Appendix **Name:** _____

A Molarity of Ions in Solution

Often it is necessary to calculate not only the concentration (in molarity) of a compound in aqueous solution but also the concentration of each ion in aqueous solution. The coefficients from the balanced dissolution equation are used in this type of calculation.

EXAMPLE: Calculate the concentrations of Na^+ and SO_4^{-2} in an aqueous solution of 2.0 M Na_2SO_4.

Step 1: Write the balanced dissolution equation (i.e. equation showing how the strong electrolyte dissolves in water).

$$Na_2SO_4(s) \xrightarrow{H_2O} 2\ Na^+(aq) + SO_4^{-2}(aq)$$

Step 2: Use the coefficients from the balanced dissolution equation to calculate the concentration of each ion in aqueous solution.

Molarity of Na^+:

$$\frac{2.0\ \text{mol } Na_2SO_4}{1\ \text{L soln}} \times \frac{2\ \text{mol } Na^+}{1\ \text{mol } Na_2SO_4} = \frac{4.0\ \text{mol } Na^+}{\text{L soln}} \quad \text{OR } \mathbf{4.0\ M\ Na^+}$$

↑ molarity of soln

↑ coefficients from the balanced dissolution eqn.

Molarity of SO_4^{-2}:

$$\frac{2.0\ \text{mol } Na_2SO_4}{1\ \text{L soln}} \times \frac{1\ \text{mol } SO_4^{-2}}{1\ \text{mol } Na_2SO_4} = \frac{2.0\ \text{mol } SO_4^{-2}}{\text{L soln}} \quad \text{OR } \mathbf{2.0\ M\ SO_4^{-2}}$$

↑ molarity of soln

↑ coefficients from the balanced dissolution eqn.

Questions:

1. A 0.25 M aqueous solution of CaI_2 is _____ M in Ca^{+2} and _____ M in I^-.

2. A 0.75 M aqueous solution of $Fe(ClO_4)_3$ is _____ M in Fe^{+3} and _____ M in ClO_4^-.

3. A 2.5 M aqueous solution of $Fe_2(SO_4)_3$ is _____ M in Fe^{+3} and _____ M in SO_4^{-2}.

4. An aqueous solution of $Al_2(SO_4)_3$ is 0.36 M in SO_4^{-2}. Calculate the concentration (in M) of $Al_2(SO_4)_3$ in this solution.

EXAMPLE: Calculate the concentrations of Mg^{+2} and Cl^- in an aqueous solution prepared by dissolving 19 g $MgCl_2$ in enough water to prepare 250. mL of solution.

Step 1: Calculate the molarity of the $MgCl_2$ solution.

$$\frac{19\text{ g MgCl}_2}{250\text{ mL soln}} \times \frac{1\text{ mol MgCl}_2}{95.21\text{ g MgCl}_2} \times \frac{1000\text{ mL soln}}{1\text{ L soln}} = \mathbf{0.80\ M\ MgCl_2}$$

Step 2: Write the balanced dissolution equation (i.e. equation showing how the strong electrolyte dissolves in water).

$$MgCl_2(s) \xrightarrow{H_2O} Mg^{+2}(aq) + 2\ Cl^-(aq)$$

Step 3: Use the coefficients from the balanced dissolution equation to calculate the concentration of each ion in aqueous solution.

Molarity of Mg^{+2}:

$$\frac{0.80\text{ mol MgCl}_2}{1\text{ L soln}} \times \frac{1\text{ mol Mg}^{+2}}{1\text{ mol MgCl}_2} = \frac{0.80\text{ mol Mg}^{+2}}{\text{L soln}} \text{ OR } \mathbf{0.80\ M\ Mg^{+2}}$$

↕ coefficients from the balanced dissolution eqn. ↕

Molarity of Cl^-:

$$\frac{0.80\text{ mol MgCl}_2}{1\text{ L soln}} \times \frac{2\text{ mol Cl}^-}{1\text{ mol MgCl}_2} = \frac{1.6\text{ mol Cl}^-}{\text{L soln}} \text{ OR } \mathbf{1.6\ M\ Cl^-}$$

Appendix A **Molarity of Ions in Solution** **Name:** _____

Questions:

1. Calculate the concentrations of K^+ and NO_3^- in an aqueous solution prepared by dissolving 30.3 g KNO_3 in enough water to make 300. mL of solution.

2. Calculate the concentrations of Al^{+3} and SO_4^{-2} in an aqueous solution prepared by dissolving 17.1 g $Al_2(SO_4)_3$ in enough water to make 400. mL of solution.

3. Calculate the concentrations of Na^+ and SO_4^{-2} in an aqueous solution prepared by dissolving 852 g Na_2SO_4 in enough water to make 4.00 L of solution.

4. What mass (in g) of $CaCl_2$ is needed to prepare 100. mL of an aqueous solution that is 0.25 M in Cl^-?

5. If 100. mL of 18.0 M H_2SO_4 solution are diluted to 10.0 L, what are the concentrations of H^+ and SO_4^{-2} in the diluted solution?