# Basic chemical calculations.

**Atomic weight**: The atomic weight of an element is the mass of an atom on a scale that alligns Carbon a mass of exactly twelve.
eg. Atomic weight of Potassium is 39, Atomic weight of $S = 32$

**Molecular weight**: The molecular weight of a compound is the sum of the atomic weights of atoms that constitute a molecule of a compound.
eg. Molecular weight of $NH_4Cl = 14 + 4 \times 1 + 35.5 = 53.5$ g

**Mole**: The amount of substance of a system which contains as many elementary entities as there are atoms in 12 grams of carbon-12 is defined as mole.

No of atoms in 12 grams of C-12 $= 6.022 \times 10^{23}$ = Avogadro number

For chemical compounds, a mole is defined as the amount of substance equal to its formula weight. The formula weight is called the molar mass or molecular weight.

1 mol NaCl $= 23 + 35.5 = 58.5$ g NaCl

1 mol $H_2O$ = 18 g $H_2O$

1 mol $C_2H_5OH$ = 46 g $C_2H_5OH$

1 mol = 1 g mol = 1 gram mole

1 kmol = 1 kg mol = 1 kilogram mole.

$$\text{mole of a substance} = \frac{\text{mass in grams}}{\text{molecular weight}}$$

$$\text{Kilomol of a substance} = \frac{\text{mass in Kg}}{\text{molecular weight}}$$

**Gram atom**: Mass in gram of an element which is numerically equal to its atomic weight

$$\text{gram atom of an Element} = \frac{\text{weight in grams}}{\text{Atomic weight}}$$

$$\text{Kilogram atom of an Element} = \frac{\text{weight in kg}}{\text{Atomic weight}}$$

1 gatom Al = 27 g Al

1 Katom Na = 23 kg Na

1 mol $O_2$ = 2 gatm $O_2$ = 32 g $O_2$

1 Kmol $H_2$ = 2 K atom $H_2$ = 2 kg $H_2$

## Basic chemical calculations: -

**Mole:** The amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilograms of carbon-12 is defined as a mole
(No. of atoms in 0.012 kg of C-12 = $6.022 \times 10^{23}$ = Avogadro number)
For chemical compounds, a mole is defined as the amount of substance equal to its formula weight. (molar mass or mol. wt) Mole of a substance = $\frac{\text{mass in grams}}{\text{mol. wt.}}$

$1 \text{ Kmol } H_2 = 2 \text{ Kg } H_2$

$1 \text{ mol NaCl} = 23 + 35.5 = 58.5 \text{ g NaCl}.$

$1 \text{ Kmol} = 1 \text{ kilogram mole} = 1 \text{ Kgmole} = \frac{\text{weight in kg}}{\text{Molecular weight}}$

**Atomic weight:** The atomic weight of an element is the mass of an atom on a scale that assigns carbon a mass of exactly twelve, Atomic wt. of S = 32
eg. Atomic weight of potassium = 39,
**Molecular weight:** Molecular weight of a compound is the sum of the atomic weights of atoms that constitute a molecule of a compound.
eg. Molecular weight of $NH_4Cl = 14 + 4 + 35.5 = 53.5$

**Gram atom:** mass in gram of an element which is numerically equal to its atomic weight

$$\text{gram atom of Element} = \frac{\text{Weight in grams}}{\text{Atomic weight.}}$$

$$\text{Kilogram atom of Element} = \frac{\text{weight in kg}}{\text{Atomic weight}}$$

# Basic Chemical Calculations-

Atomic weight: The atomic weight of an element is the mass of an atom on a scale that assigns Carbon a mass of exactly twelve.

Molecular weight: The molecular weight of a compound is the sum of the atomic weights of atoms that constitute a molecule of a compound.

Mole: The amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 ~~kg~~ kilograms of carbon-12 is defined as mole.

For chemical compounds, a mole is defined as the amount of substance equal to its formula weight. The formula weight is called the molar mass or molecular weight

$$\text{moles of a substance} = \frac{\text{mass in grams}}{\text{molecular weight}}$$

## Gram atom.

Mass in grams of a given element that is numerically equal to its atomic weight is called gram atom.

For example, if 35.46 grams of Chlorine, which has an atomic weight of ~~55.84~~ 35.46, are taken, and if 55.84 grams of iron, which has an atomic weight of 55.84, are taken, there will be exactly the same number of chlorine atoms as of iron atoms ~~as of iron atoms~~ in these respective masses of material.

$$\text{g-atoms of an elementary substance} = \frac{\text{mass in grams}}{\text{atomic weight}}$$

## Methods of Expressing the composition of mixtures and solutions

Considering a binary system, composed of components which will be designated as A and B

$W$ - total weight of the system

$W_A$ and $W_B$ - respective weights of components A and B

$M_A$ and $M_B$ - respective molecular weights of components A & B

$A_A$ and $A_B$ - respective atomic weights of components A and B

$V$ - volume of the system at a particular temperature & pressure.

$V_A$ and $V_B$ - respective pure component volumes

(The pure-component volume is defined as the volume occupied by a particular component if it is separated from the mixture, and brought to the same temperature and pressure as the original mixture)

$$\text{Weight Percent of A} = \frac{W_A}{W} \times 100$$ (Solids & liquids)

$$\text{volume percent of A} = \left(\frac{V_A}{V}\right) \times 100$$ For gases, occasionally for liquids very seldom for ~~gases~~ solids.

$$\text{Mole fraction of A} = \frac{W_A/M_A}{\frac{W_A}{M_A} + \frac{W_B}{M_B}}$$

$$\text{mole \% of A} = \text{mole fraction} \times 100$$

$$\text{Atomic fraction of A} = \frac{W_A/A_A}{(W_A/A_A) + (W_B/A_B)}$$

$$\text{Atomic \% of A} = \text{atomic fraction} \times 100$$

# Equivalent weight

One equivalent weight of an element or compound has precisely the same power for chemical combination as one equivalent weight of any other element or compound. It strictly depends upon the reaction in which the molecule participates. Consider the reaction

$$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$$

$H_2$ - monovalent

$O_2$ - divalent

In this reaction, hydrogen is monovalent whereas Oxygen is divalent. Two atoms of hydrogen combine with one atom of oxygen to form water.

Again $KOH + HNO_3 \rightarrow KNO_3 + H_2O$

In this reaction, one Equivalent weight of KOH combines with one equivalent weight of $HNO_3$ to produce one equivalent weight of $KNO_3$ and one Equivalent of $H_2O$

In simple terms, the equivalent weight of an element or a compound is equal to the atomic weight or molecular weight divided by the valence.

$$\text{Equivalent weight} = \frac{\text{molecular weight}}{\text{valence}}$$

The valence of an element or a compound depends on the numbers of hydrogen ions accepted or the hydroxyl ions donated for each atomic weight or molecular weight

$$\text{Equivalent weight} = \frac{\text{molecular weight}}{\text{Valence}}$$

1 g equivalent weight of hydrogen $= \frac{1}{1} = 1$ g of hydrogen

1 g equivalent weight of oxygen $= \frac{16}{2} = 8$ g of oxygen

1 g Equivalent weight of Copper $= \frac{63.5}{2} = 31.75$ g Cu

1 g Equivalent weight of $H_3PO_4 = \frac{98.1}{3} = 32.7$ g $H_3PO_4$