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1. SOME BASIC CONCEPTS OF CHEMISTRY

Properties of matter (Physical)

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

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

eg:- $0.001 = 1 \times 10^{-3}$
$2.123 = 2123 \times 10^{-2}$

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
$1\,nm = 10^{-9}\,m$
$1\,pm = 10^{-12}\,m$

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

4. Density $= \frac{mass}{volume} = \frac{kg}{L}$ or $\frac{kg}{dm^3} = kgL^{-1}$

$= \frac{g}{cm^3} = gL^{-1} = gm \cdot m^{-1}$

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5. Temperature :- Temperature is measured in °C (degree celsius), °F (degree Fahrenheit) and K (Kelvin).

Relation between °C and K is $\boxed{K = °C + 273.15}$

Relation between °C and °F is $\boxed{°F = \frac{9}{5}(°C) + 32}$

Q) Convert the following °C temperature to K and °F.

1.) 40°C

$\therefore K = °C + 273$

$= 40 + 273$

$= 313\ K$

$°F = \frac{9}{5}(°C) + 32$

$= \frac{9}{\cancel{5}_{1}} \times \cancel{40}^{8} + 32$

$= 72 + 32$

$= 104°F$

2.) 30°C

$K = °C + 273$

$= 30 + 273$

$= 303K$

$°F = \frac{9}{5}(°C) + 32$

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

$= 54 + 32$

$= 86°F$

3) 37°C

$K = °C + 273$

$= 37 + 273$

$= 310\ K$

$°F = \frac{9}{5}(°C) + 32$

$= \frac{9}{\cancel{5}_{1}} \times \overset{7.4}{37} + 32$

$= 66.6 + 32$

$= 98.6°F$

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* 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 proportion of elements by weight, irrespective of its source either natural or synthetic (man-made).

Eg:- Scientist Joseph Proust performed experiment of two samples of cupric carbonate ($Cu_2(CO_3)$). 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

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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.

Eg i) Hydrogen + Oxygen ⟶ Water

H_2	$1/2\,O_2$	H_2O
2g	16g	18g

ii) Hydrogen + Oxygen ⟶ Hydrogen peroxide

H_2	O_2	H_2O_2
2g	32g	34g

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 is 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.

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

$$Nitrogen_{(g)} + Hydrogen_{(g)} \longrightarrow Ammonia_{(g)}$$

$$N_2 \qquad 3H_2 \qquad 2NH_3$$

1L (1 vol) | 3L (3 vol) | 2L (2 vol)

Volume ratio is 1 : 3 : 2

* Avogadro Law

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

Eg :-> $H_2 + O_2 \longrightarrow H_2O$

100 mL | 50 mL | 100 mL

(2 vol) | (1 vol) | (2 vol)

∴ 2 molecules | 1 molecule | 2 molecules

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

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

A ⟹ 1. mass of 1 molecule of oxygen (O_2) in amu

$= 0 + 0$

$= 16 + 16$

$= 32\ u$

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

$1\ amu = 1.66 \times 10^{-24}\ gm$

$32\ amu = 32 \times (1.66 \times 10^{-24})\ gm$

$= 53.12 \times 10^{-24}\ gm.$

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

A ⟹ 1. mass of 1 molecule of nitrogen (N_2) in amu.

$= N + N$

$= 14 + 14$

$= 28\ u$

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

$1\ amu = 1.66 \times 10^{-24}\ gm$

$28\ amu = 28 \times (1.66 \times 10^{-24})\ gm$

$= 46.48 \times 10^{-24}\ gm.$

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* Formula mass

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

Q. Find - The ~~form~~ formula mass.

1. NaCl

Na = 23

Cl = 35.5

→ NaCl

= 23 + 35.5

= 58.5 u

2. $Cu(NO_3)_2$

Cu = 63.5

N = 14

O = 16

→ $Cu(NO_3)_2$

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

$= 63.5 + 2(14 + 48)$

$= 63.5 + 2 \times 62$

$= 63.5 + 124$

$= 187.5$ u

3. $CaSO_4$

Ca = 40

S = 32

O = 16

→ $CaSO_4$

$= 40 + 32 + 4 \times 16$

$= 72 + 64$

$= 136$ u

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Q. Calculate

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

$\Longrightarrow$ Urea $\Rightarrow$ NH_2CONH_2

molecular mass of NH_2CONH_2 (urea)
$= 14 + 2\times1 + 12 + 16 + 14 + 2\times1$
$= 14 + 2 + 28 + 14 + 2$
$= 16 + 28 + 16$
$= 60$ ~~gm~~ u

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

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

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

$= 0.0933$ mol

Number of molecules = Number of moles $\times N_A$
$= 0.0933 \times 6.022 \times 10^{23}$
$= 5.618 \times 10^{22}$ molecules

Ans.: Number of moles = 0.0933 mol
Number of molecules = 5.618×10^{22} molecules

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

$\Rightarrow$ Molecular mass of CO_2 (carbon dioxide)
$= 12 + 2 \times 16$
$= 12 + 32$
$= 44\ u$

$\therefore$ molar mass of urea $= 44$ g/mol

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

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

$= 0.5$ mol

Number of molecules = Number of moles $\times N_A$
$= 0.5 \times 6.022 \times 10^{23}$
$= 3.011 \times 10^{23}$ molecules

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

Ans. molecular mass of CH_3COOH
$= 2 \times C + 4 \times H + 2 \times O$
$= 2 \times 12 + 4 \times 1 + 2 \times 16$
$= 24 + 4 + 32$
$= 60\ u.$

∴ molar mass of CH_3COOH = 60 g/mol

1. No. of moles in CH_3COOH = $\frac{\text{Given mass}}{\text{molar mass}}$

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

= 0.367 mol

2. No. of molecules in CH_3COOH = no. of moles × N_A

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

= ~~2.201~~ 2.22814×10^{23}

∴ No. of moles in CH_3COOH = 0.36 moles

No. of molecules in CH_3COOH = ~~2.168 × 10^23~~ 2.23×10^{23}

4. The no. of moles and molecules of $(NH_3)_g$ in a volume of 67.2 dm

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

= $\frac{67.2}{22.4}$

= 3 moles

No. of molecules = No. of moles × N_A

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

= 18.066×10^{23}

= 18.07×10^{23} molecules

——— X ———