

1. SOME BASIC CONCEPTS OF CHEMISTRY

Properties of matter (Physical)

1. Volume :- Volume is measured in litre
 $1\text{ L} = 1\text{ dm}^3 = 1000\text{ mL} = 1000\text{ cm}^3$

Note :- When decimal point shifted from L.H.S to R.H.S, power become negative.

eg:- $0.001 = 1 \times 10^{-3}$
 $2.123 = 2.123 \times 10^{-2}$

When decimal point is shifted from R.H.S to L.H.S, power becomes positive.

eg:- $100 = 1 \times 10^2$
 $2469.2 = 2.4692 \times 10^3$

2. Length :- Length is measured in meter
 $1\text{ nm} = 10^{-9}\text{ m}$
 $1\text{ pm} = 10^{-12}\text{ m}$

3. Mass :- Mass is measured in kilogram.
 $1\text{ kg} = 1000\text{ gm} = 10^3\text{ gm}$

4. Density = $\frac{\text{mass}}{\text{volume}} = \frac{\text{kg}}{\text{L}} \text{ or } \frac{\text{kg}}{\text{dm}^3} = \text{kg L}^{-1}$
 $= \frac{\text{g}}{\text{cm}^3} = \text{g L}^{-1} = \text{gm} \cdot \text{m}^{-3}$

5. Temperature :- Temperature is measured in $^{\circ}\text{C}$ (degree celsius), $^{\circ}\text{F}$ (degree Fahrenheit) and K (Kelvin).

Relation between $^{\circ}\text{C}$ and K is $K = ^{\circ}\text{C} + 273.15$

Relation between $^{\circ}\text{C}$ and $^{\circ}\text{F}$ is $^{\circ}\text{F} = \frac{9}{5} (^{\circ}\text{C}) + 32$

Q) Convert the following $^{\circ}\text{C}$ temperature to K and $^{\circ}\text{F}$.

1.) 40°C

$$\therefore K = ^{\circ}\text{C} + 273$$

$$= 40 + 273$$

$$= 313 \text{ K}$$

$$^{\circ}\text{F} = \frac{9}{5} (^{\circ}\text{C}) + 32$$

$$= \frac{9}{5} \times 40 + 32$$

$$= 72 + 32$$

$$= 104^{\circ}\text{F}$$

2.) 30°C

$$K = ^{\circ}\text{C} + 273$$

$$= 30 + 273$$

$$= 303 \text{ K}$$

$$^{\circ}\text{F} = \frac{9}{5} (^{\circ}\text{C}) + 32$$

$$= \frac{9}{5} \times 30 + 32$$

$$= 54 + 32$$

$$= 86^{\circ}\text{F}$$

3.) 37°C

$$K = ^{\circ}\text{C} + 273$$

$$= 37 + 273$$

$$= 310 \text{ K}$$

$$^{\circ}\text{F} = \frac{9}{5} (^{\circ}\text{C}) + 32$$

$$= \frac{9}{5} \times 37 + 32$$

$$= 66.6 + 32$$

$$= 98.6^{\circ}\text{F}$$

* Law of Conservation of mass

Mass can neither be created nor destroyed.

Total mass of reactants = Total mass of products.

Q. State and explain → Law of definite proportions.

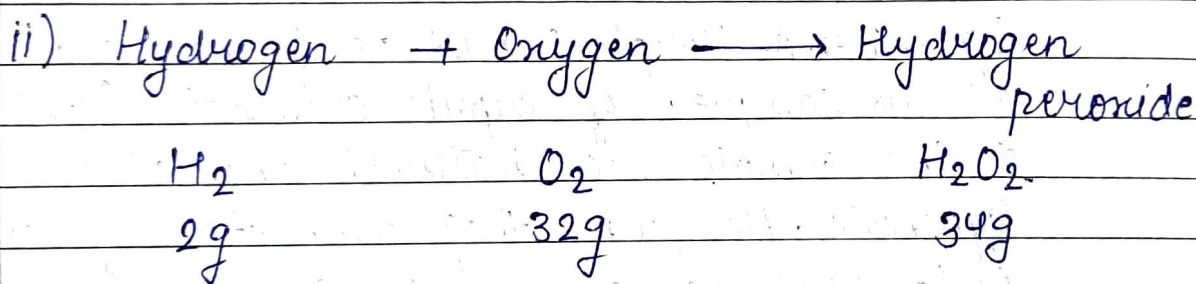
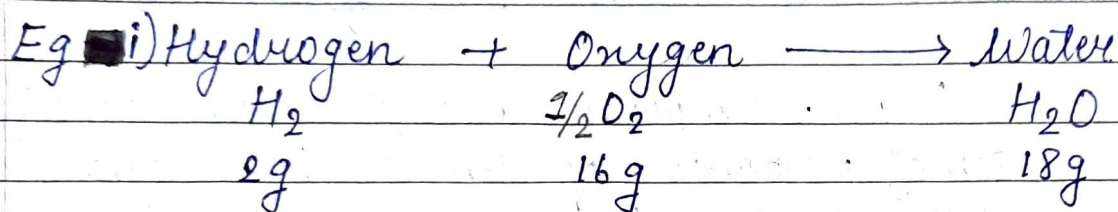
A given compound always contains exactly the same ^{its} proportion of elements by weight, irrespective of the source either natural or synthetic (man-made).

Eg:- Scientist Joseph Proust performed experiment of two samples of cupric carbonate ($\text{Cu}_2(\text{O}_3)$). One of the sample was natural and other was synthetic. He found that composition of element in it was same on both samples.

Cupric Carbonate	% of copper	% of oxygen	% of carbon
Natural Sample	51.35	9.74	38.91
Synthetic Sample	51.35	9.74	38.91

Q State and explain → Law of multiple proportion.

When two elements A and B combine to form more than one compounds, the masses of element B that combine with a given mass of A are always in the ratio of small whole number.

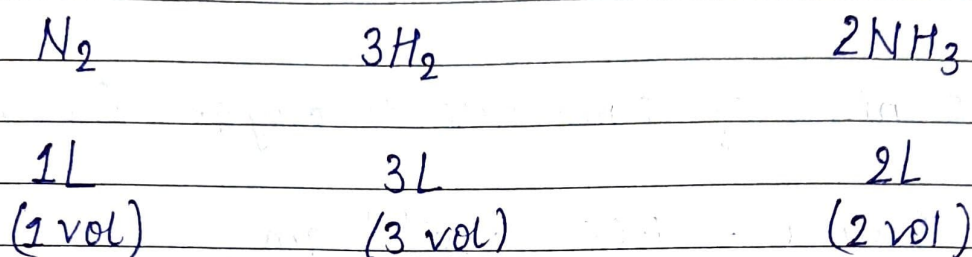
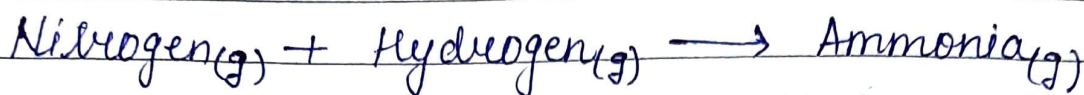


In above examples it was found that, the two masses of oxygen i.e 16 gm and 32 g which combine with a fixed mass of hydrogen i.e 2g are in simple whole number ratio 16 : 32 i.e 1:2.

Q State and explain → Gay Lussac Law of Gaseous Volume.

When gases combine during chemical reaction, in such a way that their volume is in simple whole number ratio at same temperature and pressure.

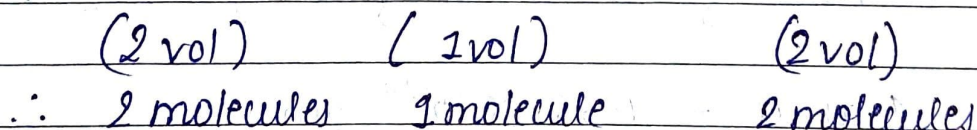
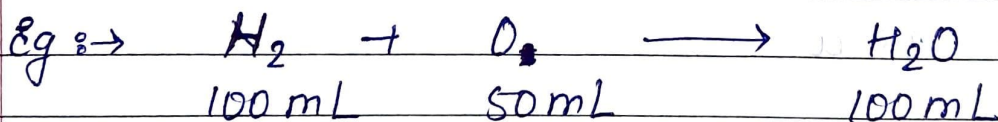
eg:-> Under the same condition of temperature and pressure of Nitrogen gas combine with 3L of Hydrogen to produce 2L of ammonia gas.



Volume ratio is 1:3:2

* Avogadro Law

Equal volumes of all gases at the same temperature and pressure contain equal number of molecules.



Note :- The value of Avogadro number is
 $N_A = 6.022 \times 10^{23}$ molecules.

Q Find the mass of 1 molecule of oxygen (O_2) atom in amu (u) and in grams.

$$\begin{aligned} A \Rightarrow 1. \text{ mass of 1 molecule of oxygen } (O_2) \text{ in amu} \\ &= 0 + 0 \\ &= 16 + 16 \\ &= 32 u \end{aligned}$$

2. mass of 1 molecule of oxygen (O_2) in gm.

$$\begin{aligned} 1 \text{ amu} &= 1.66 \times 10^{-24} \text{ gm} \\ 32 \text{ amu} &= 32 \times (1.66 \times 10^{-24}) \text{ gm} \\ &= 53.12 \times 10^{-24} \text{ gm.} \end{aligned}$$

Q Find the mass of 1 molecule of nitrogen (N_2) atom in amu (u) and in grams.

$$\begin{aligned} A \Rightarrow 1. \text{ mass of 1 molecule of nitrogen } (N_2) \text{ in amu.} \\ &= N + N \\ &= 14 + 14 \\ &= 28 u \end{aligned}$$

2. mass of 1 molecule of nitrogen (N_2) in gm.

$$\begin{aligned} 1 \text{ amu} &= 1.66 \times 10^{-24} \text{ gm} \\ 28 \text{ amu} &= 28 \times (1.66 \times 10^{-24}) \text{ gm} \\ &= 46.48 \times 10^{-24} \text{ gm.} \end{aligned}$$

* Formula mass

→ Formula mass of a substance is the sum of atomic masses of atoms present in the formula.

Q. Find - The formula mass.

1. NaCl

$$\text{Na} = 23$$

$$\text{Cl} = 35.5$$

→ NaCl

$$= 23 + 35.5$$

$$= 58.5 \text{ u}$$

2. $\text{Cu}(\text{NO}_3)_2$

$$\text{Cu} = 63.5$$

$$\text{N} = 14$$

$$\text{O} = 16$$

→ $\text{Cu}(\text{NO}_3)_2$

$$= 63.5 + 2(14 + 3 \times 16)$$

$$= 63.5 + 2(14 + 48)$$

$$= 63.5 + 2 \times 62$$

$$= 63.5 + 124$$

$$= 187.5 \text{ u}$$

3. CaSO_4

$$\text{Ca} = 40$$

→ CaSO_4

$$\text{S} = 32$$

$$= 40 + 32 + 4 \times 16$$

$$\text{O} = 16$$

$$= 72 + 64$$

$$= 136 \text{ u}$$

Q. Calculate

1. The number of moles and molecules of 5.6 gm of urea?



molecular mass of NH_2CONH_2 (urea)

$$= 14 + 2 \times 1 + 12 + 16 + 14 + 2 \times 1$$

$$= 14 + 2 + 28 + 14 + 2$$

$$= 16 + 28 + 16$$

$$= 60 \text{ gm u}$$

$$\therefore \text{molar mass of urea} = 60 \text{ g/mol}$$

$$\text{Number of moles} = \frac{\text{Given mass}}{\text{molecular mass}}$$

$$= \frac{5.6 \text{ gm}}{60 \text{ gm mol}^{-1}}$$

$$= 0.0933 \text{ mol}$$

$$\begin{aligned} \text{Number of molecules} &= \text{Number of moles} \times N_A \\ &= 0.0933 \times 6.022 \times 10^{23} \\ &= 5.618 \times 10^{22} \text{ molecules} \end{aligned}$$

Ans.: Number of moles = 0.0933 mol

Number of molecules = 5.618×10^{22} molecules

2. The ~~the~~ number of moles and molecules of 22 gm of CO_2 ?

$$\begin{aligned} \Rightarrow \text{Molecular mass of } \text{CO}_2 \text{ (carbon dioxide)} \\ &= 12 + 2 \times 16 \\ &= 12 + 32 \\ &= 44 \text{ u} \end{aligned}$$

$$\therefore \text{molar mass of } \text{CO}_2 = 44 \text{ g/mol}$$

$$\text{Number of moles} = \frac{\text{Given mass}}{\text{molecular mass}}$$

$$= \frac{22 \text{ gm}}{44 \text{ g mol}^{-1}}$$

$$= 0.5 \text{ mol}$$

$$\begin{aligned} \text{Number of molecules} &= \text{Number of moles} \times N_A \\ &= 0.5 \times 6.022 \times 10^{23} \\ &= 3.011 \times 10^{23} \text{ molecules} \end{aligned}$$

3. The number of moles and molecules of 22 gm of acetic acid CH_3COOH .

$$\begin{aligned} \text{Ans. molecular mass of } \text{CH}_3\text{COOH} \\ &= 2 \times \text{C} + 4 \times \text{H} + 2 \times \text{O} \\ &= 2 \times 12 + 4 \times 1 + 2 \times 16 \\ &= 24 + 4 + 32 \\ &= 60 \text{ u} \end{aligned}$$

$\therefore$ molar mass of $\text{CH}_3\text{COOH} = 60 \text{ g/mol}$

1. No. of moles in $\text{CH}_3\text{COOH} = \frac{\text{Given mass}}{\text{molar mass}}$

$$= \frac{22 \text{ gm}}{60 \text{ gm mol}^{-1}}$$

$$= 0.367 \text{ mol}$$

2. No. of molecules in $\text{CH}_3\text{COOH} = \text{no. of moles} \times N_A$

$$= 0.367 \times 6.022 \times 10^{23}$$

$$= \cancel{2.207} \times 10^{23}$$

$$2.22814 \times 10^{23}$$

$\therefore$ No. of moles in $\text{CH}_3\text{COOH} = 0.36 \text{ moles}$

No. of molecules in $\text{CH}_3\text{COOH} = \cancel{2.207 \times 10^{23}} \quad 2.23 \times 10^{23}$

4. The no. of moles and molecules of $(\text{NH}_3)_g$ in a volume of 67.2 dm³

→ No. of moles = $\frac{\text{Given volume}}{\text{Volume in STP}}$

$$= \frac{67.2}{22.4}$$

$$= 3 \text{ moles}$$

No. of molecules = No. of moles $\times N_A$

$$= 3 \times 6.022 \times 10^{23}$$

$$= 18.066 \times 10^{23}$$

$$= 18.07 \times 10^{23} \text{ molecules}$$

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