Name: Key. per

Limiting Reactant

Practice Sheet #

1. Copper (II) sulfate is reacted with zinc to produce copper and zinc sulfate.
   a. Write a balanced chemical equation for this reaction.

$$1\,CuSO_4 + 1\,Zn \rightarrow 1\,Cu + 1\,ZnSO_4$$

   b. If 2.00 moles of copper (II) sulfate are combined with 3.00 mol of zinc, which reactant is limiting and which is excess?

$$2.00\text{ moles } CuSO_4 \times \frac{1\text{ mol Cu}}{1\text{ mol } CuSO_4} = 2.00 \quad \text{L.R}$$

$$3.00\text{ moles Zn} \times \frac{1\text{ mol Cu}}{1\text{ mol Zn}} = 3.00$$

   c. What is the mass of each of the products?

$$2.00\text{ mol } CuSO_4 \times \frac{1\text{ mol Cu}}{1\text{ mol } CuSO_4} \times \frac{63.55\text{ g Cu}}{1\text{ mol Cu}} = 127\text{ g Cu}$$

$$\text{"} \quad \text{"} \quad \frac{1\text{ mol } ZnSO_4}{1\text{ mol } CuSO_4} \times \frac{161.44\text{ g } ZnSO_4}{1\text{ mol } ZnSO_4} = 323\text{ g } ZnSO_4$$

2. Calcium hydroxide reacts with phosphoric acid to produce water and calcium phosphate.
   a. Write a balanced chemical equation for this reaction.

$$3\,Ca(OH)_2 + 2\,H_3PO_4 \rightarrow 6\,H_2O + 1\,Ca_3(PO_4)_2$$

   b. If 4.20 mol of calcium hydroxide are reacted with 2.20 mol of phosphoric acid, which reactant is limiting and which is excess.

$$4.20\text{ mol } Ca(OH)_2 \times \frac{6\text{ mol } H_2O}{3\text{ mol } Ca(OH)_2} = 8.4\text{ mol } H_2O$$

$$2.20\text{ mol } H_3PO_4 \times \frac{6\text{ mol } H_2O}{2\text{ mol } H_3PO_4} = 6.6\text{ mol } H_2O$$

H_3PO_4 = L.R

   c. What is the mass of each of the products?

$$2.20\text{ mol } H_3PO_4 \times \frac{6\text{ mol } H_2O}{2\text{ mol } H_3PO_4} \times \frac{18.02\text{ g } H_2O}{1\text{ mol } H_2O} = 119\text{ g } H_2O$$

$$\text{"} \times \frac{1\text{ mol } Ca_3(PO_4)_2}{2\text{ mol } H_3PO_4} \times \frac{310.18\text{ g}}{1\text{ mol } Ca_3(PO_4)_2} = 341\text{ g } Ca_3(PO_4)_2$$

3. Lithium is reacted with iodine.
   a. Write a balanced chemical equation for this reaction.

$$2\,Li + 1\,I_2 \rightarrow 2\,LiI$$

   b. If 15.10 grams of lithium are combined with 200.4 g of iodine, which reactant is limiting. and which is excess? c. What is the mass of the product?

$$15.10\text{ g Li} \times \frac{1\text{ mol Li}}{6.939\text{ g Li}} \times \frac{2\text{ mol LiI}}{2\text{ mol Li}} \times \frac{133.8\text{ g LiI}}{1\text{ mol LiI}} = 291.2\text{ g LiI}$$

Li = excess

$$200.4\text{ g } I_2 \times \frac{1\text{ mol } I_2}{253.8\text{ g } I_2} \times \frac{2\text{ mol LiI}}{1\text{ mol } I_2} \times \frac{133.8\text{ g LiI}}{1\text{ mol LiI}} = 211.3\text{ g LiI}$$

I_2 = limiting

_____ per____

d. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$200.4\text{g } I_2 \times \frac{1\text{mol } I_2}{253.8\text{g } I_2} \times \frac{2\text{mol Li}}{1\text{mol } I_2} \times \frac{6.939\text{g Li}}{1\text{mol Li}} = 10.96\text{g Li used in reaction}$

$15.10\text{g Li} - 10.96\text{g} = 4.142\text{g Li in excess}$

4. Barium carbonate is reacted with ammonium fluoride.

a. Write a balanced chemical equation for this reaction.

$\_BaCO_3 + \underline{2}\ NH_4F \longrightarrow \_BaF_2 + \_(NH_4)_2CO_3$

b. If 240 g of barium ~~chloride~~ carbonate and 95.0 g ammonium fluoride are combined, which reactant is limiting and which is excess? c. What is the mass of the products.

L.R $240\text{g } BaCO_3 \times \frac{1\text{mol } BaCO_3}{197.31\text{g } BaCO_3} \times \frac{1\text{mol } BaF_2}{1\text{mol } BaCO_3} \times \frac{175.3\text{g } BaF_2}{1\text{mol } BaF_2} = 213 \rightarrow 210\text{g } BaF_2$

$\frac{1\text{mol } (NH_4)_2CO_3}{1\text{mol } BaCO_3} \times \frac{96.09\text{g}}{1\text{mol } (NH_4)_2CO_3} = 116 \rightarrow 120\text{g } (NH_4)_2CO_3$

EXCESS $95\text{g } NH_4F \times \frac{1\text{mol } NH_4F}{37.04\text{g } NH_4F} \times \frac{1\text{mol } BaF_2}{2\text{mol } NH_4F} \times \frac{175.3\text{g } BaF_2}{1\text{mol } BaF_2} = 224 \rightarrow 220\text{g } BaF_2$

$95\text{g } NH_4F \times \text{"} \times \frac{1\text{mol } (NH_4)_2CO_3}{2\text{mol } NH_4F} \times \frac{96.09\text{g}}{1\text{mol } (NH_4)_2CO_3} = 123 \rightarrow 120\text{ g } (NH_4)_2CO_3$

d. mass of BaF_2 actually obtained:

$100\text{g } (NH_4)_2CO_3 \times \frac{1\text{ mol}}{96.09\text{ g } (NH_4)_2CO_3} \times \frac{1\text{mol } BaF_2}{1\text{ mol } (NH_4)_2CO_3} \times \frac{175.3\text{ g } BaF_2}{1\text{mol } BaF_2} = 182\ BaF_2$

% yield 85.5

e. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$240\text{g } BaCO_3 \times \frac{1\text{ mol}}{197.31\text{g } BaCO_3} \times \frac{2\text{ mol } NH_4F}{1\text{ mol } BaCO_3} \times \frac{37.04\text{ g } NH_4F}{1\text{mol } NH_4F} = 90.1 \rightarrow 90\text{ g used}$

$95.0 - 90 = 5.0$ grams excess.

5. Aluminum bromide is reacted with chlorine.

a. Write a balanced chemical equation for this reaction.

$\underline{2}\ AlBr_3 + \underline{3}\ Cl_2 \longrightarrow \underline{3}\ Br_2 + \underline{2}\ AlCl_3$

b. If 135 g of aluminum bromide and 50.0 g of chloride are combined, which reactant is limiting and which is excess?

EXCESS $135\text{g } AlBr_3 \times \frac{1\text{ mol } AlBr_3}{266.71\text{g } AlBr_3} \times \frac{3\text{ mol } Br_2}{2\text{ mol } AlBr_3} = 0.759\text{ mol } Br_2$

LR $50.0\text{g } Cl_2 \times \frac{1\text{mol } Cl_2}{70.90\text{g } Cl_2} \times \frac{3\text{ mol } Br_2}{3\text{ mol } Cl_2} = 0.705\text{ mol } Br_2$

c. What is the mass of each of the products?

$0.705\text{mol } Br_2 \times \frac{159.82\text{g } Br_2}{1\text{mol } Br_2} = 113\text{g } Br_2$

$50.0\text{g } Cl_2 \times \frac{1\text{mol } Cl_2}{70.9\text{g } Cl_2} \times \frac{2\text{ mol } AlCl_3}{3\text{mol } Cl_2} \times \frac{133.33\text{g}}{1\text{mol } AlCl_3} = 62.7\text{ g } AlCl_3$

d. If the reaction yields 104 g of bromine, determine the percent yield. What mass of aluminum chloride would actually be obtained?

$\frac{104\text{g}}{113\text{g}} \times 100 = 92\%$ yield

$104\text{g } Br_2 \times \frac{1\text{ mol } Br_2}{159.82\text{g } Br_2} \times \frac{2\text{ mol } AlCl_3}{3\text{ mol } Br_2} \times \frac{133.33\text{g } AlCl_3}{1\text{ mol } AlCl_3} = 57.8\text{ g } AlCl_3$

e. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?

$50.0\text{g } Cl_2 \times \frac{1\text{mol } Cl_2}{70.90\text{g } Cl_2} \times \frac{2\text{ mol } AlBr_3}{3\text{ mol } Cl_2} \times \frac{266.71\text{ g}}{1\text{mol}} = 125.\text{g } AlBr_3 \text{ used}$

$135\text{g} - 125\text{g} = 10\text{ g excess}$