Chemistry I Chapter 11
Extra Limiting Reagent Problems

1. Phosphorus trifluoride may be prepared by the reaction:

$$2PCl_3 + 3PbF_2 \text{ --------> } 2PF_3 + 3PbCl_2$$

What mass of PF_3 should be obtainable from a mixture of 75.0 g of PCl_3 and 100.0 g of PbF_2?

2. The reaction of TiO_2, carbon, and chlorine yields $TiCl_4$ and CO_2. (a) Write the balanced chemical equation for the reaction. (b) What mass of titanium (IV) chloride is theoretically obtainable from 10.00 g of TiO_2 and 9.00 g of Cl_2 if an excess of C is present?

3. The reaction of P_4O_{10} and PCl_5 yields $POCl_3$ as the only product. (a) Write the chemical equation for the transformation. (b) What mass of $POCl_3$ is theoretically obtainable from a mixture of 2.00 g of P_4O_{10} and 7.00 g of PCl_5?

4. 4.0 g of magnesium wire is ignited in 4.0 g of nitrogen. Given the following reaction,

$$Mg_{(s)} + N_{2(g)} \text{ --------> } Mg_3N_{2(s)}$$

(a) Which reactant is present in excess?

(b) Find the mass, in grams, of the excess.

(c) How many grams of Mg_3N_2 are formed?

5. Methanol (wood alcohol, CH_3OH), formerly produced by the distillation of wood, is produced by the "Lurgi Process",

$$CO_{(g)} + 2H_{2(g)} \text{ ---}\underline{Cu}\text{---> } CH_3OH_{(l)}$$

If equal mass of reactants are used, which one is present in excess?

6. A gaseous mixture containing 10.0 moles H_2 and 12.0 moles Cl_2 reacts to form $HCl_{(g)}$.

(a) Write a balanced equation for the reaction.
(b) Which reactant is limiting?
(c) If all the limiting reactant is consumed, how many moles of HCl are formed?
(d) How many moles of the excess reactant remain when the reaction is over?

7. Hydrogen reacts with sodium to produce solid sodium hydride. A reaction mixture contains 6.75 g Na and 3.03 g hydrogen.

   (a) Write a balanced equation for NaH formation.
   (b) Which reactant is limiting?
   (c) What is the theoretical yield of NaH from the above reaction mixture?

8. A tool set contains 4 wrenches, 3 screw drivers, and 2 pliers. The manufacturer has in stock 1000 pliers, 2000 screwdrivers, and 1500 wrenches. Can an order for 500 tool sets be filled?

9. Chlorine and fluorine react to form gaseous chlorine trifluoride, ClF_3. You start with 3.40 moles Cl_2 and 7.16 moles F_2.

   (a) Write a balanced equation for the reaction.
   (b) What is the limiting reactant?
   (c) What is the theoretical yield of ClF_3?
   (d) How many moles of the excess reactant remain unreacted?

10. Oxyacetylene torches are used for welding, reaching temperatures near 2000°C. These temperatures are due to the combustion of acetylene, C_2H_2, with oxygen:

$$C_2H_{2(g)} + O_{2(g)} \text{ --------> } CO_{2(g)} + H_2O_{(g)}$$

   (a) Balance the quation.
   (b) Starting with 125 g of both C_2H_2 and O_2, which reactant is limiting?
   (c) What is the theoretical yield of H_2O from this reaction mixture?