Worksheet: Percent Yield, Limiting Reactant

1. What is the percent yield of the following reaction if 50.0 g LiOH gives 72.8 g of $LiHCO_3$?

$LiOH(s) + CO_2(g) \rightarrow LiHCO_3(s)$

use to get theoretical

actual yield

$$50.0\text{ g LiOH} \times \frac{1\text{ mol LiOH}}{23.95\text{ g LiOH}} \times \frac{1\text{ mol LiHCO}_3}{1\text{ mol LiOH}} \times \frac{67.96\text{ g LiHCO}_3}{1\text{ mol LiHCO}_3} = 141.9\text{ g LiHCO}_3$$

theoretical yield

$$\%\text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100 = \frac{72.8}{141.9} \times 100 = \boxed{51.3\%}$$

2. If 56.6 g of calcium are mixed with nitrogen gas and 32.4 g of calcium nitride are produced, what is the percent yield of the following reaction?

actual yield

$3Ca(s) + N_2(g) \rightarrow Ca_3N_2(s)$

theoretical yield

$$56.6\text{ g Ca} \times \frac{1\text{ mol Ca}}{40.08\text{ g Ca}} \times \frac{1\text{ mol Ca}_3\text{N}_2}{3\text{ mol Ca}} \times \frac{148.24\text{ g Ca}_3\text{N}_2}{1\text{ mol Ca}_3\text{N}_2} = 69.8\text{ g Ca}_3\text{N}_2$$

$$\%\text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100 = \frac{32.4}{69.8} \times 100 = \boxed{46.4\%}$$

3. Given the following reaction, determine the limiting reactant in each of the following mixtures of reactants:

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

a. 2.0 moles of Fe and 6.0 moles O_2 — Fe

$$2.0\text{ mol Fe} \times \frac{2\text{ mol Fe}_2\text{O}_3}{4\text{ mol Fe}} = \boxed{1\text{ mol Fe}_2\text{O}_3}$$ lower ∴ Fe

$$6.0\text{ mol O}_2 \times \frac{2\text{ mol Fe}_2\text{O}_3}{3\text{ mol O}_2} = 4\text{ mol Fe}_2\text{O}_3$$

b. 5.0 moles of Fe and 40 g O_2 — O_2

$$5.0\text{ mol Fe} \times \frac{2\text{ mol Fe}_2\text{O}_3}{4\text{ mol Fe}} = 2.5\text{ mol Fe}_2\text{O}_3$$

$$40\text{ g O}_2 \times \frac{1\text{ mol O}_2}{32\text{ g O}_2} \times \frac{2\text{ mol Fe}_2\text{O}_3}{3\text{ mol O}_2} = \boxed{0.83\text{ mol Fe}_2\text{O}_3}$$ lower ∴ O_2

c. 16.0 g Fe and 20.0 moles O_2 — Fe

$$16.0\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.85\text{ g Fe}} \times \frac{2\text{ mol Fe}_2\text{O}_3}{4\text{ mol Fe}} = \boxed{0.143\text{ mol Fe}_2\text{O}_3}$$ lower ∴ Fe

$$20\text{ mol O}_2 \times \frac{2\text{ mol Fe}_2\text{O}_3}{3\text{ mol O}_2} = 13.3\text{ mol Fe}_2\text{O}_3$$