $c = 3.00 \times 10^8 \text{ m/s}$   
 $e = 2.71828$   
 $\pi = 3.14159$

### Mass of proton ( $m_p$ ):

1.00727647 amu  
 $1.67262171 \times 10^{-27} \text{ kg}$

### Mass of neutron ( $m_n$ ):

1.00866492 amu  
 $1.67492728 \times 10^{-27} \text{ kg}$

### Mass of electron ( $m_e$ ):

$5.48579909 \times 10^{-4} \text{ amu}$   
 $9.10938262 \times 10^{-31} \text{ kg}$

### Electron charge:

$e = 1.60218 \times 10^{-19} \text{ C}$

### Temperature:

$K = ^\circ\text{C} + 273.15$   
 $^\circ\text{C} = K - 273.15$   
 $^\circ\text{F} = (1.8)^\circ\text{C} + 32$

### Equations:

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

$$\lambda v = c$$

$$E = -2.178 \times 10^{-18} \left( \frac{Z^2}{n^2} \right)$$

$$E = h\nu$$

$$\frac{1}{\lambda} = \mathfrak{R} \left( \frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$$

$$E = \frac{hc}{\lambda}$$

SOLUBILITY RULES	ACTIVITY SERIES	
1. Alkali metal compounds, acetates, nitrates, and ammonium compounds are all soluble.	<u>highest activity</u>	Li
2. Hydroxides of alkali metals and $\text{NH}_4^{+1}$ , $\text{Ca}^{+2}$ , $\text{Sr}^{+2}$ , and $\text{Ba}^{+2}$ are soluble. All others are <b>insoluble</b> .		K
3. All halides (chlorides etc.) are soluble except for those containing $\text{Ag}^{+1}$ , $\text{Pb}^{+2}$ , and $\text{Hg}_2^{+2}$ .		Ca
4. Most sulfates are soluble, except for $\text{BaSO}_4$ , $\text{SrSO}_4$ , $\text{Ag}_2\text{SO}_4$ , $\text{PbSO}_4$ , and $\text{CaSO}_4$ .		Na
5. Most phosphates, carbonates, chromates and sulfides are <b>insoluble</b> (except those of the alkali metals and ammonium).		Mg
6. In addition, all acids are soluble!		Al
		Zn
		$\text{Cr} \rightarrow \text{Cr}^{+3}$
		$\text{Fe} \rightarrow \text{Fe}^{+2}$
		Cd
		$\text{Ni} \rightarrow \text{Ni}^{+2}$
		$\text{Sn} \rightarrow \text{Sn}^{+2}$
		$\text{Pb} \rightarrow \text{Pb}^{+2}$
		Hydrogen
		$\text{Cu} \rightarrow \text{Cu}^{+2}$
		Ag
		$\text{Hg} \rightarrow \text{Hg}^{+2}$
	<u>lowest activity</u>	$\text{Au} \rightarrow \text{Au}^{+3}$

Electronegativity Increases

					18 Group 8A
13 Group 3A	14 Group 4A	15 Group 5A	16 Group 6A	17 Group 7A	18 Group 8A
B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	
Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	
Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	
In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	
Tl 1.8	Pb 1.9	Bi 1.9	Po 2.0	At 2.1	

TABLE 2-3 Standard Enthalpy of Formation of Selected Compounds (1 atm pressure, 25°C)

INORGANIC AND SIMPLE ORGANIC COMPOUNDS <sup>a</sup>	$\Delta H_f^\circ/\text{kcal mol}^{-1}$	$\Delta H_f^\circ/\text{kJ mol}^{-1}$
$\text{H}^+(\text{aq})$	0.0 (by convention)	0
$\text{LiCl}(\text{c})$	-97.7	-408.8
$\text{NaCl}(\text{c})$	-98.2	-410.9
$\text{NaF}(\text{c})$	-136.0	-569.0
$\text{NaBr}(\text{c})$	-86.0	-359.8
$\text{NaI}(\text{c})$	-68.8	-287.9
$\text{KCl}(\text{c})$	-104.2	-436.0
$\text{MgCl}_2(\text{c})$	-153.4	-641.8
$\text{CO}(\text{g})$	-26.42	-110.5
$\text{CO}_2(\text{g})$	-94.05	-393.5
$\text{CO}_2(\text{aq})$	-98.69	-412.9
$\text{CH}_4(\text{g})$	-17.89	-74.85
$\text{HCOOH}(\text{g})$	-86.67	-362.6
$\text{H}_2\text{CO}_3(\text{aq})$	-167.0	-698.7
$\text{HCO}_3(\text{aq})$	-165.18	-691.1
$\text{CO}_3^{2-}(\text{aq})$	-161.63	-676.2
$\text{NO}(\text{g})$	21.6	90.4
$\text{NO}_2(\text{g})$	8.09	33.8
$\text{NH}_3(\text{g})$	-11.04	-46.2
$\text{NH}_4^+(\text{aq})$	-31.74	-132.8
$\text{PO}_4^{3-}(\text{aq})$	-306.9	-1284.1
$\text{HPO}_4^{2-}(\text{aq})$	-310.4	-1298.7
$\text{H}_2\text{PO}_4^-(\text{aq})$	-311.3	-1302.5
$\text{H}_3\text{PO}_4(\text{aq})$	-308.2	-1289.5
$\text{O}_3(\text{g})$	34.0	142.3
$\text{OH}^-(\text{aq})$	-54.96	-230.0
$\text{H}_2\text{O}(\text{g})$	-57.798	-241.8
$\text{H}_2\text{O}(\text{l})$	-68.317	-285.84
$\text{SO}_2(\text{g})$	-70.6	-295.4
$\text{SO}_3(\text{g})$	-94.45	-395.2
$\text{H}_2\text{S}(\text{g})$	-4.82	-20.2
$\text{Cl}^-(\text{aq})$	-40.02	-167.4
$\text{HCl}(\text{aq})$	-40.02	-167.4