KEY

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? a) mol → mol

? HF = 0.3 mol Na_2SiO × $\frac{8 \text{ mol NF}}{1 \text{ mol } Na_2SiO_3}$ = **2.40 mol HF**

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

? g NaF = 0.500 mol HF → mol NaF → g NaF

= 0.500 mol HF × $\frac{2 \text{ mol NaF}}{8 \text{ mol HF}}$ = 0.125 mol NaF × $\frac{41.99 \text{ g NaF}}{1 \text{ mol NaF}}$ =

NaF = 41.99 g/mol **5.24 g NaF**

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

Na_2SiO_3 = 122.07 g/mol a) g → mol → mol → g problem.

? g Na_2SiO_3 = 0.800 g HF → mol HF → mol Na_2SiO_3 → g Na_2SiO_3

0.800 g HF × $\frac{1 \text{ mol HF}}{20.1 \text{ g HF}}$ × $\frac{1 \text{ mol } Na_2SiO_3}{8 \text{ mol HF}}$ × $\frac{122.07 \text{ g } Na_2SiO_3}{1 \text{ mol } Na_2SiO_3}$ = **0.607 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?

? mol CO_2 = 0.400 mol $C_6H_{12}O_6$ × $\frac{2 \text{ mol } CO_2}{1 \text{ mol } C_6H_{12}O_6}$ = **0.800 mol CO_2**

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

? g $C_6H_{12}O_6$ = 7.50 g C_2H_5OH. a) g → mol → mol → g problem.

? g $C_6H_{12}O_6$ = 7.50 g C_2H_5OH × $\frac{1 \text{ mol } C_2H_5OH}{46.08 \text{ g } C_2H_5OH}$ × $\frac{1\ C_6H_{12}O_6}{2\ C_2H_5OH}$ × $\frac{180.18 \text{ g } C_6H_{12}O_6}{1 \text{ mol}}$ = **14.7 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 g C_2H_5OH × $\frac{1 \text{ mol } C_2H_5OH}{46.08 \text{ g } C_2H_5OH}$ × $\frac{2\ CO_2}{2\ C_2H_5OH}$ = **7.16 g CO_2**

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

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

0.150 kg Fe_2O_3 = 150 g Fe_2O_3 × $\frac{1 \text{ mol } Fe_2O_3}{159.70 \text{ g } Fe_2O_3}$ × $\frac{3\ CO}{1\ Fe_2O_3}$ × $\frac{28.01 \text{ g CO}}{1 \text{ mol CO}}$ =

78.9 g CO

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

① $150 \text{ g } Fe_2O_3 \times \frac{1 \text{ mol } Fe_2O_3}{159.70 \text{ g } Fe_2O_3} = 0.939 \text{ mol } Fe_2O_3 \times \frac{3 \text{ mol } CO_2}{1 \text{ mol } Fe_2O_3} \times \frac{44.01 \text{ g } CO_2}{1 \text{ mol } CO_2} = 124 \text{ g } CO_2$ ②

② $0.939 \text{ mol } Fe_2O_3 \times \frac{2 \text{ mol Fe}}{1 \text{ mol } Fe_2O_3} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 105 \text{ g Fe}$

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

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

$\frac{2 \text{ mol NaOH}}{1 \text{ mol } CO_2}$ because $\frac{1.85 \text{ mol NaOH}}{1 \text{ mol } CO_2}$ is too small a ratio,

NaOH is the limiting reactant

b. How many moles of Na_2CO_3 can be produced?

$1.85 \text{ mol NaOH} \times \frac{1 \text{ mol } Na_2CO_3}{2 \text{ mol NaOH}} = 0.925 \text{ mol } Na_2CO_3$

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?

a) $30.0 \text{ g } C_6H_6 \times \frac{1 \text{ mol } C_6H_6}{78.12 \text{ g } C_6H_6} \times \frac{1 \text{ } C_6H_5Br}{1 \text{ } C_6H_6} \times \frac{157.01 \text{ g } C_6H_5Br}{1 \text{ mol } C_6H_5Br} = 60.3 \text{ g } C_6H_5Br$

b) $65.0 \text{ g } Br_2 \times \frac{1 \text{ mol } Br_2}{159.8 \text{ g } Br_2} \times \frac{1 \text{ } C_6H_5Br}{1 \text{ } Br_2} \times \frac{157.01 \text{ g } C_6H_5Br}{1 \text{ mol } C_6H_5Br} = 63.9 \text{ g } C_6H_5Br$

The smallest value is the answer.
This is the theoretical yield.
The limiting reactant is C_6H_6. Br_2 is in excess.

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

$\frac{\text{actual}}{\text{theo.}} \times 100 = \% = \frac{56.7}{60.3} \times 100 = 94.0\% \text{ yield}$

→ How much excess? 3.6 g Br_2 There are 2 ways to calc.

① $60.3 \text{ g } C_6H_5Br \times \frac{1 \text{ mol } C_6H_5Br}{157.01 \text{ g } C_6H_5Br} \times \frac{1 \text{ mol } Br_2}{1 \text{ mol } C_6H_5Br} \times \frac{159.8 \text{ g } Br_2}{1 \text{ mol } Br_2} = 61.4 \text{ g } Br$ used

65 g start − 61.4 g used = 3.6 g excess

② $65.0 - \left(65.0 \times \frac{60.3}{63.9}\right) = 3.6 \text{ g excess}$