Name: _____ **Honors Unit 7 Study Guide – Chapters 11 & 12**

Chm.2.2.4 Analyze the stoichiometric relationships inherent in a chemical reaction ***(questions 10, 11, 12, 13, 14, 15)***

- Interpret coefficients of a balanced equation as mole ratios. ***(questions 8, 9, 10, 13, 14, 15)***
- Use mole ratios from the balanced equation to calculate the quantity of one substance in a reaction given the quantity of another substance in the reaction. (given moles, particles, mass, or volume and ending with moles, particles, mass, or volume of the desired substance) ***(questions 8, 9, 10, 13, 14, 15)***

Chm.2.2.5 Analyze quantitatively the composition of a substance (empirical formula, molecular formula, percent composition, and hydrates) ***(question 1)***

- Calculate empirical formula from mass or percent using experimental data. ***(questions 3, 4, 7)***
- Calculate molecular formula from empirical formula using molecular weight. ***(questions 5, 6)***
- Determine percentage composition by mass of a given compound. ***(question 2)***
- Perform calculations based on percent composition. ***(questions 3, 6)***
- Determine the composition of hydrates using experimental data. ***(question 7)***

"The Mole"

1) Use a factor-label expression to solve the following problems.

a. If you need to measure out 0.20 moles of sodium chloride, how many grams should you weigh out?

b. How many molecules of water are there in 75.0 g of water?

c. How many grams of carbon dioxide contain 4.50×10^{23} molecules of CO_2?

d. How many atoms of oxygen are in 4.33 moles of sulfur trioxide?

2) Calculate the % composition of each element in the following compounds.

Aluminum Carbonate = _____ %Al _____%C _____%O

Barium Cyanide = _____%Ba _____%C _____%N

3) Calculate the empirical formulas of the following compounds given their percent compositions.

a) 47.35%C, 10.60% H, 42.05% O

b) What acid contains 3.69%H, 37.77%P, and 58.54%O?

4) Given the following molecular formulas, give the empirical formula.

a) $C_6H_3N_3O_6$ _____ b) $C_{12}H_{22}O_{11}$ _____ c) $C_2H_4Br_2$ _____

5) Given the following empirical formulas and molecular masses, calculate the molecular formulas.

a) CH_2O, 150.1 $\frac{g}{mol}$ b) $CHCl_3$, 119.4 $\frac{g}{mol}$

molecular formula = _____ molecular formula = _____

6) If a compound has a molecular mass of 164.3 g/mol and is composed of 87.73% C and 12.27% H, what is the molecular formula of the compound?

7) Given the following lab data, determine the empirical formula of the compound. A 2.50 g sample of a hydrate containing copper, chlorine and water was measured out. It was heated until it came to a constant mass of 1.50 g. The remaining solid was allowed to react with a metal to produce 0.71 g of copper. The remainder of the compound was assumed to be chlorine.

a) What was the mass of water in the compound?

b) What was the number of moles of water in the compound?

c) What was the mass of copper in the compound?

d) What was the number of moles of copper in the compound?

e) What was the mass of chlorine in the compound?

f) What was the number of moles of chlorine in the compound?

g) If the formula of the compound was $Cu_xCl_y \cdot ZH_2O$. What are x, y, and z?

"Stoichiometry"

8) Given the equation for the reaction of copper (II) chloride and aluminum

$$\mathbf{3\ CuCl_{2\,(aq)} + 2\ Al_{(s)} \rightarrow 2\ AlCl_{3\,(aq)} + 3\ Cu_{(s)}}$$

a. How many **moles** of $CuCl_2$ will react with 0.54 **moles** of aluminum?

b. How many **moles** of copper would precipitate when 1.2 **moles** of aluminum reacted?

9) For the reaction of hydrochloric acid and barium hydroxide,

$$\mathbf{2\ HCl_{(aq)} + Ba(OH)_{2\,(s)} \rightarrow BaCl_{2\,(aq)} + 2\ H_2O_{(l)}}$$

a. How many **moles** of hydrochloric acid will react with 0.750 **grams** of barium hydroxide?

b. How many **grams** of barium hydroxide should be used to produce 3.40 **moles** of water?

10) For the reaction of lead (II) nitrate and potassium iodide to produce lead (II) iodide and potassium nitrate, **write a balanced equation <u>first</u>**:

a. How many **grams** of potassium nitrate are needed to cause 0.450 **grams** of lead (II) nitrate to completely react?

b. What is the theoretical yield of lead (II) iodide from the reaction in part a?

c. If 0.495 **grams** of lead (II) iodide are actually recovered, what is the percent yield?

11) What is the definition of the limiting reactant?

12) If you are making hamburgers and you have the following ingredients:

16 buns, 24 hamburger patties, 36 pickle slices, 16 slices of cheese, and 30 strips of bacon...

a) How many bacon cheeseburgers can you make if each one requires 1 bun, 1 hamburger, 3 pickles, 1 slice of cheese and 3 strips of bacon?

b) How many pickles will you have left over?

13) For the reaction:

$$\mathbf{2\ CuNO_{3\,(aq)} + K_2CO_{3\,(aq)} \rightarrow Cu_2CO_{3\,(s)} + 2\ KNO_{3\,(aq)}}$$

Identify AND **circle** the **limiting reactant** for the following mixtures. ***Work must be shown to support your answer***.

a) 5.0 **moles** $CuNO_3$, 5.0 **moles** K_2CO_3

b) 15.00 **moles** $CuNO_3$, 5.00 **moles** K_2CO_3

c) 10.00 **moles** $CuNO_3$, 5.00 **moles** K_2CO_3

d) 4.00 **g** $CuNO_3$, 2.00 **g** K_2CO_3

e) 2.50 **g** of $CuNO_3$, 1.60 **g** of K_2CO_3

14) $\mathbf{Mg(NO_3)_{2(aq)} + 2\ NaOH_{(aq)} \rightarrow Mg(OH)_{2(s)} + 2\ NaNO_{3(aq)}}$

a. If 3.00 grams of magnesium nitrate react with 4.00 grams of sodium hydroxide, which reactant is limiting?

b. What mass of magnesium hydroxide **should** precipitate as a result?

c. If this reaction only works in 65% yield, what mass of magnesium hydroxide is **actually** collected?

15) When 2.50 moles of zinc react with 3.50 moles of iron (III) hydroxide to produce an actual yield of 47.5 grams of iron, what is the percent yield of the reaction?