Pre-AP Chemistry
Unit #11—Solutions
Solution Stoichiometry Formulas

Mass Percent/Percent by Mass

What is the percent by mass of NaHCO3 in a solution containing 20 grams of the compound dissolved in 600 mL of water?

$$\frac{20 \text{ g } NaHCO_3}{(20 \text{ g } NaHCO_3 + 600 \text{ g } H_2O)} = 3\% \text{ } NaHCO_3$$

Volume Percent/Percent by Volume

What is the percent by volume of ethanol in a solution that contains 35 mL of ethanol dissolved in 115 mL of water?

$$\frac{35 \text{ mL ethanol}}{(35 \text{ mL ethanol} + 115 \text{ mL water})} = 23\% \text{ ethanol}$$

Molality

What is the molality of a solution that contains 10 grams of sodium sulfate dissolved in 1000 grams of water?

$$\frac{1000 \text{ g } H_2O \left| \frac{1 \text{ kg } H_2O}{1000 \text{ g } H_2O} \right.}{} = 1 \text{ kg } H_2O \qquad \frac{10 \text{ g } Na_2SO_4 \left| \frac{1 \text{ mol } Na_2SO_4}{142.042 \text{ g } Na_2SO_4} \right.}{} = 0.070 \text{ mol } Na_2SO_4 \qquad \frac{0.070 \text{ mol } Na_2SO_4}{1 \text{ kg } H_2O} = 0.070 \text{ m } Na_2SO_4$$

Molarity

What is the Molarity of a solution that contains 3.5 moles of hydrochloric acid in 4 L of water?

$$\frac{3.5 \text{ mol HCl}}{4 \text{ L soln}} = 0.875 \text{ M HCl}$$

Calculate the Molarity of 778 mL solution that contains 1.09 moles of carbon tetrachloride.

$$\frac{778 \text{ mL soln} \left| \frac{1 \text{ L soln}}{1000 \text{ mL soln}} \right.}{} = 0.778 \text{ L soln} \qquad \frac{1.09 \text{ mol } CCl_4}{0.778 \text{ L soln}} = 0.140 \text{ M } CCl_4$$

What is the Molarity of a solution that contains 38.0 grams of titanium (IV) oxide in 2.3 L of water?

$$38 \text{ g } TiO_2 \quad \frac{1 \text{ mol } TiO_2}{79.865 \text{ g } TiO_2} = 0.476 \text{ mol } TiO_2 \qquad \frac{0.476 \text{ mol } TiO_2}{2.3 \text{ L soln}} = 0.207 \text{ M } TiO_2$$

Calculate the molarity of magnesium nitride when there is 3.55 grams of it in 450 mL of water.

$$\frac{450 \text{ mL soln} \left| \frac{1 \text{ L soln}}{1000 \text{ mL soln}} \right.}{} = 0.450 \text{ L soln} \qquad \frac{3.55 \text{ g } Mg_3N_2 \left| \frac{1 \text{ mol } Mg_3N_2}{100.929 \text{ g } Mg_3N_2} \right.}{} = 0.035 \text{ g } Mg_3N_2 \qquad \frac{0.035 \text{ mol } Mg_3N_2}{0.450 \text{ L soln}} = 0.078 \text{ M } Mg_3N_2$$

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Liters to Moles
How many moles of sodium chloride are present in a 4.8 L of 2.5 M solution?

$$\frac{4.8 \text{ L soln NaCl} \mid 2.5 \text{ mol NaCl}}{1 \text{ L soln NaCl}} = 12 \text{ mol NaCl}$$

Moles to Liters
Calculate the liters of solvent needed to make an 8.0 M solution of 5.34 moles manganese (II) fluoride.

$$\frac{5.34 \text{ mol } MnF_2 \mid 1 \text{ L soln } MnF_2}{8.0 \text{ mol } MnF_2} = 0.668 \text{ L soln } MnF_2$$

Milliliters to Moles
How many moles of sodium chloride are present in a 790 mL of 2.5 M solution?

$$\frac{790 \text{ mL soln NaCl} \mid ?? \text{ L soln NaCl} \mid 2.5 \text{ mol NaCl}}{1000 \text{ mL soln NaCl} \mid 1 \text{ L soln NaCl}} = 1.975 \text{ mol NaCl}$$

Moles to Milliliters
Calculate the milliliters of water needed to make a 4.0 M solution of 5.34 moles manganese (II) fluoride.

$$\frac{5.34 \text{ mol } MnF_2 \mid 1 \text{ L soln } MnF_2 \mid 1000 \text{ mL soln } MnF_2}{4.0 \text{ mol } MnF_2 \mid 1 \text{ L soln } MnF_2} = 1{,}335 \text{ mL soln } MnF_2$$

Liters to Grams
How many grams of calcium chloride, $CaCl_2$, would be dissolved in 1.0 L of a 0.10 M solution of $CaCl_2$?

$$\frac{1 \text{ L soln } CaCl_2 \mid 0.10 \text{ mol } CaCl_2 \mid 110.984 \text{ g } CaCl_2}{1 \text{ L soln } CaCl_2 \mid 1 \text{ mol } CaCl_2} = 11.098 \text{ g } CaCl_2$$

Grams to Liters
Calculate the liters of water needed to make a 1.5 M solution with 0.070 grams of hydrofluoric acid, HF.

$$\frac{0.070 \text{ g HF} \mid 1 \text{ mol HF} \mid 1 \text{ L soln HF}}{20.006 \text{ g HF} \mid 1.5 \text{ mol HF}} = 0.002 \text{ L soln HF}$$

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Milliliters to Grams

How many grams of calcium chloride should be dissolved in 500.0 mL of water to make a 0.20 M solution of calcium chloride?

$$\frac{500 \text{ mL soln } CaCl_2}{} \left| \frac{1 \text{ L soln } CaCl_2}{1000 \text{ mL soln } CaCl_2} \right| \frac{0.20 \text{ mol } CaCl_2}{1 \text{ L soln } CaCl_2} \left| \frac{110.984 \text{ g } CaCl_2}{1 \text{ mol } CaCl_2} \right. = 11.098 \text{ g } CaCl_2$$

Grams to Milliliters

Calculate the milliliters of water needed to make a 4.0 M solution with 0.887 grams of hydrofluoric acid, HF.

$$\frac{0.887 \text{ g HF}}{} \left| \frac{1 \text{ mol HF}}{20.006 \text{ g HF}} \right| \frac{1 \text{ L soln HF}}{4.0 \text{ mol HF}} \left| \frac{1000 \text{ mL soln HF}}{1 \text{ L soln HF}} \right. = 11.084 \text{ mL HF}$$