**Empirical Formula**

"Empirical formula" is a REAL IMPORTANT concept. Here's the definition:

the formula of a compound expressed as the smallest possible whole-number ratio of subscripts of the elements in the formula

For example, CH3COOH has two carbons, four hydrogens and two oxygens. So we could write the formula like this: C2H4O2 and so it reduces to CH2O.

Contrast the above definition to this one for "molecular formula:"

the formula of a compound in which the subscripts give the actual number of each element in the formula

Here are the four formulas being used as examples:

|  |  |
| --- | --- |
| Molecular Formula  | Empirical Formula  |
| H2O  | H2O  |
| CH3COOH  | CH2O  |
| CH2O  | CH2O  |
| C6H12O6  | CH2O  |

Notice two things:

1. The molecular formula and the empirical formula can be identical.
2. You scale up from the empirical formula to the molecular formula by a whole number factor.

The tutorial below will focus on empirical formulas, but molecular formulas will return very, very soon. You will need the "scale up" idea when molecular formula questions get joined up with empirical formula questions.

The article below describes the steps involved in calculating an empirical formula. Read it carefully.

**A Simple Rhyme for a Simple Formula
by Joel S. Thompson
*Journal of Chemical Education*
Vol. 65, No. 8; August 1988, p. 704**

When teaching the method for converting percentage composition to an empirical formula, I have devised the following rhyme:

Percent to mass
Mass to mole
Divide by small
Multiply 'til whole

Here's an example of how it works. A compound consists of 72.2% magnesium and 27.8% nitrogen by mass. What is the empirical formula?

(1) Percent to mass:

Assume 100 g of the substance, then 72.2 g magnesium and 27.8 g nitrogen.

(2) Mass to moles:

for Mg: 72.2 g Mg x (1 mol Mg/24.3 g Mg) = 2.97 mol Mg
for N: 27.8 g N x (1 mol N/14.0 g N) = 1.99 mol N

(3) Divide by small:

for Mg: 2.97 mol / l.99 mol = 1.49
for N: 1.99 mol / l.99 mol = 1.00

(4) Multiply 'til whole:

for Mg: 2 x 1.49 = 2.98 (i.e., 3)
for N: 2 x 1.00 = 2

AnswerL Mg3N2