Name _____**Chem 161, Section**: _____**Group Number:** _____

ALE 13. Stoichiometry: Mole-Mass Relationships

(Reference: Chapter 3 - Silberberg 5th edition)

Important!! For answers that involve a calculation you must show your work neatly using dimensional analysis with correct significant figures and units to receive full credit. No work, no credit. Report numerical answers to the correct number of significant figures. **CIRCLE ALL NUMERICAL RESPONSES**.

Section 3.2 Determining the Formula of an Unknown Compound

1. Is $MgCl_2$ an empirical and/or a molecular formula for magnesium chloride? Explain.

2. What is the molecular formula for each of the following compounds?
   a.) Empirical formula: CH; Molar Mass of compound = 78.11 g/mol

   b.) Empirical formula: $C_3H_6O_2$; Molar Mass of compound = 74.08 g/mol

   c.) Empirical formula: HgCl; Molar Mass of compound = 472.1 g/mol

   d.) Empirical formula: $C_7H_4O_2$; Molar Mass of compound = 240.20 g/mol

3. A chloride of silicon contains 79.1 mass % Cl.
   a.) What is the empirical formula of the chloride?

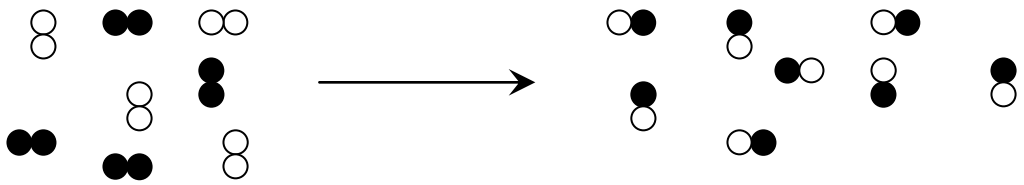
   b.) If the molar mass is 269 g/mol, what is the molecular formula?

4. A Menthol (molar mass = 156.3 g/mol), a strong smelling substance used in cough drops, is a compound of carbon, hydrogen, and oxygen. When 0.1595 g of menthol was subjected to combustion analysis, it produced 0.449 g of CO_2 and 0.184 g of H_2O. What is its molecular formula?

Section 3.3 Writing and Balancing Equations

5. What three types of information does a balanced chemical equation provide? How?

6. The following boxes represent a chemical reaction between elements A (white) and B (black):



Which of the following best represents the balanced equation for the reaction? Be able to explain your reasoning.

(a) $2A + 2B \rightarrow A_2 + B_2$ (b) $2A + 2B \rightarrow 2\ AB$

(c) $B_2 + 2AB \rightarrow A_2 + 2B_2$ (d) $4A_2 + 4B_2 \rightarrow 8\ AB$

7. Write balanced equations for each of the following by inserting the correct coefficients in the blanks:

a.) ____$Cu(NO_3)_2(aq)$ + ____$KOH(aq)$ → ____$Cu(OH)_2(s)$ + ____$KNO_3(aq)$

b.) ____$BCl_3(g)$ + ____$H_2O(l)$ → ____$H_3BO_3(s)$ + ____$HCl(g)$

c.) ____$CaSiO_3(s)$ + ____$HF(g)$ → ____$SiF_4(g)$ + ____$CaF_2(s)$ + ____$H_2O(l)$

d.) ____$(CN)_2(g)$ + ____$H_2O(l)$ → ____$H_2C_2O_4(aq)$ + ____$NH_3(g)$

8. Write balanced equations for each of the following by inserting the correct coefficients in the blanks:

a) ____$SO_2(g)$ + ____$O_2(g)$ → ____$SO_3(g)$

b) ____$Sc_2O_3(s)$ + ____$H_2O(l)$ → ____$Sc(OH)_3(s)$

c) ____$H_3PO_4(aq)$ + ____$NaOH(aq)$ → ____$Na_2HPO_4(aq)$ + ____$H_2O(l)$

d) ____$C_6H_{10}O_5(s)$ + ____$O_2(g)$ → ____$CO_2(g)$ + ____$H_2O(g)$

9. Convert the following into balanced chemical equations:

a.) When lead (II) nitrate solution is added to a solution of potassium iodide, solid lead (II) iodide forms and potassium nitrate remains in solution.

b.) Liquid disilicon hexachloride reacts with liquid water to form solid silicon dioxide, hydrogen chloride gas, and hydrogen gas.

c.) When nitrogen dioxide is bubbled into water, a solution of nitric acid forms and gaseous nitrogen monoxide is released.

Section 3.4 Calculating Amounts of Reactant and Product

10. Chromium (III) oxide reacts with hydrogen sulfide gas to form chromium (III) sulfide and water:

$$Cr_2O_3(s) + 3\ H_2S(g) \rightarrow Cr_2S_3(s) + 3\ H_2O(l)$$

a.) How many moles of chromium (III) oxide are needed to produce 421 g of chromium (III) sulfide?

b.) How many grams of chromium (III) oxide are needed to produce 421 g of chromium (III) sulfide?

11. Calculate the mass of each product formed when 175 g if silver sulfide reacts with excess hydrochloric acid in the following unbalanced reaction:

$$Ag_2S(s) + HCl(aq) \rightarrow AgCl(s) + H_2S(g)$$

12. Metal hydrides react with water to form hydrogen gas and the metal hydroxide. For example:

$$SrH_2(s) + 2\,H_2O(l) \rightarrow Sr(OH)_2(s) + 2H_2\,(g)$$

You wish to calculate the mass of hydrogen gas that can be prepared from 5.63 g of strontium hydride and 4.80 g of water.

a.) If all of the strontium hydride reacts, how many moles of hydrogen gas will be produced?

b.) If all of the water reacts, how many moles of hydrogen gas will be produced?

c.) Which reactant is the limiting reactant? Explain.

d.) Calculate how many grams of hydrogen can be produced.

13. Calcium nitrate and ammonium fluoride react to form calcium fluoride, dinitrogen monoxide, and water vapor. What mass of each substance is present after 16.8 g of calcium nitrate and 17.50 g of ammonium fluoride react completely?

14. What is the percent yield of a reaction in which 200. g of phosphorus trichloride reacts with excess water to form 128 g of HCl and aqueous phosphorous acid, H_3PO_3?