Atomic & Formula Mass

Protons and neutrons are roughly the same mass, and their mass is given a special unit, the amu.

Protons and neutrons are approximately 1 amu each, while an electron is so small we say it is 0 amu.

Using this information, we can conclude that the atomic mass of an element is equal to the atomic mass number in amu.

Formula mass is a little different. Formula mass is the sum of the atomic masses in a compound (ex. H_2O = 18.0 amu)

Molar Mass

We know how to find the formula and atomic masses. Molar mass is the next step.

The molar mass of a compound is the mass of one mole of a compound. The unit for this is g/mol. It is directly related to atomic and formula masses.

Example: What is the molar mass of the following compound?: **PF_3**

Answer: mass of 1 P = 31.0 g, mass of 3 F (3 x 19.0 g) = 57 g
total mass = 88.0 g/mol

Percent Composition

The percent of the mass made up by each element in a compound.

$$\% \text{ comp.} = \frac{\text{Mass of Element}}{\text{Mass of Compound}} \times 100$$

Suppose you had a mole of CO_2. What is the percent composition of each element?

The Mole

The mole is a unit of measure, just like a dozen, a gross or a ream.

To use the atom as the standard unit of measure for the mass is difficult. It is impossible to directly measure the mass of an atom. So, we would like to use a different measure, the gram.

It would make sense to have the mass of a certain number of atoms the same as the atomic mass number, only in grams instead of amu.

Mole Determination

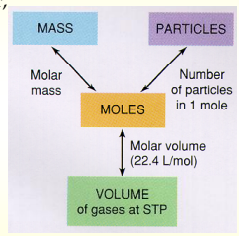
To find the equivalent number of atoms to make the amu# equal to the mass #, we can use the fact that 1 amu = 1.66×10^{-24} g, and determine how many atoms are in a mole.

Through a simple calculation, Amadeo Avogadro, in the early 1800's determined what this number would be. It is also termed Avogadro's number (N).

This number is called the mole. In every mole of a substance, there are 6.02×10^{23} particles.

Mole Conversions

Throughout the rest of the year, we will need to know how many moles are in a certain sample of a compound. We may know the mass, moles, volume of gas (at STP) or # of particles.



Conversion factors

1 mole = 6.02×10^{23} atoms or molecules

1 mole = 22.4 L of gas

1 mole = molar mass

Empirical Formula

A formula that gives the simplest whole-number ratio of the atoms of the elements in a compound.

To determine the empirical formula:

1) Determine the moles of each element in the compound.
2) Set-up a mole ratio for the elements.
3) Divide each number by the smallest mole value.
4) Round numbers off to nearest whole number, and write the formula.

Molecular Formulas

The formula that gives the actual number of atoms of each element in a compound.

In order to find the molecular formula:

1) Determine the molar mass of the molecular compound.
2) Determine the empirical formula mass.
3) Divide (Step1/Step2): The number you get is how many times more atoms are in the molecular formula than the empirical.