Name: **Honors Chemistry**

Section: Determining Empirical and Molecular Formulas

Percentage composition data allow you to calculate the *simplest* ratio among the elements of a compound. A formula that represents this simplest ratio is called an **empirical formula**. For example, ammonium nitrite has the true formula NH4NO2 and consists of ammonium, NH4+, and nitrite, NO2-, ions in a 1:1 ratio. Using data from elemental analysis, a chemist would calculate the empirical formula to be NH2O because this formula represents the *simplest* ratio of elements.

If you are given the percent composition of a compound, you can determine its formula. To do this:

1. Assume that you have a 100 gram sample, and the % of each element becomes the grams of that element in the sample.
2. Find the number of moles of each element present.
3. Find the smallest whole number ratio between the moles of the elements present, and use these numbers as the subscripts in the formula.

The true formula is some whole number multiple, *n*, of the empirical formula; *n* can be determined by finding the ratio of the molar mass of the empirical formula and the actual molar mass.

1. The percent composition of lycopene, which gives tomatoes, pink grapefruit and watermelons their red color, is 89.47% C and 10.53% H by mass. The potential of lycopene as a cancer-fighting agent has been extensively studied. Determine the empirical formula of lycopene.
2. A compound is 85.62% carbon and 14.38% hydrogen. The molar mass of the compound is 56 g/mol. Find the empirical formula and the molecular (true) formula for the compound.
3. Determine the empirical formula for a compound with a composition of 46.56% Fe and 53.44% S.

1. A compound contains 40.27% potassium, 26.78% chromium, and 32.96% oxygen. Calculate the empirical formula of this compound.
2. A compound contains 57.54% carbon, 3.45% hydrogen and 39.01% fluorine by mass. Determine the empirical formula of this compound.
3. Find the formula for the hydrate with the following masses of components: 3.71 g Na2CO3, 6.29 g H2O. Name the hydrate.
4. Guaifenesin is an expectorant found in over-the-counter cough and cold medicines such as Robitussin. By loosening phlegm and increasing lubrication in the lungs, it can allow for a productive cough and decreased chest congestion. A sample of guaifenesin was found to contain 9.09 g C, 1.07 g H, and 4.84 g O by mass. Guaifenesin has a molar mass of 198 g/mol. Find the empirical formula and the molecular (true) formula for the compound.