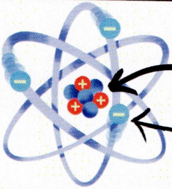
SOME BASIC CONCEPTS

Basic Terminologies

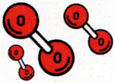


Atom has subatomic particles

Nucleus Containing **Protons (+ve)** and **Neutrons (neutral)** which sums to Mass number.

Electrons (-ve) which helps define atomic number

Atoms of Element Oxygen

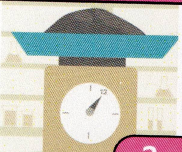


Molecules of Element Oxygen

Compound of Element Oxygen

MOLE - The concept

A mole is quantity of anything that has the same number of particles found in 12.000 grams of carbon-12. That no. of particles is Avogadro's Number, which is roughly 6.02×10^{23}.



Atomic Mass Unit (amu, Da, u)

AMU of an element is a measure of its atomic mass. Also called dalton (Da) or unified atomic mass unit (u).

1 amu = 1.66×10^{-24}g = 1/12 (mass of 1 Carbon atom)

Atomic & Molecular Mass

$$\text{Atomic Mass} = \frac{\text{mass of an element}}{(\frac{1}{12})\text{mass of 1-C atom}}$$

$$\text{Molecular Mass} = \frac{\text{mass of a molecule}}{(\frac{1}{12})\text{mass of 1-C atom}}$$

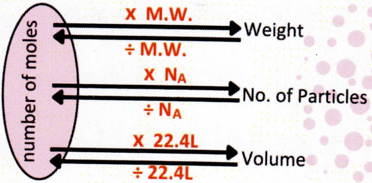
Both are dimensionless quantity

Molar Mass

Mass of N_A number of particles (calculated in grams)

Number of moles (n)

$$n = \frac{\text{Given w}}{\text{M.W.}} = \frac{\text{No. of particles}}{6.02 \times 10^{23}} = \frac{\text{V at STP}}{22.4\text{L}}$$



Percentage Composition

$$\% \text{ composition } = \frac{\text{A. W.} \times \text{no. of atoms}}{\text{Total Molecular weight}} \times 100$$

Density (Absolute and relative)

Case of Solids and Liquids

Absolute Density (g/mL)	Specific Gravity (Unitless)
$\text{Density (d)} = \frac{\text{Mass}}{\text{Volume}}$	$\text{R. D.} = \frac{\text{Density of substance}}{\text{Density of water at } 4°\text{C}}$

Case of Gases

Absolute Density (g/L)	Relative Density (Unitless)
$d = \frac{PM}{RT}$ R = Gas Constant	$d \propto M \, ; \, \frac{d_1}{d_2} = \frac{M_1}{M_2}$

Vapour Density (V.D.)

$$\text{V. D.} = \frac{M_1}{M_{H_2}} = \frac{M_1}{2}$$

Density of the gas with respect to hydrogen gas at constant T,P

Average Atomic Weight for isotopes

$$\sum (\%\text{Abundance} \times \text{Atomic Weight}) / 100$$

Mean Molar mass

$$\sum n_i M_i / \sum n_i$$

Molecular and Empirical Formula

Molecular Formula (H_2O_2)	**Empirical Formula (HO)**
Formula showing **exact number of atoms** present of each element in one molecule of compound	Formula showing **simplest ratio of atoms** present of each element in one molecule of compound

$$M.F. = (E.F.)_x \text{ where } x = \frac{\text{Molecular mass}}{\text{Empirical mass}}$$

Element	%	Relative moles (%/A.W.)	Simplest ratio	Simplest whole no.

Concentration Terms

- **Mole Fraction (x) :** For a mixture of A,B & C.

$$x_A = \frac{n_A}{n_A + n_B + n_C} \text{ and } x_A + x_B + x_C = 1$$

Percentage by mass

$$\frac{\%w}{w} = \frac{w_{solute}}{w_{solution}} \times 100$$

Percentage by Volume

$$\frac{\%V}{V} = \frac{V_{solute}}{V_{solution}} \times 100$$

Percentage mass/volume

$$\frac{\%w}{V} \text{ in g/mL} = \frac{w_{solute}}{V_{solution}} \times 100$$

e.g. 20g Glucose in 100mL solution

Parts per million (ppm)

$$ppm = \frac{w_{solute}}{w_{solution}} \times 10^6 \; ; \; ppb = \frac{w_{solute}}{w_{solution}} \times 10^9$$

Concentration Terms (Solute = B ; Solvent = A)

Molarity (mol L^{-1})	**Molality (mol kg^{-1})**	Terms with
Temp. Dependent	Temp. Independent	**Volume** are
$M = \frac{n_B}{V_{sol}(L)}$	$m = \frac{n_B}{w_{sol}(kg)}$	Temp. Dependent

Relation between concentration terms

Between M and %w/w	**Between M and m**
$M = \frac{10.z.d}{MW_B}$; $z = \frac{\%w}{w}$ d = density in g/mL or g/cc	$M = \frac{m.d}{1 + m.\frac{MW_B}{1000}}$

Molarity on Dilution	Molarity on mixing
$M_fV_f = M_iV_i$	$M_{mix} = \frac{M_1V_1 + M_2V_2\ldots}{V_1 + V_2\ldots}$

NORMALITY (N) = Molarity x n-factor

$$\text{Normality} = \frac{\text{no. of g} - \text{equivalents of solute}}{\text{Volume of solution (L)}}$$

- n-Factor for Acids = **No. H^+ ions**, e.g. HCl = 1
- n-Factor for Bases = **No. of OH^- ions**, e.g. $Mg(OH)_2 = 2$
- In redox reaction, n factor is calculated by multiplying the change in oxidation state with no. of atoms present in the molecule.