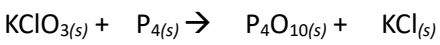
Unit 3 – Chapter 3: Stoichiometry **Name _____**

Assignment #3: Basic Stoichiometry, Limiting Reagents, % Yield **Period _____**

1) The reaction between potassium chlorate and red phosphorus takes place when you strike a match on a matchbox. If you were to react 52.9 g of potassium chlorate ($KClO_3$) with excess red phosphorus, what mass of tetraphosphorus decaoxide (P_4O_{10}) would be produced?



$$KClO_{3(s)} + P_{4(s)} \rightarrow P_4O_{10(s)} + KCl_{(s)}$$

****UNBALANCED****

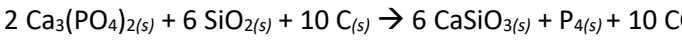
2) One of the relatively few reactions that takes place directly between two solids at room temperature is

$$Ba(OH)_2 \cdot 8\,H_2O_{(s)} + NH_4SCN_{(s)} \rightarrow Ba(SCN)_{2(s)} + H_2O_{(l)} + NH_{3(g)}$$

a. Balance this equation.

b. What mass of ammonium thiocyanate (NH_4SCN) must be used if it is to react completely with 6.5 g barium hydroxide octahydrate?

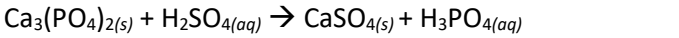
3) Phosphorus can be prepared from calcium phosphate by the following reaction:



$$2\,Ca_3(PO_4)_{2(s)} + 6\,SiO_{2(s)} + 10\,C_{(s)} \rightarrow 6\,CaSiO_{3(s)} + P_{4(s)} + 10\,CO_{(g)}$$

Phosphorite is a mineral that contains $Ca_3(PO_4)_2$ plus other non-phosphorus-containing compounds. What is the maximum amount of P_4 that can be produced from 1.0 kg of phosphorite if the phosphorite sample is 75% $Ca_3(PO_4)_2$ by mass? Assume an excess of the other reactants.

4) Consider the following **unbalanced** equation:



$$Ca_3(PO_4)_{2(s)} + H_2SO_{4(aq)} \rightarrow CaSO_{4(s)} + H_3PO_{4(aq)}$$

What masses of calcium sulfate and phosphoric acid can be produced from the reaction of 1.0 kg of calcium phosphate with 1.0 kg of concentrated sulfuric acid (98% H_2SO_4 by mass)?

5) DDT, an insecticide harmful to fish, birds, and humans, is produced by the following reaction:

$$2\ C_6H_5Cl + C_2HOCl_3 \rightarrow C_{14}H_9Cl_5 + H_2O$$

chlorobenzene chloral DDT

In a government lab, 1142 g of chlorobenzene is reacted with 485 g of chloral.

a. What mass of DDT is formed?
b. Which reactant is limiting? Which is in excess?
c. What mass of excess reactant is left over?
d. If the actual yield of DDT is 200.0 g, what is the percent yield?

6) Consider the following **unbalanced** reaction:

$$P_{4(s)} + F_{2(g)} \rightarrow PF_{3(g)}$$

What mass of F_2 is needed to produce 120.0 g of PF_3 if the reaction has a 78.1% yield?

7) Methane (CH_4) is the main component of marsh gas. Heating methane in the presence of sulfur produces carbon disulfide and hydrogen sulfide as the only products.
   a. Write the balanced chemical equation for the reaction of methane and sulfur.
   b. Calculate the theoretical yield of carbon disulfide when 120.0 g of methane is reacted with an equal mass of sulfur.