Chem11 The Mole Concept : Notes-10

When doing chemistry calculations, it is convenient to count atoms, molecules or formula units, in terms of "**moles**". (abbr. - mol). It is also called **Avogadro's number**.

1 mole = 6.02×10^{23}

This large number is necessary because atoms are very small.

The mole is defined such that : one mole of carbon-12 atoms has a mass of exactly 12 grams. We say that the "**molar mass**" of carbon-12 is 12 grams. However, the molar mass of carbon is 12.011 grams, because some carbon atoms are the isotope carbon-14. The number 12.011 is called the "**atomic weight**". It is given in the periodic table.

Examples :

Convert moles to grams.	The mass of one mole of Fe is 55.8 g.
	The mass of 2.8×10^3 moles of iron atoms is $2.8 \times 10^3 \times 55.8 = 1.6 \times 10^5$ g.
	The molar mass of N_2O_4 is 2(14.0) + 4(16.0) = 92.0 g.
Convert grams to moles.	48.6 grams of Mg = 48.6/24.3 = 2.00 mol.
	7.2×10^{-2} grams of F atoms = $7.2 \times 10^{-2} / 19.0 = 3.8 \times 10^{-3}$ moles.
Convert moles to atoms.	3.7×10^{-5} moles of atoms = $3.7 \times 10^{-5} \times 6.02 \times 10^{23} = 2.2 \times 10^{19}$ atoms.
Convert atoms to moles.	7.1×10^{25} atoms = $7.1 \times 10^{25} / 6.02 \times 10^{23} = 1.2 \times 10^2$ moles.
Convert atoms to grams.	8.3×10^{16} atoms of Ca = X grams. 6.0×10^{23} atoms of Ca = 40. grams.

This leads to the ratio equation ; X/40. = $8.3 \times 10^{16} / 6.0 \times 10^{23}$, or X = 5.5×10^{-6} g.

Percentage Composition. Find the percentage composition by mass of LiCl.

For Li, {molar mass Li/molar mass LiCl} x 100% = 6.941/(6.941+ 35.453) x 100 =16.4 %. Cl = 100 - 16.4 = 83.6%.

The **empirical formula** of a compound gives the simplest whole number ratio of atoms in the compound. The **molecular formula** gives the actual number of atoms of each element in the compound. For example, the molecular formula N_2O_4, has the empirical formula; NO_2.

Example: Find the Empirical Formula, given that a compound consists of 43.6% P and 56.4% O by mass. We assume that the formula is P_aO_b. We have; aP/{aP + bO} = 0.436, or aP = aP(0.436) + bO(0.436), or 0.564 aP = 0.436bO. Since P = 31.0, and O = 16.0, we have; 17.5 a = 7.0 b. We see that a = 2 and b = 5, (or some multiple). The empirical formula is : P_2O_5.