Chemical Formula Calculations
Chemistry 110

Set-ups must be shown where applicable. You will not receive credit for only answers shown
*Problem sets are due within the first **five** minutes of lecture on the due date.*

1] What is the percentage by mass composition of Iron (III) oxide?

2 x 55.85 g/mol
3 x 16.0 g/mol

$$\% \text{ Fe} = \frac{2 \times 55.85\text{g}}{159.79\text{g}} (100) = 69.9\% \text{Fe}$$

Fe_2O_3=159.7 g/mol

% O = 100%-69.9% = 30.1% O

2] Calculate the molar mass of $C_3H_5N_3O_9$ (Nitroglycerin, an explosive)

3 C =	**3(12.0g/mol)**	**= 36.0 g/mol**
5 H =	**5(1.0g/mol)**	**= 5.0 g/mol**
3 N =	**3(14.0g/mol)**	**= 42.0 g/mol**
9 O =	**9(16.0g/mol)**	**= 144.0 g/mol**
		227.0 g/mol

3] How many atoms are found in 1.55 grams in chlorine gas?

$$1.55\text{g} \times \frac{1\text{mol } Cl_2}{71.0\text{g}} \times \frac{6.02 \times 10^{23} Cl_2 \text{ molecules}}{1 \text{ mole}} \times \frac{2 \text{ atoms Cl}}{1\text{molecule } Cl_2} = 2.62 \times 10^{22} \text{atoms Cl}$$

4] When silver was selling for $16.00 per ounce, how many silver atoms could you buy for 10.00 dollars?

$$\$10.00 \times \frac{1\text{oz Ag}}{\$16.00} \times \frac{28.34\text{g}}{1\text{oz}} \times \frac{1\text{mol Ag}}{107.9\text{gAg}} \times \frac{6.02\times10^{23}\text{Ag atoms}}{1\text{mol Ag}} = 9.88\times10^{22} \text{ atoms}$$

5] How many grams of carbon are there in 14.0 g of $Pb(C_2H_5)_4$ (tetraethyllead, a gasoline additive)?

$$14.0\text{g } Pb(C_2H_5)_4 \times \frac{1\text{mol } Pb(C_2H_5)_4}{323.4\text{g } Pb(C_2H_5)_4} \times \frac{8\text{mol C}}{1\text{mol } Pb(C_2H_5)_4} \times \frac{12.0\text{g}}{1\text{mol C}} = 4.13 \text{ g C}$$

6] A mixture contains 10.00 g of NaBr and 5.00 g of $BaBr_2$. What is the total number of moles of bromide ions in the mixture?

$$10.00\text{g NaBr} \times \frac{1\text{mol NaBr}}{102.9\text{g NaBr}} \times \frac{1\text{mol Br}}{1\text{mol NaBr}} = 0.09718\text{mol Br}$$

$$5.00\text{g } BaBr_2 \times \frac{1\text{mol } BaBr_2}{297.1\text{g } BaBr_2} \times \frac{2\text{mol Br}}{1\text{mol } BaBr_2} = 0.0337\text{mol Br}$$

0.09718 mol Br + 0.0337 mol Br = 0.1309 mol Br

7] Determine the moles of sodium in 7.22 x 10^{100} kg of $Na_2S_2O_3$

$$7.22 \times 10^{100}\text{Kg } Na_2S_2O_3 \times \frac{10^3\text{g}}{1\text{kg}} \times \frac{1\text{mol } Na_2S_2O_3}{157.9\text{g}} \times \frac{2\text{mol Na}}{1\text{mol } Na_2S_2O_3} = 9.14 \times 10^{101}\text{mol}$$

8] How many atoms of Zn would contain the same number of grams as 7.54 x 10^{-6} mg of Cu?

$$7.54 \times 10^{-6}\text{mg Cu} \times \frac{10^{-3}\text{g}}{1\text{mg}} = 7.54 \times 10^{-9}\text{g Cu}$$

$$7.54 \times 10^{-9}\text{g Zn} \times \frac{\text{1mol Zn}}{\text{65.4g Zn}} \times \frac{6.02\times10^{23}\text{Zn atoms}}{\text{1mol Zn}} = 6.94 \times 10^{13} \text{ Zn atoms}$$

9] What is the <u>total</u> number of atoms in 8.00 mole aluminum dichromate?

$$\text{8.00mol } Al_2(Cr_2O_7)_3 \times \frac{6.02\times10^{23}\text{formula units } Al_2(Cr_2O_7)_3}{\text{1mol } Al_2(Cr_2O_7)_3} \times \frac{\text{29 atoms}}{\text{1 formula unit}} =$$

1.40×10^{26} total atoms

10] A typical aspirin tablet contains 5.0 grains of acetyl salicylic acid, $C_9H_8O_4$. How many moles of acetyl salicylic acid are in a single tablet?(0.0648 g = 1.00 grain)

$$\text{5.0 grain} \times \frac{\text{0.0648g}}{\text{1.00grain}} \times \frac{\text{1mol } C_9H_8O_4}{\text{180.2 g } C_9H_8O_4} = 1.5 \times 10^{-3}\text{mol } C_9H_8O_4$$

11] 4.159 g of a iron and sulfur containing compound is decomposed to give 2.233g of iron
What is the empirical formula?

Fe 2.233g ÷ 55.8g/mol = **0.0400 mol Fe**

S (4.159 - 2.233g) ÷ 32.1g/mol = **0.0600 mol S**

$$Fe_{\frac{.04}{.04}} S_{\frac{.06}{.04}}$$

$$= Fe_1S_{1.5} \quad \times 2$$

$$\Rightarrow Fe_2S_3$$

12] The percent composition of a compound is 20.0% C, 2.2% H, and 77.8% Cl. The molar mass of the compound is 182.0 g/mol

a. Find the empirical formula

C 20.0g ÷ 12.0 g/mol = **1.67 mol C**

H 2.2 g ÷ 1.0 g/mol = **2.2 mol H**

Cl 77.8 g ÷ 35.5 g/mol = **2.19 mol Cl**

$$C_{\frac{1.67}{1.67}} H_{\frac{2.2}{1.67}} Cl_{\frac{2.19}{1.67}}$$

$$= C_1H_{1.32}Cl_{1.32} \quad \times 3$$

$$\Rightarrow C_3H_4Cl_4$$

b. Find the molecular formula

3 C	=	3 x	12.0g/mol
4 H	=	4 x	1.0g/mol
4Cl	=	4 x	35.5g/mol
			182.0g/mol

$$\frac{182g}{182g} = 1 \Rightarrow \quad C_3H_4Cl_4$$