Some Basic Concept
Of
Chemistry

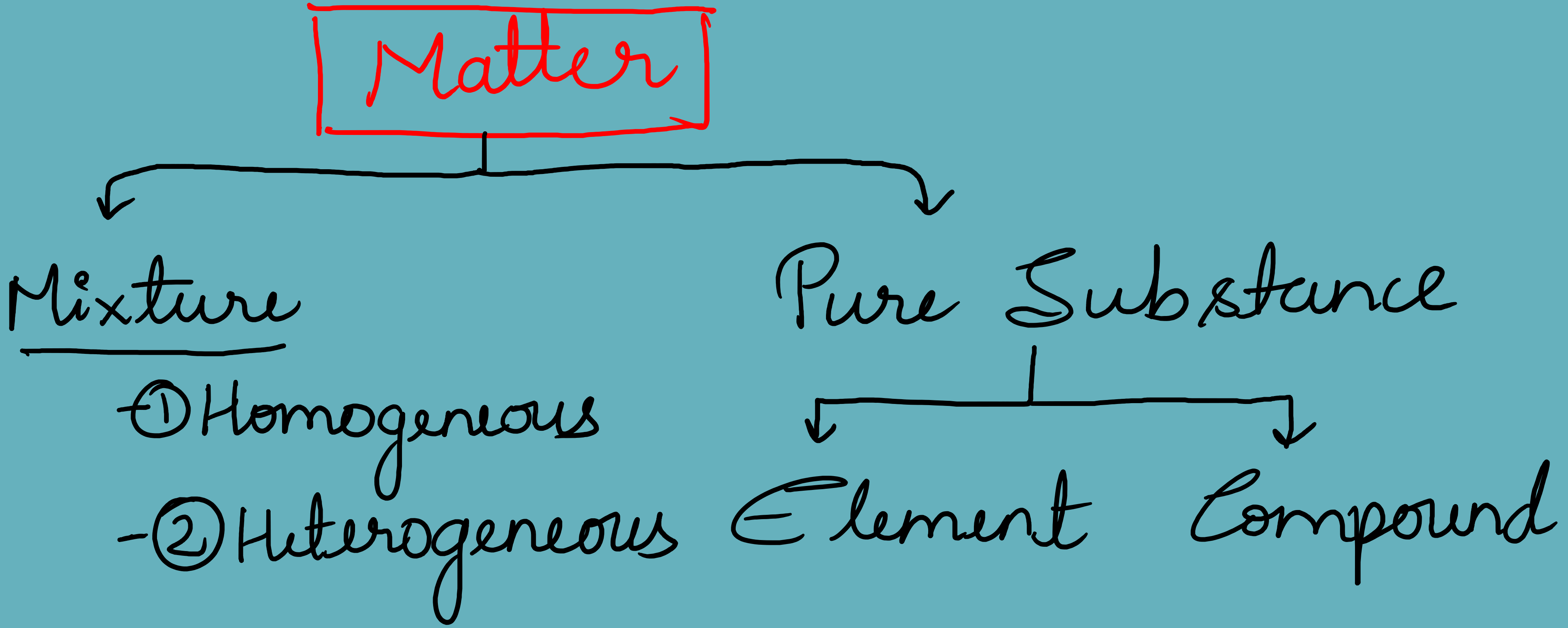
Some Basic Concepts of Chemistry

Matter → Anything which has mass and occupies space

→ Basic Constituents of Matter is atom and Molecules

→ Matter can exist three Physical States - ① Solid
② Liquid
③ Gas

Nature of Matter



- Matter
  - Mixture
    - ① Homogeneous
    - ② Heterogeneous
  - Pure Substance
    - Element
    - Compound

Laws of Chemical Combination

→ Chemical Combination laws ⇒ 5

① Law of Conservation of Mass –

→ given by Lavosier

→ It states, Matter can neither be created nor be destroyed.

→ In Chemical Rxn,

✓ Mass of Reactant = Mass of Product

Reactant → Product

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

$$\underbrace{2g \qquad 16g}_{\text{Reactant} = 18g} \qquad\qquad 18g$$

18g Product

② Law of Definite Proportion

→ Given by Joseph Proust

→ He stated that a given Compd always contain exactly the same Proportion of elements by weight

eg → $CuCO_3$ (Cupric Carbonate)

	% of Cu	% of O	% of C
✓ Natural Sample	51.35	9.74	38.91
✓ Synthetic Sample	51.35	9.74	38.91

③ Law of Multiple Proportion

→ Given by Dalton

→ If two elements can combine to form more than One Compound, the masses of one element that combine with a fixed mass of the other elements, are in the Ratio of whole Number eg → $\underbrace{H_2}_{2g}\underbrace{O}_{16g}$ & $\underbrace{H_2}_{2g}\underbrace{O_2}_{32g}$

16 : 32

1 : 2

Ques → Law of Multiple propotion is —

(a) $\underline{H_2}S$ & $\underline{S}O_2$

(b) $\underbrace{Na_2}S$ & $\underbrace{Na_2}O$

(c) NH_3 & NO_2

✓(d) $\underbrace{N_2}O$ & NO

$O \rightarrow 16g$

16 : 32

$\boxed{1 : 2}$

$(NO)_2 = \underbrace{N_2}\underbrace{O_2}_{32g}$

④ Gay Lussac's law of Gaseous Volumes

→ At same temp & Press. all Gases combine in Reaction by Simple ratio of Volume.

✓ $2H_2 + O_2 \longrightarrow 2H_2O$

100ml   50ml   100ml

H   O

$\boxed{2 : 1}$

⑤ Avogadro Law →

At Same temp & Press. equal volume of Gas Contains equal No. of molecules.

atom ✗

$$\boxed{V \propto \text{No. of } \underline{\text{Molecules}}}$$

$$H_2 + O_2 \longrightarrow H_2O$$

$2V \qquad 1V \qquad \underline{\underline{2V}}$

✓ Relative Atomic Mass

$$\boxed{\text{RAM} = \frac{\text{Mass of one atom of an element}}{\frac{1}{12} \times \text{mass of one } \underset{\text{Isotope}}{\underline{\text{C-12}}} \text{ atom}}}$$

RAM = Number of nucleon Present in atom or Molecule

Atomic mass unit

$$\boxed{1\,\text{amu} = \frac{1}{12}^{\text{th}} \times \text{mass of one } \underline{\text{C-12}} \text{ atom}}$$

$$1\,\text{amu} = 1.66 \times 10^{-24}\,\text{g}$$

$$= 1.66 \times \underline{10^{-27}}\,\text{kg}$$

✓ Atomic Mass & Molecular mass

→ Mass of 1 atom or 1 molecule (in amu)

→ AM = RAM × 1amu

→ MM = RAM × 1amu

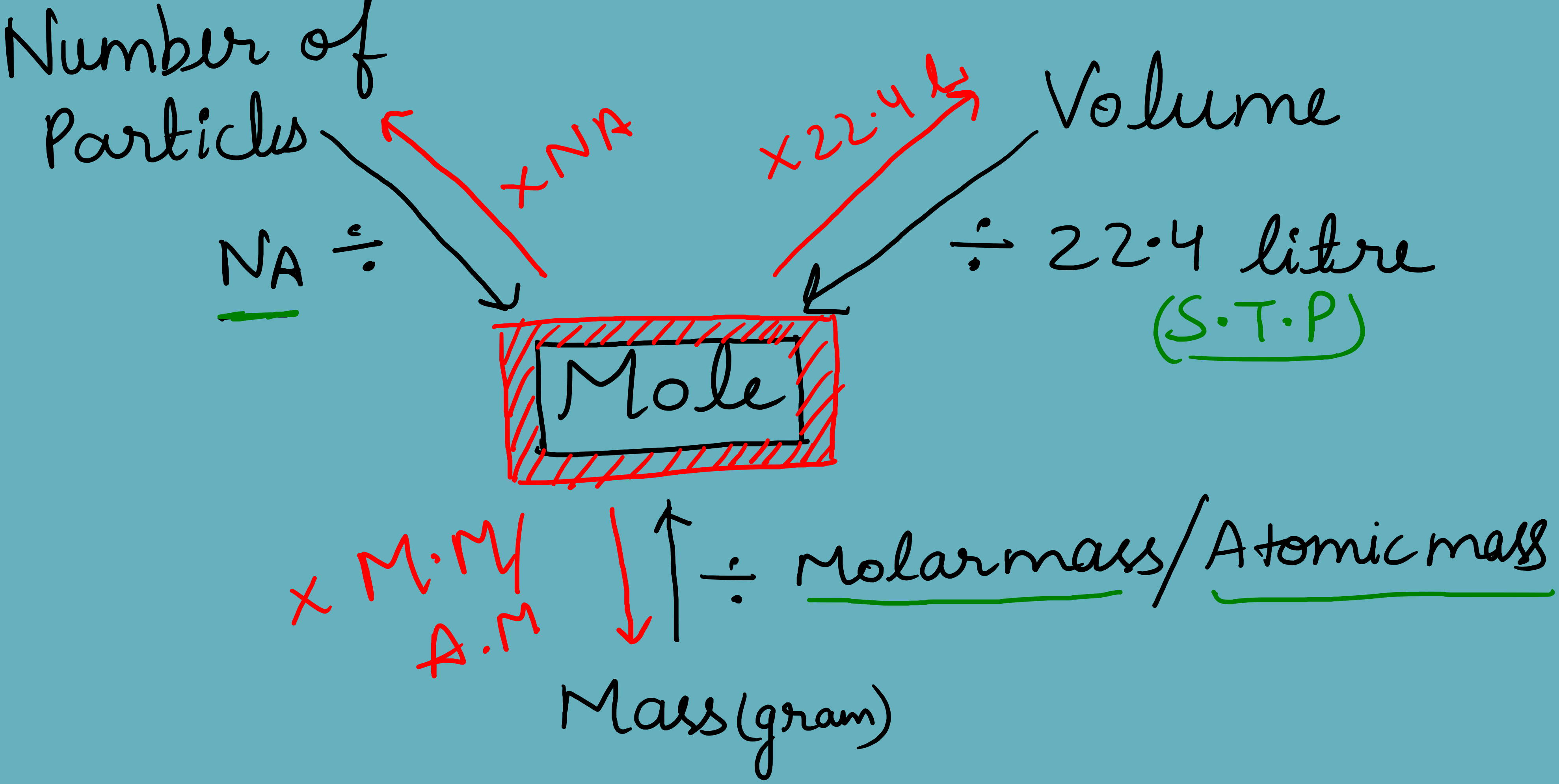
✓ Gram Atomic Mass

→ This is also
- Mass of 1 Mole
- Mass of NA Particles

NA ↓ 6.023×10^{23}

Note → 1 amu × NA = 1 gram

How to Calculate mole ?



$$\boxed{N_A = 6{\cdot}023 \times 10^{23}}$$

① If weight is given

n = mole

$$\boxed{n = \frac{\omega}{Mw/Aw}}$$

atom/molecule/ ion

② If No. of Entities is given

$$\boxed{n = \frac{N}{N_A}}$$

③ If Volume of S.T.P is given

$$\boxed{n = \frac{V(L)}{22.4}}$$

→ Volume Litre

Ques In which case is the Number of Molecules is maximum? (NEET 2018)

(a) 0.00224 L of water Vapour at 1 atm and 273 K   S.T.P

(b) 0.18g of H_2O ③ $= NA$ $n = \frac{\text{No. of Molecule}}{NA}$

✓(c) 18 ml of H_2O ④ $N = 10^{-3} \times NA$ No. of Molecule $= n \times NA$

(d) 10^{-3} mole of H_2O

$$\text{mole} = \frac{.18}{18} \times NA$$

$$② = 10^{-2} \times NA$$

$$n = \frac{\cancel{224}^{0} \times 10^{-\cancel{5}}(L)}{\cancel{22}4(L)} = 10^{-4}$$

$$① N = 10^{-4} \times NA$$

Ques The Total Number of electron in 18ml of water (density 1g/ml)

(a) 6.023×10^{25}

✓(b) 6.023×10^{24}

(c) $6.023 \times 18 \times 10^{23}$

(d) 6.023×10^{23}

$$d = \frac{M}{V}$$

$$1 \times 18 = M$$

$$H_2O = 2+8$$
$$= 10\,e$$

Number of electron

$$\Rightarrow \text{Mole} \times N_A \times 10$$

$$= \frac{\cancel{18}}{\cancel{18}} \times N_A \times 10$$

$$6.023 \times 10^{23} \times 10$$

Ques Mass of 0.1 mole of methane is

$\boxed{CH_4}$ $12+4 = 16$

a) 1 g

b) 16 g

[✓ c) 1.6 g]

d) 0.1 g

$$\text{Mole} = \frac{\text{Mass}}{\text{Mol. Mass}}$$

$$\text{Mass} = \text{mole} \times \text{M.M}$$

$$= 0.1 \times 16$$

$$= 1.6 \text{ gram}$$

Ques- The Number of molecules in 18 mg of H_2O in terms of NA (Avogadro Num)

✓a) 10^{-3} NA

b) 10^{-2} NA

c) 10^{-1} NA

d) 10 NA

$$N = \text{mole} \times NA$$

$$= \frac{\cancel{18} \times 10^{-3}}{\cancel{18}} \times NA$$

$$= 10^{-3}\, NA$$

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Some Basic Concept Of Chemistry

Lecture-02

% Composition (% by mass)

✓✓ ✓

$$\text{\% Comp. of Element} = \frac{\text{At. wt. of Element} \times \text{No. of Atom} \times 100}{\text{M.w of Compound}}$$

① eg → find % Composition of Ca, C & O in $CaCO_3$

$\underline{Ca}CO_3$

eg-② find % of C, H & O in $C_6H_{12}O_6$ (Mw = 180)

Glucose

$C_6H_{12}O_6$

$$\% C = \frac{12 \times \cancel{6} \times 100}{\underset{3}{\cancel{18}}0} = 40\%$$

$$\% H = \frac{1 \times 12 \times 100}{180} =$$

$$\% O = \frac{16 \times 6 \times 100}{180} =$$

Average Atomic Weight

Use → for Isotopes [Same At. Number
diff mass Number]

Isotope 1	% abundance	At. wt.
Isotope 2	% abundance	At. wt

$$\boxed{\text{Avg At. wt} = \frac{\%\,\text{abun.}_1 \times \text{At.wt}_1 + \%\,\text{abun}_2 \times \text{At wt}_2}{100}}$$

Ques find avg. atomic wt.

Isotopes	% abundance
Cl^{35}	$\boxed{75}\%$
Cl^{37}	$\boxed{25}\%$

$$\text{Avg. atomic wt} = \frac{75\% \times 35 + 25\% \times 37}{100\%}$$

$$=$$

✓ Mean Molar mass

Use → for Gaseous mixture

Gas-1 + Gas-2 + Gas-3

$$\boxed{\text{Mean Molar Mass} = \frac{n_1M_1 + n_2M_2 + n_3M_3}{n_1+n_2+n_3}}$$

$$\text{Mole} = \frac{\text{Mass}}{\text{Molar mass}}$$

Ques find **Mean molar mass** ?

Gas	mole%
O_2 (Mw = 32)	80
N_2 (Mw = 28)	20

Solve M·M M $= \dfrac{n_1M_1 + n_2M_2}{n_1+n_2}$

$$= \frac{80\times32 + 20\times28}{80+20}$$

$$=$$

Limiting Reagent or (Reactant)

→ Balanced the chemical Rxn

Use → when both Reactant moles is given

"The Reactant or Reagent which is consume first in a chemical Rxn is called L.R

Ques → # $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ (find L.R)

Given mole

5.6 3.2

#L.R

$\frac{5.6}{1} = \boxed{5.6}$ $\frac{3.2}{1/2} = \boxed{6.4}$

$\boxed{H_2 \text{ is } L.R}$

Ques → ④ Moles of N_2 is reacted with ⑨ moles of H_2 to form NH_3 ?

$$① N_2 + ③ \overset{L \cdot R}{H_2} \longrightarrow 2NH_3$$

$H_2 \rightarrow L \cdot R$

Solve

Given mole $\quad \frac{4\text{ mol}}{1} \quad \frac{9\text{ mol}}{3}$

③ - - - - →

Reacted mole $= 4$

$(4-3) = 1 \times 1 = ①$

$(3-3) \times 3 = 0$

0

2×3

$3 \rightarrow 2$

$9 \rightarrow x$

$x = \frac{18}{3}$

$x = 6$

6 mol

Ques ⇒ 10 gram of Hydrogen & 64 g of Oxygen were filled in a steel vessel and exploded. Amount of water Produced in this reaction will be

CBSE AIPMT

a.) 3 mol

✓ b.) 4 mol

c.) 1 mol

d.) 2 mol

$$\text{①} H_2 + \text{①}\!\!\!\!\!\;\tfrac{1}{2} O_2 \xrightarrow{L.R} 1 H_2O$$

4 mol

$$\frac{10}{2} = 5 \qquad \frac{64}{32} = 2$$

Given mole

Reacted moles

$$\frac{5}{1} = 5 \qquad \frac{2}{1/2} = 4 \rightarrow 4$$

$$\frac{1}{2} \rightarrow 1$$

$$2 - 4\text{ mol} \rightarrow H_2O$$

Stoichiometry

→ Use Balanced Chemical Reaction

① $CH_{4(g)} + \underline{2}O_{2(g)} \longrightarrow 1CO_{2(g)} + 2H_2O_{(g)}$

① ⇒ 1 mol of CH_4 & 2 mol of O_2 Produced
1 mol of CO_2 & 2 mol H_2O

② ⇒ 16g of CH_4 & 2×32g of O_2 Produced
1×44g of CO_2 & 2×18g of H_2O

Ques find the Number of Moles of $\underline{CO_2}$ = ? Produced by the Complete Combustion of 2.5 moles of Propane ?

$$\boxed{C_3H_8} + 5O_2 \longrightarrow \underline{3CO_2} + 4H_2O$$

2.5

$$\begin{tikzcd} 1 \arrow[r] & 3 \arrow[dl] \\ 2.5 \arrow[r] & x \end{tikzcd}$$

$x = 2.5 \times 3 = 7.5$ mol Ans

$CO_2 = 7.5$ mol

Ques✓ Calculate weight of Residue obtained when 1 mole $CaCO_3$ is strongly heated?

$$CaCO_{3(s)} \longrightarrow \underbrace{CaO_{(s)}}_{\text{Residue}} + CO_{2(g)}$$

Solve 1 mol $\boxed{1\,mol}$

Weight of $\underbrace{CaO}_{40+16=56} = 1 \times 56 = 56\,g$

Ques How many ltr. O_2 at NTP required for Complete Combustion of 2 moles of C_5H_{10} ?

$$\rightarrow \quad C_5H_{10} + \frac{15}{2}O_2 \longrightarrow 5CO_2 + 5H_2O$$

Solve

2mol

CO_2	O_2
1	$\frac{15}{2}$
2	x

$$x = \frac{15}{2} \times 2 = 15 \text{ mol of } O_2$$

$$n = \frac{V(L)}{22.4} \Rightarrow V = 15 \times 22.4L$$

$=$

Empirical Formula

Molecular formula $= (E \cdot F)_n$

#
$$\boxed{n = \frac{\text{Molecular formula weight}}{\text{Emp. formula weight}}}$$

Q// find E.F of $C = 60\%$, $H = 24\%$ & $O = 16\%$

Solve

$C = \frac{60}{12} = 5$

$H = \frac{24}{1} = 24$

$O = \frac{16}{16} = 1$

E.F $\boxed{C_5H_{24}O_1}$

Ques ⇒ find Empirical formula of the Compd If M = 68% (atomic mass = 34) & Remaining 32% oxygen. (O = 16)

(AIIMS)

✓ a) MO

b) M_2O

c) MO_2

d) M_2O_3

$$M = \frac{\cancel{68}}{\cancel{34}} = 2$$

$$O = \frac{\cancel{32}}{\cancel{16}} = 2$$

$$M_{\cancel{2}}^{①} O_{\cancel{2}}^{①}$$

$$\boxed{MO}$$