DETERMINATION OF EMPIRICAL AND MOLECULAR FORMULAS

The following document will teach you how to turn a list of element percentages into an empirical formula.

STEPS TO FOLLOW:

1. Assume 100 grams of compound (if based on %, it's easiest to compare to 100 g)
2. Convert grams to moles (divide by molar mass)
3. Divide each mole value by the smallest number of moles
4. Write the empirical formula

Let's try a fun and exciting example. . . . . (I know you can't wait):

Determine the empirical formula of a compound containing 24.75% K, 34.77% Mn, and 40.51% O.

To determine a molecular formula:

Use the same steps as for determining a empirical formula THEN compare the formula mass of the empirical formula to the molar mass of the compound:

$$\frac{\text{Molar mass of compound}}{\text{mass of empirical formula}} = \text{(a whole number multiple)}$$

Multiply the_____by the whole number multiple to get the molecular formula.

Another exciting example to try:

Caffeine contains 49.48% C, 5.15% H, 28.87% N, and 16.49% O and has a molar mass of 194.2 g/mol. Determine its molecular formula.

Determining an Empirical Formula from Experimental Data:

The following technique is referred to as combustion analysis.

Example: 11.50 g of an unknown alcohol $C_xH_yO_z$ is combusted. A complete combustion reaction takes place and 22.0 g of CO_2 and 13.5 g of H_2O are produced. Determine the empirical formula.