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

Liters to Grams

What mass of NaCl is needed to precipitate the silver ions from 2.0 L of 0.100 M $AgNO_3$ solution?

$$NaCl\ (aq) + AgNO_3\ (aq) \Rightarrow NaNO_3\ (aq) + AgCl\ (s)$$

$$\frac{2\text{ L soln } AgNO_3}{} \left| \frac{0.100\text{ mol } AgNO_3}{1\text{ L soln } AgNO_3} \right| \frac{1\text{ mol NaCl}}{1\text{ mol } AgNO_3} \left| \frac{58.443\text{ g NaCl}}{1\text{ mol NaCl}} \right. = 11.689\text{ g NaCl}$$

Grams to Liters

How many liters of 0.120 M HCl are needed to completely neutralize 15.0 grams of $Ba(OH)_2$?

$$2\ HCl\ (aq) + Ba(OH)_2\ (aq) \Rightarrow 2\ NaCl\ (aq) + 2\ H_2O\ (l)$$

$$\frac{15.0\text{ g } Ba(OH)_2}{} \left| \frac{1\text{ mol } Ba(OH)_2}{171.334\text{ g } Ba(OH)_2} \right| \frac{2\text{ mol HCl}}{1\text{ mol } Ba(OH)_2} \left| \frac{1\text{ L soln HCl}}{0.120\text{ mol HCl}} \right. = 1.459\text{ L soln HCl}$$

Milliliters to Grams

How many grams of NaOH are needed to neutralized 20.0 mL of 0.150 M H_2SO_4 solution?

$$H_2SO_4\ (aq) + 2\ NaOH\ (aq) \Rightarrow Na_2SO_4\ (aq) + 2\ H_2O\ (l)$$

$$\frac{20\text{ mL soln } H_2SO_4}{} \left| \frac{1\text{ L soln } H_2SO_4}{1000\text{ mL soln } H_2SO_4} \right| \frac{0.150\text{ mol } H_2SO_4}{1\text{ L soln } H_2SO_4} \left| \frac{2\text{ mol NaOH}}{1\text{ mol } H2_SO_4} \right| \frac{39.997\text{ g NaOH}}{1\text{ mol NaOH}} \left. = 0.240\text{ g NaOH} \right.$$

Grams to Milliliters

How many milliliters of 0.650 M silver nitrate need to mix with 0.750 grams of potassium phosphate for the reaction to go to completion?

$$2\ AgNO_3\ (aq) + K_3PO_4\ (aq) \Rightarrow Ag_2PO_4\ (s) + 2\ KNO_3\ (aq)$$

$$\frac{0.750\text{ g } K_3PO_4}{} \left| \frac{1\text{ mol } K_3PO_4}{212.264\text{ g } K_3PO_4} \right| \frac{2\text{ mol } AgNO_3}{1\text{ mol } K_3PO_4} \left| \frac{1\text{ L soln } AgNO_3}{0.650\text{ mol AgNO3}} \right| \frac{1000\text{ mL soln } AgNO_3}{1\text{ L soln } AgNO_3} \left. = 10.872\text{ mL soln } AgNO_3 \right.$$

Moles to Liters

How many liters of 0.500 M HCl are needed to react completed with 0.100 mol of $Pb(NO_3)_2$ to form the precipitant?

$$2\ HCl\ (aq) + Pb(NO_3)_2\ (aq) \Rightarrow 2\ HNO_3\ (aq) + PbCl_2\ (s)$$

$$\frac{0.100\text{ mol } Pb(NO_3)_2}{} \left| \frac{2\text{ mol HCl}}{1\text{ mol } Pb(NO_3)_2} \right| \frac{1\text{ L soln HCl}}{0.500\text{ mol HCl}} \left. = 0.400\text{ L soln HCl} \right.$$

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

Liters to Moles

Sodium bicarbonate is added to a sulfuric acid spill on the lab bench. If 4 L of 6.0 M $H2SO_4$ was spilled, how many moles of sodium bicarbonate will be needed to neutralize the acid on the lab bench?

$$2\ NaHCO_3\ (aq) + H_2SO_4\ (aq) \Rightarrow Na_2SO_4\ (aq) + 2\ H_2O\ (l) + 2\ CO_2\ (g)$$

$$\frac{4\text{ L soln } H_2SO_4}{} \left| \frac{6.0\text{ mol } H_2SO_4}{1\text{ L soln } H_2SO_4} \right| \frac{2\text{ mol } NaHCO_3}{1\text{ mol } H_2SO_4} = 48.000\text{ mol } NaHCO_3$$

Moles to Milliliters

How many milliliters of 0.100 M HNO_3 is needed to neutralize 0.445 moles of $Ca(OH)_2$?

$$2\ HNO_3\ (aq) + Ca(OH)_2\ (aq) \Rightarrow Ca(NO_3)_2\ (aq) + 2\ H_2O\ (l)$$

$$\frac{0.445\text{ mol } Ca(OH)_2}{} \left| \frac{2\text{ mol } HNO_3}{1\text{ mol } Ca(OH)_2} \right| \frac{1\text{ L soln } HNO_3}{0.100\text{ mol } HNO_3} \left| \frac{1000\text{ mL soln } HNO_3}{1\text{ L soln } HNO_3} \right. = 8900.000\text{ mL soln } HNO_3$$

Milliliters to Moles

Sodium bicarbonate is added to a sulfuric acid spill on the lab bench. If 25 mL of 6.0 M $H2SO_4$ was spilled, how many moles of sodium bicarbonate will be needed to neutralize the acid on the lab bench?

$$2\ NaHCO_3\ (aq) + H_2SO_4\ (aq) \Rightarrow Na_2SO_4\ (aq) + 2\ H_2O\ (l) + 2\ CO_2\ (g)$$

$$\frac{25\text{ mL soln } H_2SO_4}{} \left| \frac{1\text{ L soln } H_2SO_4}{1000\text{ mL soln } H_2SO_4} \right| \frac{6.0\text{ mol } H_2SO_4}{1\text{ L soln } H_2SO_4} \left| \frac{2\text{ mol } NaHCO_3}{1\text{ mol } H_2SO_4} \right. = 0.300\text{ mol } NaHCO_3$$

Milliliters to Milliliters

A 25 mL of a 0.100 M HBr solution is titrated with a 0.200 M NaOH solution. How many milliliters of the NaOH solution are required to reach the equivalence point for the chemical reaction?

$$HBr\ (aq) + NaOH\ (aq) \Rightarrow NaBr\ (aq) + H2O\ (l)$$

$$\frac{25\text{ mL soln HBr}}{} \left| \frac{1\text{ L soln HBr}}{1000\text{ mL soln HBr}} \right| \frac{0.100\text{ mol HBr}}{1\text{ L soln HBr}} \left| \frac{1\text{ mol NaOH}}{1\text{ mol HBr}} \right| \frac{1\text{ L soln NaOH}}{0.200\text{ mol NaOH}} \left| \frac{1000\text{ mL soln NaOH}}{1\text{ L soln NaOH}} \right. = 12.50\text{ mL soln NaOH}$$

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

Milliliters to Liters

How many liters of 0.550 M beryllium hydroxide will complete react with a 25.00 mL solution of 2.5 M lead (IV) chloride?

$$2\ Be(OH)_2\ (aq) + PbCl_4\ (aq) \Rightarrow 2\ BeCl_2\ (aq) + Pb(OH)_4(s)$$

$$\frac{25.0\text{ mL soln } PbCl_4}{} \left| \frac{1\text{ L soln } PbCl_4}{1000\text{ mL soln PbCl4}} \right| \frac{2.5\text{ mol } PbCl_4}{1\text{ L soln } PbCl_4} \left| \frac{2\text{ mol } Be(OH)_2}{1\text{ mol } PbCl_4} \right| \frac{1\text{ L soln } Be(OH)_2}{0.550\text{ mol } Be(OH)_2} = 0.227\text{ L soln } Be(OH)_2$$

Liters to Milliliters

How many milliliters of 0.550 M beryllium hydroxide will complete react with a 0.05 L solution of 2.5 M lead (IV) chloride?

$$2\ Be(OH)_2\ (aq) + PbCl_4\ (aq) \Rightarrow 2\ BeCl_2\ (aq) + Pb(OH)_4(s)$$

$$\frac{0.05\text{ L soln } PbCl_4}{} \left| \frac{2.5\text{ mol } PbCl_4}{1\text{ L soln } PbCl_4} \right| \frac{2\text{ mol } Be(OH)_2}{1\text{ mol } PbCl_4} \left| \frac{1\text{ L soln } Be(OH)_2}{0.550\text{ mol } Be(OH)_2} \right| \frac{1000\text{ mL soln } Be(OH)_2}{1\text{ L soln } Be(OH)_2} = 454.545\text{ mL soln } Be(OH)_2$$

Liters to Liters

How many liters of 0.550 M beryllium hydroxide will complete react with a 0.05 L solution of 2.5 M lead (IV) chloride?

$$2\ Be(OH)_2\ (aq) + PbCl_4\ (aq) \Rightarrow 2\ BeCl_2\ (aq) + Pb(OH)_4(s)$$

$$\frac{0.05\text{ L soln } PbCl_4}{} \left| \frac{2.5\text{ mol } PbCl_4}{1\text{ L soln } PbCl_4} \right| \frac{2\text{ mol } Be(OH)_2}{1\text{ mol } PbCl_4} \left| \frac{1\text{ L soln } Be(OH)_2}{0.550\text{ mol } Be(OH)_2} \right| = 0.455\text{ L soln } Be(OH)_2$$

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

Limiting Reactants for Solution Stoichiometry

1. ***Convert values from unit of measure to moles.***
2. ***Convert moles of one reactant to another reactant using Mole Ratios.***
3. ***Determine Limiting Reactant.***
4. ***Determine Theoretical Yield/Maximum Yield/Maximum Amount of all Products for the reaction.***

A solution of 100.0 mL of 0.200 M potassium hydroxide is mixed with a solution of 200.0 mL of 0.150 M nickel (II) sulfate. What is the limiting reactant for the reaction? How much precipitant forms from the reaction?

$$2\ KOH\ (aq) + NiSO_4\ (aq) \Rightarrow K_2SO_4\ (aq) + Ni(OH)_2\ (s)$$

$$KOH = \frac{100.0\ mL\ soln\ KOH}{1} \left| \frac{1\ L\ soln\ KOH}{1000\ mL\ soln\ KOH} \right| \frac{0.200\ mol\ KOH}{1\ L\ soln\ KOH} = \boxed{0.020\ mol\ KOH} \left| \frac{1\ mol\ NiSO_4}{2\ mol\ KOH} \right| = 0.010\ mol\ NiSO_4$$

AVAILABLE NEEDED

$$NiSO_4 = \frac{200.0\ mL\ soln\ NiSO_4}{1} \left| \frac{1\ L\ soln\ NiSO_4}{1000\ mL\ soln\ NiSO_4} \right| \frac{0.150\ mol\ NiSO_4}{1\ L\ soln\ NiSO_4} = 0.030\ mol\ NiSO_4 \left| \frac{2\ mol\ KOH}{1\ mol\ NiSO_4} \right| = 0.060\ mol\ KOH$$

$$\frac{0.020\ mol\ KOH}{1} \left| \frac{1\ mol\ Ni(OH)_2}{1\ mol\ KOH} \right| \frac{92.707\ g\ Ni(OH)_2}{1\ mol\ Ni(OH)_2} = 1.854\ g\ Ni(OH)_2$$