Honors Chemistry Hour\_\_\_\_\_ Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Dr. Wexler  
Determining the Empirical and Molecular Formula of a Compound Worksheet 1  
Date:

Part I. Empirical Formula  
The empirical formula of a compound is the molar ratio between its component elements. For example, the compound MgCl2 has a molar ratio of 1Mg:2Cl.

This formula can be experimentally determined if one knows the masses of the individual elements within a sample of that compound.

Example:

A sample of copper metal weighing 2.50 g is heated to form an oxide of copper. The final mass of the oxide is 3.13 g. Determine the empirical formula of the oxide.

Your procedure is:   
a) List the masses of the two elements  
The mass of copper equals 2.50g  
The mass of oxygen equals the mass of CuO minus the mass of Cu = 3.13g-2.50g = 0.63g.

b) Calculate the number of moles of each element  
Moles Cu = 2.50 g/63.546 g/mol = 0.03934 mol

Moles O = 0.63/15.999 g/mol = 0.03938 mol

c) Calculate the molar ratio of Cu:O adjusted to whole numbers  
 0.03934:0.03939 = 0.99873:1 = 1:1

d) Write the empirical formula  
 CuO

Problems:

1. Determine the empirical formula of a compound containing 2.644 g of gold and 0.476 g of chlorine.
2. Determine the empirical formula of a compound containing 0.928 g of gallium and 0.412 g of phosphorus.
3. Find the empirical formula of a compound, given that the compound is found to be 47.9 % zinc and 52.1 % chlorine by mass.

Part II. Molecular Formula  
I f you know the molar mass and the empirical formula of a compound you can then determine its molecular formula.

Example:

A compound with molar mass 60.0 g/mol was found to contain 12.0 g of carbon, 2.0 g of hydrogen and 16.0 g of oxygen. What is the molecular formula of the compound?

Your procedure is:   
a) Calculate the empirical molar mass (the molar mass of the empirical formula)  
12.0 g carbon = 1 mol   
2.0 g hydrogen = 2 mol  
16.0 g oxygen = 1 mol

The empirical formula is therefore CH2O and the empirical molar mass = 12.0 + 2.0 + 16.0 = 30.0 g/mol

b) Divide the compound’s actual molar mass by its empirical molar mass to find the whole number multiplication factor

60.0 g/mol ÷ 30.0 g/mol = 2 = multiplication factor

c) Multiply the multiplication factor times the subscripts of the empirical formula.

Thus, CH2O becomes C2H4O2

Problems:

1. Find the molecular formula of a compound that contains 42.56 g of palladium and 0.80 g of hydrogen. The molar mass of the compound is 216.8 g/mol.
2. Octane, a compound of hydrogen and carbon, has a molar mass of 114.26 g/mol. If one mole of the compound contains 18.17 g of hydrogen, what is its molecular formula?
3. Find the molecular formula of a compound that contains 30.45 % nitrogen and 69.55 % oxygen. The molar mass of the compound is 92.02 g/mol.