Limiting Reagent Worksheet

For the following reactions, find the following:

a) Which of the reagents is the limiting reagent?
b) What is the maximum amount of each product that can be formed?
c) How much of the other reagent is left over after the reaction is complete?

1) Consider the following reaction:

$$3\ NH_4NO_3 + Na_3PO_4 \rightarrow (NH_4)_3PO_4 + 3\ NaNO_3$$

Answer the questions above, assuming we started with 30 grams of ammonium nitrate and 50 grams of sodium phosphate.

$30\text{g } NH_4NO_3 \times \frac{1\text{ mol } NH_4NO_3}{80.05\text{ g } NH_4NO_3} = .37\text{ mol } NH_4NO_3 \text{ available}$

$50\text{g } Na_3PO_4 \times \frac{1\text{ mol } Na_3PO_4}{163.94\text{ g } Na_3PO_4} = .30\text{ mol } Na_3PO_4 \text{ available}$

more Na_3PO_4 is available than is required. therefore, NH_4NO_3 is the limiting reactant.

$.37\text{ mol } NH_4NO_3 \times \frac{1\text{ mol } Na_3PO_4}{3\text{ mol } NH_4NO_3} = .12\text{ mol } Na_3PO_4 \text{ required}$

$.37\text{ mol } NH_4NO_3 \times \frac{1\text{ mol } (NH_4)_3PO_4}{3\text{ mol } NH_4NO_3} \times \frac{141.03\text{g } (NH_4)_3PO_4}{1\text{ mol } (NH_4)_3PO_4} = 17\text{g } (NH_4)_3PO_4$

2) Consider the following reaction:

$$3\ CaCO_3 + 2\ FePO_4 \rightarrow Ca_3(PO_4)_2 + Fe_2(CO_3)_3$$

Answer the questions at the top of this sheet, assuming we start with 100. grams of calcium carbonate and 45 grams of iron (III) phosphate.

$100.\text{g } CaCO_3 \times \frac{1\text{ mol } CaCO_3}{100.09\text{ g } CaCO_3} = .999\text{ mol } CaCO_3 \text{ available}$

$45\text{ g } FePO_4 \times \frac{1\text{ mol } FePO_4}{150.82\text{ g } FePO_4} = .30\text{ mol } FePO_4 \text{ available}$

less $FePO_4$ is available than is required. therefore, $FePO_4$ is the limiting reactant.

$.999\text{ mol } CaCO_3 \times \frac{2\text{ mol } FePO_4}{3\text{ mol } CaCO_3} = .666\text{ mol } FePO_4 \text{ required}$

$.30\text{ mol } FePO_4 \times \frac{1\text{ mol } Ca_3(PO_4)_2}{2\text{ mol } FePO_4} \times \frac{310.18\text{ g } Ca_3(PO_4)_2}{1\text{ mol } Ca_3(PO_4)_2} = 47.\text{g } Ca_3(PO_4)_2$

$= 31\text{ g } NaNO_3$

$= 44\text{ g } Fe_2(CO_3)_3$

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All of the questions on this worksheet involve the following reaction: When copper (II) chloride reacts with sodium nitrate, copper (II) nitrate and sodium chloride are formed.

1) Write the balanced equation for the reaction given above:

$$CuCl_2 + 2\,NaNO_3 \longrightarrow Cu(NO_3)_2 + 2\,NaCl$$

2) If 15 grams of copper (II) chloride react with 20 grams of sodium nitrate, how much sodium chloride can be formed?

$15\,g\ CuCl_2 \times \frac{1\ mol\ CuCl_2}{134.45\,g\ CuCl_2} = .11\ mol\ CuCl_2$ available

$20\,g\ NaNO_3 \times \frac{1\ mol\ NaNO_3}{85.00\,g\ NaNO_3} = .24\ mol\ NaNO_3$ available

$.11\ mol\ CuCl_2 \times \frac{2\ mol\ NaNO_3}{1\ mol\ CuCl_2} = .22\ mol\ NaNO_3$ required

$.11\ mol\ CuCl_2 \times \frac{2\ mol\ NaCl}{1\ mol\ CuCl_2} \times \frac{58.44\,g\ NaCl}{1\ mol\ NaCl} = 13\,g\ NaCl$

$NaNO_3$ available > $NaNO_3$ required, so $CuCl_2$ is limiting reactant.

3) What is the limiting reagent for the reaction in #2? $CuCl_2$

~~4)~~ How much of the nonlimiting reagent is left over in this reaction?

DO LATER

5) If 11.3 grams of sodium chloride are formed in the reaction described in problem #2, what is the percent yield of this reaction?