STOICHIOMETRY WORKSHEET II

1. Determine the mass in grams of sodium to add to 50.0g of fluorine to make sodium fluoride (this is the salt added to water to prevent tooth decay).

2. Milk of magnesia, a suspension of $Mg(OH)_2$, reacts with stomach acid, HCl, in a neutralization reaction. The products are water and a salt.
   a) Write the equation and balance it.
   b) What mass, in grams, of $MgCl_2$ will be produced if 3.00 g of $Mg(OH)_2$ reacts?
   c) What mass of HCl is required to produce 3.00 g of $MgCl_2$?

3. For the reaction $2\ N_2H_4 + N_2O_4 \rightarrow 3\ N_2 + 4\ H_2O$, if 10.81 g of N_2H_4 is used, what mass of nitrogen is produced?

4. 10.6 g of magnesium reacts with excess hydrochloric acid.
   a) Write the balanced equation for the reaction
   b) What mass of hydrogen gas is produced?
   c) Classify this reaction as single or double displacement, decomposition, synthesis, or combustion.

5. Potassium hydroxide decomposes into potassium oxide and water.
   a) Write the balanced equation for the reaction.
   b) What is the amount of water formed if 34.9 g of potassium hydroxide are used?

6. Barium hydroxide reacts with sulfuric acid.
   a) Write the balanced equation for the reaction.
   b) What mass of barium hydroxide is needed to completely react with 9.58 g of sulfuric acid?
   c) Classify this reaction as to type.

7. The actual amount of product produced in a reaction is 33.13g, although a mass-mass calculation predicted 46.87g. What is the percentage yield of this product?

8. Hydrogen burns in oxygen according to the following reaction: $2\ H_2 + O_2 \rightarrow 2\ H_2O$. What is the percent yield if 9.28 g of oxygen react with excess hydrogen to produce 8.81 g of water?

9. 28.0 g of magnesium carbonate reacts with sulfuric acid. What mass of water is produced? (Hint – CO_2 is also produced.)

10. 17.1 g of C_2H_6 is burned in oxygen. What mass of oxygen was consumed? Assume complete combustion.

11. Consider the reaction of iron (III) phosphate with sodium sulfate to make iron (III) sulfate and sodium phosphate.
   a) Write the balanced chemical equation.
   b) If I perform this reaction with 25 grams of iron (III) phosphate and an excess of sodium sulfate, how many grams of iron (III) sulfate can I make?
   c) If 18.5 grams of Iron (III) sulfate are actually made when I do this reaction, what is my percent yield?
   d) Is your answer reasonable?

Examples from the Pulp and Paper Industry:

12. In a Kraft chemical recovery boiler, sodium sulfate and carbon (C) are combined to produce sodium sulfide and carbon dioxide.

a) If 500.0 g of sodium sulfate and 900.0 g of carbon are available, how much sodium sulfide would be produced?
b) What is the limiting reagent?
c) If only 238 g of sodium sulfide are produced, what is the percent yield?

13. In the causticizing reaction that occurs in a modern pulp and paper mill, sodium carbonate is combined with calcium hydroxide to produce sodium hydroxide and calcium carbonate. If 95.0 g of calcium hydroxide is added to 106.0 g of sodium carbonate,

a) How much sodium hydroxide is produced?
b) What limits the reaction?
c) If only 45.0 g of sodium hydroxide is produced, what is the percent yield?

14. In a piece of equipment called the Slaker, the slaking reaction occurs. In this reaction, 243 moles of calcium oxide (also known as lime) is combined with 305 g of water to produce calcium hydroxide.

a) How much calcium hydroxide is produced?
b) What limits the reaction?
c) How much additional water is required to react all of the calcium oxide?

ANSWERS:

1. 60.5 g Na
2a. $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$
2b. 4.90 g $MgCl_2$
2c. 2.30 g HCl
3. 14.18 g N_2
4a. $Mg + 2HCl \rightarrow MgCl2 + H_2$
4b. .879 g H_2
4c. single replacement
5a. $2KOH \rightarrow K_2O + H_2O$
5b. 5.60 g H_2O
6a. $Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$
6b. 16.7 g $Ba(OH)_2$
6c. double replacement
7. 70.68%
8. 84.3%
9. 5.98 g H_2O
10. 63.7 g O_2
11a. $2FePO_4 + 3Na_2SO_4 \rightarrow Fe_2(SO_4)_3 + 2Na_3PO_4$
11b. 33.1 g $Fe_2(SO_4)_3$
11c. 55.9%
11d. Yes – the percent yield should not be greater than 100%.
12a. $Na_2SO_4 + 2C \rightarrow Na_2S + 2CO_2$; 274.7 g Na_2S
12b. sodium sulfate limits the reaction
12c. 86.6%
13a. $Na_2CO_3 + Ca(OH)_2 \rightarrow 2NaOH + CaCO_3$; 80.0 g NaOH
13b. sodium carbonate limits the reaction
13c. 56.2%
14a. $CaO + H_2O \rightarrow Ca(OH)_2$; 1250 g $Ca(OH)_2$ produced
14b. Water limits the reaction
14c. 4070 g H_2O