Percent Composition

Instead of describing the composition of a compound using the ratio of the atoms we can describe the composition of a compound with the mass percentage of element in a compound.

We can determine the percent composition of each element by taking the mass of the individual element divided by the total mass of the compound.

Ex: Determine the percent composition of each element in ethanol.

C_2H_5OH

$$H: \frac{6.048}{46.07} = 13.13\% \qquad C: \frac{24.02}{46.07} = 52.14\%$$

O: 16.00g mol^{-1}

C: 2x 12.01g mol^{-1}

H: 6x 1.008g mol^{-1}

Total= 46.07g mol^{-1}

$$O: \frac{16.00}{46.07} = 34.73\%$$

Ex:

Atomic Masses

Relative atomic masses were first determined in the 1800's by Dalton, Avogadro and others.

At first atomic masses were measured relative to oxygen, the modern atomic masses on the periodic table are determined relative to carbon-12

Because different isotopes have different masses the values on the periodic table are weighted averages of all the isotopes.

Ex: Copper is comprised of two main isotopes 69.09% Cu-63 and 30.91% Cu-65, atomic masses of 62.93 and 64.93 respectively. What is the average mass of natural copper?

$$A.M. = (62.93 \cdot 0.6909) + (64.93 \cdot 0.3091) = 63.55$$

Moles and Molar Mass

In chemical reactions we need to keep track of how many atoms are reacting, but even small masses of matter have huge numbers of atoms. So, we need some way to count atoms by weighing them.

To do this we want a way to relate the mass of a sample to how many atoms are in that sample. We define a quantity called the "mole" as a way to do this. A mole is 6.022e23 things. We call this number Avagadro's number.

Choosing a mole in this way creates a conversion between the atomic mass in grams and a mole. This is because Avagadro's number is the number of atoms in 12 grams of C-12. Since C-12 is used as the base of the periodic table we can use this value for all the elements.

Ex: How many moles are there in 12.5g of Al. How many Atoms?

$$12.5\text{g Al} \cdot \frac{1\text{mol Al}}{26.98\text{g Al}} = 0.463\text{mol Al} \qquad 0.463\text{mol Al} \cdot \frac{6.022 \cdot 10^{23}\text{atoms Al}}{1\text{mol Al}} = 2.79 \cdot 10^{23}\text{atoms Al}$$

Molar Mass or Molecular Weight

When we have a molecule we need to find the molar mass of the molecule as a group, to do this we simply add up the atomic masses of all the atoms in the molecule.

Ex: Determine the molar mass of methane. CH_4

C: 12.01g mol^{-1}

\+ H: 4x 1.008g mol^{-1}

16.04g mol^{-1}

Ex:

Future Thoughts-

What does a chemical formula represent?