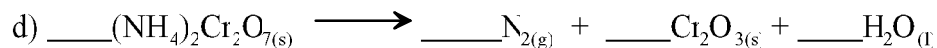
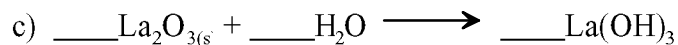
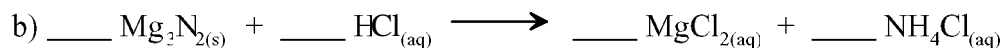
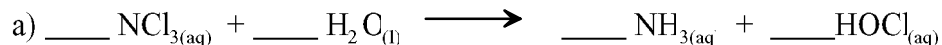


CHEM 130  
Problem Set Ch.3

[Key begins on page 3.](#)

1. Balance the following equations.



2. An atom of an element weighs  $9.12 \times 10^{-23}$  g. What is the **atomic mass** of this element in **g/mol**?

\_\_\_\_\_g/mol

3. How many **moles** of  $\text{SO}_3$  are in a 24.0 g sample?

\_\_\_\_\_mol

4. A 3.22 g sample of an oxide of chromium contains 2.00 g of chromium. What is its **empirical formula**?

\_\_\_\_\_

5. A sample of a gas mixture from a neon sign contains 0.0856 mol Ne and 0.0254 mol Kr. What are the mass percentages of Ne and Kr in the gas mixture?

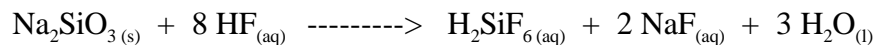
\_\_\_\_\_ % Ne

\_\_\_\_\_ % Kr

6. Malonic acid is used in the manufacture of barbiturates (sleeping pills). The composition of the acid is 34.6% C, 3.9% H, and 61.5% O. What is Malonic acid's empirical formula?

\_\_\_\_\_

**USE THE FOLLOWING EQUATION TO ANSWER QUESTIONS 7-10**



MW(g/mol) =      (122.1)          (20.0)                      (144.1)          (42.0)          (18.0)

**7.** How many **moles of water** would be produced by the complete reaction of 15.0 mol HF?

\_\_\_\_\_ mol H<sub>2</sub>O

**8.** Calculate the number of **grams of NaF** produced by the complete reaction of 300.0 grams Na<sub>2</sub>SiO<sub>3</sub> (assuming excess HF).

\_\_\_\_\_ g NaF

**9.** If 200.0 grams **each** of HF and Na<sub>2</sub>SiO<sub>3</sub> react, indicate which reactant is in **excess** and how many grams of it remain after the limiting reagent is exhausted.

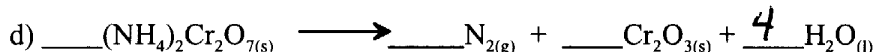
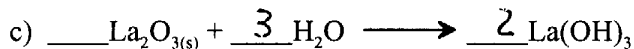
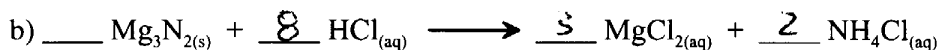
\_\_\_\_\_ g

**10.** If 150.0 g Na<sub>2</sub>SiO<sub>3</sub> reacts completely to produce only 78.5 g NaF, calculate the **percent yield** of the reaction.

\_\_\_\_\_ %

**CHEM 130**  
**Problem Set Ch.3**

1. Balance the following equations.



2. An atom of an element weighs  $9.12 \times 10^{-23}$  g. What is the **atomic mass** of this element in **g/mol**?

$$(9.12 \times 10^{-23} \text{ g/Atom}) (6.02 \times 10^{23} \text{ Atoms/mol}) = 54.9 \text{ g/mol}$$

54.9 g/mol

3. How many **moles** of  $\text{SO}_3$  are in a 24.0 g sample?

$$24.0 \text{ g SO}_3 \left( \frac{1 \text{ mol SO}_3}{80.1 \text{ g SO}_3} \right) = 0.300 \text{ mol SO}_3$$

0.300 mol

4. A 3.22 g sample of an oxide of chromium contains 2.00 g of chromium. What is its **empirical formula**?

$$\begin{array}{r} 3.22 \text{ g SAMPLE} \\ - 2.00 \text{ g Cr} \\ \hline 1.22 \text{ g O} \end{array} \longrightarrow \begin{array}{l} 2.00 \text{ g Cr} \left( \frac{1 \text{ mol}}{52 \text{ g}} \right) = 0.0385 \text{ mol Cr} \\ 1.22 \text{ g O} \left( \frac{1 \text{ mol}}{16 \text{ g}} \right) = 0.07625 \text{ mol O} \end{array}$$

$$\begin{array}{l} 0.0385 \text{ Cr} \div 0.0385 = 1 \\ 0.07625 \text{ O} \div 0.0385 = 2 \end{array}$$

CrO<sub>2</sub>

5. A sample of a gas mixture from a neon sign contains 0.0856 mol Ne and 0.0254 mol Kr. What are the mass percentages of Ne and Kr in the gas mixture?

$$0.0856 \text{ mol Ne} \left( \frac{20.2 \text{ g}}{1 \text{ mol Ne}} \right) = 1.73 \text{ g Ne}$$

$$0.0254 \text{ mol Kr} \left( \frac{83.8 \text{ g}}{1 \text{ mol Kr}} \right) = 2.13 \text{ g Kr}$$

3.86 g TOTAL

$$\% \text{ Ne} = \frac{1.73 \text{ g}}{3.86 \text{ g TOTAL}} \times 100 = 44.8\%$$

$$\% \text{ Kr} = \frac{2.13 \text{ g}}{3.86 \text{ g TOTAL}} \times 100 = 55.2\%$$

44.8 % Ne

55.2 % Kr

6. Malonic acid is used in the manufacture of barbiturates (sleeping pills). The composition of the acid is 34.6% C, 3.9% H, and 61.5% O. What is Malonic acid's empirical formula?

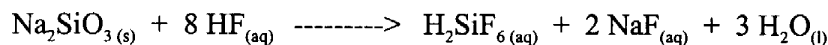
$$34.6 \text{ g C} \left( \frac{1 \text{ mol}}{12 \text{ g}} \right) = 2.88 \text{ mol C} \div 2.88 = 1 \quad 3$$

$$3.9 \text{ g H} \left( \frac{1 \text{ mol}}{1 \text{ g}} \right) = 3.86 \text{ mol H} \div 2.88 = 1.35 \quad 4$$

$$61.5 \text{ g O} \left( \frac{1 \text{ mol}}{16 \text{ g}} \right) = 3.84 \text{ mol O} \div 2.88 = 1.35 \quad 4$$

C<sub>3</sub>H<sub>4</sub>O<sub>4</sub>

USE THE FOLLOWING EQUATION TO ANSWER QUESTIONS 7-10



MW(g/mol) =      (122.1)          (20.0)                  (144.1)          (42.0)          (18.0)

7. How many **moles of water** would be produced by the complete reaction of 15.0 mol HF?

$$15 \text{ mol HF} \left( \frac{3 \text{ mol H}_2\text{O}}{8 \text{ mol HF}} \right) = 5.625 \text{ mol H}_2\text{O}$$

5.63 mol H<sub>2</sub>O

8. Calculate the number of **grams of NaF** produced by the complete reaction of 300.0 grams Na<sub>2</sub>SiO<sub>3</sub> (assuming excess HF).

$$(300.0 \text{ g Na}_2\text{SiO}_3) \left( \frac{1 \text{ mol Na}_2\text{SiO}_3}{122.1 \text{ g Na}_2\text{SiO}_3} \right) \left( \frac{2 \text{ mol NaF}}{1 \text{ mol Na}_2\text{SiO}_3} \right) \left( \frac{42.0 \text{ g NaF}}{1 \text{ mol NaF}} \right) = 206.4$$

206.4 g NaF

9. If 200.0 grams **each** of HF and Na<sub>2</sub>SiO<sub>3</sub> react, indicate which reactant is in **excess** and how many grams of it remain after the limiting reagent is exhausted.

$$(200.0 \text{ g Na}_2\text{SiO}_3) \left( \frac{1 \text{ mol Na}_2\text{SiO}_3}{122.1 \text{ g Na}_2\text{SiO}_3} \right) \left( \frac{8 \text{ mol HF}}{1 \text{ mol Na}_2\text{SiO}_3} \right) \left( \frac{20 \text{ g HF}}{1 \text{ mol HF}} \right) = 262 \text{ g HF} \left( \begin{array}{l} \text{NOT ENOUGH} \\ \text{AVAILABLE...SO HF} \\ \text{LIMITS RXN} \end{array} \right)$$

$$200 \text{ g HF} \left( \frac{1 \text{ mol HF}}{20.0 \text{ g}} \right) \left( \frac{1 \text{ mol Na}_2\text{SiO}_3}{8 \text{ mol HF}} \right) \left( \frac{122.1 \text{ g Na}_2\text{SiO}_3}{1 \text{ mol Na}_2\text{SiO}_3} \right) = 152.6 \text{ g Na}_2\text{SiO}_3 \text{ ACTUALLY USED...SO } \frac{47.4 \text{ g Na}_2\text{SiO}_3}{\text{LEFT OVER}}$$

10. If 150.0 g Na<sub>2</sub>SiO<sub>3</sub> reacts completely to produce only 78.5 g NaF, calculate the **percent yield** of the reaction.

$$150.0 \text{ g Na}_2\text{SiO}_3 \left( \frac{1 \text{ mol Na}_2\text{SiO}_3}{122.1 \text{ g Na}_2\text{SiO}_3} \right) \left( \frac{2 \text{ mol NaF}}{1 \text{ mol Na}_2\text{SiO}_3} \right) \left( \frac{42.0 \text{ g NaF}}{1 \text{ mol NaF}} \right) = 103.2 \text{ g THEORETICAL YIELD}$$

$$\% \text{ YIELD} = \frac{78.5 \text{ g ACTUAL}}{103.2 \text{ g THEORETICAL}} \times 100 = 76.1\%$$

76.1 %