

# CHEM 1411 FORMULA SHEET

## Solubility Rules

|    | Rule Statement                                                                                                             | Exceptions                                                                                                                                                                                                               |
|----|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | All Group 1A ionic compounds are soluble ( $\text{Li}^+$ , $\text{Na}^+$ , $\text{K}^+$ , $\text{Rb}^+$ , $\text{Cs}^+$ ). | --                                                                                                                                                                                                                       |
| 2  | All nitrates ( $\text{NO}_3^-$ ) are soluble.                                                                              | --                                                                                                                                                                                                                       |
| 3  | All ammonium ( $\text{NH}_4^+$ ) compounds are soluble.                                                                    | --                                                                                                                                                                                                                       |
| 4  | All chlorates ( $\text{ClO}_3^-$ ) and perchlorates ( $\text{ClO}_4^-$ ) are soluble.                                      | --                                                                                                                                                                                                                       |
| 5  | Most acetates ( $\text{C}_2\text{H}_3\text{O}_2^-$ ) are soluble.                                                          | $\text{AgC}_2\text{H}_3\text{O}_2$ , * $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ *                                                                                                                                   |
| 6  | Most chlorides, bromides, and iodides are soluble.                                                                         | $\text{AgCl}$ , $\text{Hg}_2\text{Cl}_2$ , $\text{PbCl}_2$ , * $\text{AgBr}$ , $\text{HgBr}_2$ , $\text{Hg}_2\text{Br}_2$ , $\text{PbBr}_2$ , * $\text{AgI}$ , $\text{HgI}_2$ , $\text{Hg}_2\text{I}_2$ , $\text{PbI}_2$ |
| 7  | Most sulfates ( $\text{SO}_4^{2-}$ ) are soluble.                                                                          | $\text{CaSO}_4$ , $\text{SrSO}_4$ , $\text{BaSO}_4$ , $\text{Ag}_2\text{SO}_4$ , $\text{Hg}_2\text{SO}_4$ , $\text{PbSO}_4$                                                                                              |
| 8  | Most carbonates ( $\text{CO}_3^{2-}$ ) are <u>insoluble</u> .                                                              | Group 1A carbonates, $(\text{NH}_4)_2\text{CO}_3$                                                                                                                                                                        |
| 9  | Most phosphates ( $\text{PO}_4^{3-}$ ) are <u>insoluble</u> .                                                              | Group 1A phosphates, $(\text{NH}_4)_3\text{PO}_4$                                                                                                                                                                        |
| 10 | Most sulfides ( $\text{S}^{2-}$ ) are <u>insoluble</u> .                                                                   | Group 1A sulfides, $(\text{NH}_4)_2\text{S}$                                                                                                                                                                             |
| 11 | Most hydroxides ( $\text{OH}^-$ ) are <u>insoluble</u> .                                                                   | Group 1A hydroxides, $\text{Sr}(\text{OH})_2$ , * $\text{Ba}(\text{OH})_2$ *                                                                                                                                             |
| 12 | Most chromates ( $\text{CrO}_4^{2-}$ ) are <u>insoluble</u> .                                                              | Group 1A chromates, $(\text{NH}_4)_2\text{CrO}_4$                                                                                                                                                                        |

\* Moderately soluble

### Constants

$1 \text{ g} = 6.022 \times 10^{23} \text{ amu}$   
 Specific heat of water =  $4.184 \text{ J/(g}^\circ\text{C)}$   
 Gas constant =  $R = 0.08206 \text{ (L atm) / (mol K)}$   
 Planck's constant =  $h = 6.626 \times 10^{-34} \text{ J s}$   
 Speed of light =  $c = 2.998 \times 10^8 \text{ m/s}$   
 $R_H = 2.180 \times 10^{-18} \text{ J}$

### Conversion Factors and Relationships

$1 \text{ mi} = 1.6093 \text{ km}$   
 $1 \text{ \AA} = 10^{-10} \text{ m}$   
 $1 \text{ cal} = 4.184 \text{ J}$   
 $1 \text{ in} = 2.54 \text{ cm}$   
 $1 \text{ gal} = 4 \text{ qt} = 3.7854 \text{ L}$   
 $1 \text{ lb} = 453.592 \text{ g}$   
 $PV = nRT$   
 $K = ^\circ\text{C} + 273.15$   
 $^\circ\text{C} = 5/9(^{\circ}\text{F} - 32)$   
 $^\circ\text{F} = (9/5^{\circ}\text{C}) + 32$   
 $\text{KE} = \frac{1}{2}mv^2$

$\text{Heat} = q = m \times \Delta T \times s$   
 $\Delta E = q + w$   
 $\Delta E = R_H (1/n_i^2 - 1/n_f^2)$   
 $c = \lambda \nu$   
 $\Delta E = h\nu$   
 $\lambda_d = h / m\nu$   
 $1 \text{ atm} = 760 \text{ torr} = 101.325 \text{ kPa}$   
 $d = mP / RT$   
 $P_i = X_i P_t$   
 $r_1/r_2 = \sqrt{m_2/m_1}$   
 $\text{PE} = mgh \text{ (} g = 9.81 \text{ m/s}^2 \text{)}$

### Activity Series

Li  
 K  
 Ba  
 Ca  
 Na  
 Mg  
 Al  
 Mn  
 Zn  
 Cr  
 Fe  
 Co  
 Ni  
 Sn  
 Pb  
 H  
 Cu  
 Ag  
 Hg  
 Pt  
 Au