Stoichiometry Worksheet

1. Na_2SiO_3 (s) + 8 HF(aq) → H_2SiF_6 (aq) + 2 NaF(aq) + 3 H_2O (l)

a. How many moles of HF are needed to react with 0.300 mol of Na_2SiO_3?

$$0.300 \text{ mol } Na_2SiO_3 \left| \frac{8 \text{ mol HF}}{1 \text{ mol } Na_2SiO_3} \right| = 2.40 \text{ mol HF}$$

b. How many grams of NaF form when 0.500 mol of HF reacts with excess Na_2SiO_3?

$$0.500 \text{ mol HF} \left| \frac{2 \text{ mol NaF}}{8 \text{ mol HF}} \right| \left| \frac{41.988 \text{ g NaF}}{1 \text{ mol NaF}} \right| = 5.25 \text{ g NaF}$$

c. How many grams of Na_2SiO_3 can react with 0.800 g of HF?

$$0.800 \text{ g HF} \left| \frac{\text{mol HF}}{20.008 \text{ g HF}} \right| \left| \frac{1 \text{ mol } Na_2SiO_3}{8 \text{ mol HF}} \right| \left| \frac{122.0617 \text{ g } Na_2SiO_3}{\text{mol } Na_2SiO_3} \right| = 0.610 \text{ g } Na_2SiO_3$$

2. $C_6H_{12}O_6$ (aq) → 2 C_2H_5OH (aq) + 2 CO_2 (g)

a. How many moles of CO_2 are produced when 0.400 mol of $C_6H_{12}O_6$ reacts in this fashion?

$$0.400 \text{ mol } C_6H_{12}O_6 \left| \frac{2 \text{ mol } CO_2}{1 \text{ mol } C_6H_{12}O_6} \right| = 0.800 \text{ mol } CO_2$$

b. How many grams of $C_6H_{12}O_6$ are needed to form 7.50 g of C_2H_5OH?

$$7.50 \text{ g } C_2H_5OH \left| \frac{\text{mol } C_2H_5OH}{46.0688 \text{ g } C_2H_5OH} \right| \left| \frac{1 \text{ mol } C_6H_{12}O_6}{2 \text{ mol } C_2H_5OH} \right| \left| \frac{180.1572 \text{ g } C_6H_{12}O_6}{\text{mol } C_6H_{12}O_6} \right| = 14.7 \text{ g } C_6H_{12}O_6$$

c. How many grams of CO_2 form when 7.50 g of C_2H_5OH are produced?

$$7.50 \text{ g } C_2H_5OH \left| \frac{\text{mol } C_2H_5OH}{46.0688 \text{ g } C_2H_5OH} \right| \left| \frac{2 \text{ mol } CO_2}{2 \text{ mol } C_2H_5OH} \right| \left| \frac{44.0098 \text{ g } CO_2}{\text{mol } CO_2} \right| = 7.16 \text{ g } CO_2$$

3. Fe_2O_3 (s) + 3 CO (g) → 2 Fe(s) + 3 CO_2 (g) (unbalanced!)

a. Calculate the number of grams of CO that can react with 0.150 kg of Fe_2O_3

$$0.150 \text{ kg } Fe_2O_3 \left| \frac{1000 \text{ g } Fe_2O_3}{1 \text{ kg } Fe_2O_3} \right| \left| \frac{\text{mol } Fe_2O_3}{159.6922 \text{ g } Fe_2O_3} \right| \left| \frac{3 \text{ mol } CO_2}{1 \text{ mol } Fe_2O_3} \right| \left| \frac{44.0098 \text{ g } CO_2}{\text{mol } CO_2} \right| = 124 \text{ g } CO_2$$

b. Calculate the number of grams of Fe and the number of grams of CO_2 formed when 0.150 kg of Fe_2O_3 reacts

$$0.150\ kg\ Fe_2O_3 \left| \frac{1000\ g\ Fe_2O_3}{kg\ Fe_2O_3} \right| \frac{mol\ Fe_2O_3}{159.6922\ g\ Fe_2O_3} \left| \frac{2\ mol\ Fe}{1\ mol\ Fe_2O_3} \right| \frac{55.847\ g\ Fe}{mol\ Fe} = 105\ g\ Fe$$

$$0.150\ kg\ Fe_2O_3 \left| \frac{1000\ g\ Fe_2O_3}{kg\ Fe_2O_3} \right| \frac{mol\ Fe_2O_3}{159.6922\ g\ Fe_2O_3} \left| \frac{3\ mol\ CO_2}{1\ mol\ Fe_2O_3} \right| \frac{44.0098\ g\ CO_2}{mol\ CO_2} = 124\ g\ CO_2$$

4. $2\ NaOH\ (s) + CO_2\ (g) \rightarrow Na_2CO_3\ (s) + H_2O\ (l)$

a. Which reagent is the limiting reactant when 1.85 mol NaOH and 1.00 mol CO_2 are allowed to react?

L.R

NaOH:

$$1.85\ mol\ NaOH \left| \frac{1\ mol\ Na_2CO_3}{2\ mol\ NaOH} \right| = 0.925\ mol\ Na_2CO_3$$

(L.R)

CO_2: excess

$$1.00\ mol\ CO_2 \left| \frac{1\ mol\ Na_2CO_3}{1\ mol\ CO_2} \right| = 1.00\ mol\ Na_2CO_3$$

b. How many moles of Na_2CO_3 can be produced?

0.925 mol Na_2CO_3

5. $C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$

a. What is the theoretical yield of C_6H_5Br in this reaction when 30.0 g of C_6H_6 reacts with 65.0 g or Br_2?

L.R

L.R C_6H_6

$$30.0\ g\ C_6H_6 \left| \frac{mol\ C_6H_6}{79.1134\ g\ C_6H_6} \right| \frac{1\ mol\ C_6H_5Br}{1\ mol\ C_6H_6} \left| \frac{157.0095\ g\ C_6H_5Br}{mol\ C_6H_5Br} \right| = 59.5\ g\ C_6H_5Br$$

L.R

$$65.0\ g\ Br_2 \left| \frac{mol\ Br_2}{159.808} \right| \frac{1\ mol\ C_6H_5Br}{1\ mol\ Br_2} \left| \frac{157.0095\ g\ C_6H_5Br}{mol\ C_6H_5Br} \right| = 63.9\ g\ C_6H_5Br$$

b. If the actual yield of C_6H_5Br was 56.7 g, what is the percent yield?

$$\%\ yield = \left(\frac{56.7\ g}{59.5\ g} \right) \times 100 = 95.3\%$$