28/06/17

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Mole : Mole is an amount of substance that has ~~or~~ as many species (atoms / molecule / ions / electrons / protons / neutron etc) as atoms present in 12 g of C-12 isotope.

$$1 \text{ mole} = 6.022 \times 10^{23} = N_A$$

mass of 1 atoms of C-12 = 1.992648×10^{-23} g (spectroscope)

1.992648×10^{-23} g of C-12 has = 1 atom

1 g of C-12 has = $\frac{1}{1.992648 \times 10^{-23}}$ atoms

12 g of C-12 has = $\frac{1}{1.992648 \times 10^{-23}} \times 12$

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

Calculation of mole :- 3 type

Type - I If mass is given

no. of mole, $n = \frac{\text{mass given (g)}}{\text{molar Mass}}$ $\boxed{n = \frac{w}{M}}$

Ques Find no. of moles in

(1) 12 g of H_2 $n = \frac{w}{M}$ $n = \frac{12\text{g}}{12\text{g/mol}} = 6 \text{ mol}$

(2) 2 g of H $n = \frac{2}{1} = 2 \text{ mol}$

(3) 4 g of He $n = \frac{4}{4} = 1 \text{ mol}$

$H_2N-\underset{\underset{O}{\|}}{C}-NH_2$

(4) 180 g of urea $n = \frac{180\,g}{60\,g/mol} = 3\,mol$

(5) 13.2 g of CO_2 $n = \frac{13.2}{440} = \frac{132}{4400} = \frac{33}{1100} = 0.3$

(6) 24 mg of O_3 $n = \frac{24 \times 10^{-3}}{48} = 0.5 \times 10^{-3}$
$= 5 \times 10^{-4}$

(7) 1.6 Kg of SO_2 $n = \frac{1.6 \times 10^3}{64} = \frac{1}{40} \times 10^3$
$= 0.25 \times 10^2$
$= 25\,mol$

32
32
64

Ques Find mass of

(1) 4 mol of NH_3

$n = \frac{w}{M}$ $\quad M = 14+3 = 17$

$4 = \frac{w}{17}$

$w = 17 \times 4 = 68\,g$

(2) 0.25 mole of He

$w = M \times n$
$= 4 \times 0.25 = 1$ g

(3) 5 m mole of CO_2

$w = M \times n$
$= 44 \times 5 \times 10^{-3}$
$= 220 \times 10^{-3}$ g $= 0.220$ g

44
5
220

(4) 20 mole of O_3 in kg

$w = M \times n$
$= 48 \times 20 = 960$ g
$= \frac{960}{1000} = 0.960$ kg

Type-2 II If no. of particles is given

1 mole = 6.022×10^{23}

$6.022 \times 10^{23} \longrightarrow 1$ mol

$1 \longrightarrow \frac{1}{6.022 \times 10^{23}}$ mol

$N \longrightarrow \frac{1}{6.022 \times 10^{23}} \times N$ mol

($6.022 \times 10^{23} = N_A$)

$= \frac{N}{N_A}$

no. of moles, $n = \frac{\text{no. of particles given } (N)}{6.022 \times 10^{23}}$

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

Ques Find no. of moles in a sample of

(1) 6.022×10^{26} atoms of ~~Ne~~ He

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

$= \frac{6.022 \times 10^{26}}{6.022 \times 10^{23}} = 10^3$ mol

(2) 3.011×10^{21} molecules of O_2

$n = \frac{3.011 \times 10^{21}}{6.022 \times 10^{23}} = \frac{1}{2} \times \frac{1}{10^2}$

$= 0.5 \times 10^{-2}$

$= 5 \times 10^{-3}$

(3) 1.5×10^{25} ~~moles~~ molecules of NH_3

$n = \frac{1.5 \times 10^{25}}{6.022 \times 10^{23}} = \frac{1}{4} \times 10^2 = 0.25 \times 10^2$

$= 25$ mol

(4) 6.022×10^{24} atoms of O in oxygen gas cylinder.

Oxygen gas = O_2

1 molecule of O_2 = 2 atoms

2 atoms of oxygen = 1 molecule of O_2

1 atom = $\frac{1}{2}$ molecule of O_2

6.022×10^{24} = $\frac{1}{2} \times 6.022 \times 10^{24}$

$n = \frac{1/2 \times 6.022 \times 10^{24}}{6.022 \times 10^{23}} = \frac{10}{2}$

= 5 mol of O_2

Ques Find mass of

(1) 6.022×10^{25} molecules of O_3

$n = \frac{W}{M} = \frac{N}{N_A}$

$\frac{W}{48} = \frac{6.022 \times 10^{25}}{6.022 \times 10^{23}}$

$W = 10^2 \times 48 = 4800\ g$

(2) 3.011×10^{22} atoms of He

$\frac{W}{4} = \frac{3.011 \times 10^{22}}{6.022 \times 10^{23}}$

$W = \frac{1}{2} \times \frac{1}{10} \times 4$

$= 2 \times 10^{-1} = 0.2\ g$

(3) 1.5×10^{26} molecules of SO_2 (in Kg)

$\frac{32}{32}$
$\frac{64}{64}$

$$\frac{W}{64} = \frac{1.5 \times 10^{26}}{6.022 \times 10^{23}}$$

$$\frac{W}{64} = \frac{1}{4} \times 10^3$$

$$W = \frac{64}{4} \times 10^3 = 16 \times 10^3 = 16000\,g$$

$$= 16\,Kg$$

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Ques 4.8 g ozone sample is given Find
(i) no. of molecules of ozone
(ii) no. of atoms.

$$n = \frac{4.8}{48} = \frac{1}{10} = 0.1 \text{ mol of } O_3$$

(i) no. of molecules of O_3 $= 0.1\,N_A$

$$= 0.1 \times 6.022 \times 10^{23}$$

$$= 6.022 \times 10^{22}$$

(ii) no. of atoms $= 3 \times 0.1\,N_A$

$$= 0.3\,N_A$$

1 molecules of O_3 = 3 atoms of O

$0.1\,N_A$ $= 3 \times 0.1\,N_A$ atoms of O

$= 0.3\,N_A$ atoms of O

$= 0.3 \times 6.022 \times 10^{23}$ atoms

$= 1.8 \times 10^{23}$ atoms

Ques 132 g of CO_2 Find
(i) no. of moles of CO_2

$$n = \frac{132}{44} = \frac{66}{22} = \frac{33}{11} = 3$$

(ii) no. of molecules of CO_2 = $3N_A$.

(iii) no. of atoms = $3 \times 3N_A = 9N_A$

(iv) no. of O-atoms = $2 \times 3N_A = 6N_A$

(v) no. of molecules of O_2 = $3N_A$

(vi) no. of C-atom = $3N_A$

Ques 12.8 g SO_2 is given Find

(i) no. of moles SO_2

$$n = \frac{12.8}{640} = \frac{2}{10} = \frac{1}{5}$$

(ii) no. of molecules of SO_2 = $1/5\ N_A$

(iii) no. of atoms = $3 \times 1/5\ N_A = 3/5\ N_A$

(iv) no. of S atoms = $1 \times 1/5\ N_A = 1/5\ N_A$

(v) no. of O-atoms = $2 \times 1/5\ N_A = 2/5 N_A$

(vi) no. of oxygen molecule = $1 \times 1/5\ N_A = 1/5\ N_A$

AIPMT

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Ques find no. of atoms in 4.25 g of NH_3?

$$\frac{4.25}{17} = \frac{\text{no. of atoms}}{N_A} \times \frac{1}{4}$$

$$\frac{4.25}{17} \times N_A = \text{no. of atoms} \times \frac{1}{4}$$

$$4 \times \frac{4.25}{17} \times N_A = \text{no. of atoms}$$

$$4 \times \frac{1}{4} N_A =$$

no. of atoms $= N_A$

no. of H-atoms $= 3 \times 0.25\, N_A = 0.75\, N_A$

no. of e^- $= 10 \times \frac{1}{4} N_A = \frac{5}{2} N_A$

no. of proton $= 10 \times 0.25\, N_A$

no. of neutrons $= 7 \times 0.25\, N_A$

Ques 3.6 g of NH_4^+ is given then Find

(i) total atoms $5 \times 1/5\, N_A = N_A$

(ii) total atoms of H $4 \times 1/5\, N_A$

(iii) no. of e^- $= 10 \times 0.2\, N_A$

(iv) no. of protons $= 11 \times 0.2\, N_A$

(v) no. of neutrons $= 7 \times 0.2\, N_A$

$$n = \frac{3.6}{180} = \frac{2}{10} = \frac{1}{5} = 0.2$$

$1e^{\ominus} = 1.6 \times 10^{-19} C$

$C_{12}H_{22}O_{11}$ = 342
= 144 + 22 + 176
= 12×12 + 22×1 + 11×16

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Ques 3.42 g sucrose is given Find

(i) no. of molecules of ~~SO_2~~ sucrose $0.01 N_A$

(ii) no. of C-atoms $12 \times 0.01 N_A$
$= 0.12 N_A$

(iii) no. of O-atoms $11 \times 0.01 N_A$
$= 0.11 N_A$

(iv) no. of H atoms $22 \times 0.01 N_A$
$= 0.22 N_A$

$n = \frac{3.42}{342} = \frac{1}{100} = 0.01$

Ques 4.2 g of N^{-3} sample is given then find

(i) no. of ions.

~~$n = $ no. of ions / N_A mass 4.2 / 17~~

$14g + 3 \times 9.1 \times 10^{-28} g$

$N \xrightarrow{e^-} N^- \xrightarrow{e^-} N^{-2} \xrightarrow{e^-} N^{-3}$

$n = \frac{4.2}{14} = 0.3$ mol of N^{-3}

no. of ions $= 0.3 N_A$

IIT & AIPMT

(ii) no. of electron $= 10 \times 0.3 N_A = 3 N_A$

(iii) no. of proton $= 7 \times 0.3 N_A$

(iv) Find total charge in coulomb

$Q = n_{ion} \times$ charge on one e^- (3e)

$Q = ne$

$= 0.3 N_A \times 1.6 \times 10^{-19} C \times 3$

$= 0.3 \times 6.022 \times 10^{23} \times 1.6 \times 10^{-19} C^{\times 3} =$ ~~28.9×10^4~~

Ques Find no. of atoms, e^-, protons & neutrons in

(i) 0.6 g of $^{12}_{6}C$ (ii) 2 g of He

(iii) 4 g of H

(i) 0.6 g of $^{12}_{6}C$ (ii) 2 g of He (iii) 4 g of H

$n = \frac{0.6}{120} = \frac{1}{20} = 0.05$ $n = \frac{2}{4} = \frac{1}{2} = 0.5$ $n = \frac{4}{1} = 4$

no. of atoms	$= 0.05\ N_A$	$0.5\ N_A$	$4N_A$
no. of e^-	$6 \times 0.05 N_A$	$2/2\ N_A = N_A$	$4N_A$
no. of protons	$= 6 \times 0.05 N_A$	$2 \times 1/2\ N_A = N_A$	$4N_A$
no. of neutrons	$= 6 \times 0.05 N_A$	$2 \times 1/2\ N_A = N_A$	0

AIEEE

Ques Find no. of e^- in 1.8 g of water ?

$n = \frac{1.8}{18} = \frac{1}{10} = 0.1$ mol

no. of e^- $= 10 \times 0.1\ N_A$

$= 1\ N_A$

IIT

Ques Find no. of moles electrons present in 1 kg sample ?

total mass $= 1$ kg

mass of $1\ e^- = 9.1 \times 10^{-31}$ kg

no. of e^- $= \frac{1\ kg}{9.1 \times 10^{-31}\ kg}$

no. of mole e^- $= \frac{1}{9.1 \times 10^{-31}} \times \frac{1}{N_A}$

$= \frac{1}{9.1 \times 10^{-31} \times 6.022 \times 10^{23}}$

30/06/17

Type-3 If volume of gas is given at STP/NTP:-

STP $T = 0^\circ C$ $P = 1$ bar

$T = 273.15$ K

at STP/NTP, one mole of any gas have = 22.4 L volume

1 mol of H_2 = 22.4 L
1 mol of O_2 = 22.4 L
1 mol of CO_2 = 22.4 L

22.4 L → It is also known as Gram Molar Volume (GMV)

no. of moles, $n = \frac{\text{Volume (in L)}}{22.4\text{ L}}$

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

1 L = 1000 ml
$1 m^3 = 1000$ L
$(100 cm)^3 = 1000$ L
$10^6 cm^3 = 1000$ L
1 L = 1000 cm^3 = 1000 cc
1000 ml = 1000 cc
1 ml = 1 cc

1 L = 1000 ml = 1000 cc = 1 dm^3 = $10^{-3} m^3$

Ques Find no. of moles in

(i) 89.6 L of H_2 gas

$$n = \frac{89.6}{22.4} = 4 \text{ mol}$$

(ii) 2.24 L of O_3 gas

$$n = \frac{2.24}{22.4} \times \frac{10}{100} = \frac{1}{10} = 0.1$$

(iii) 112 ml of CO_2 gas

~~$n = \frac{112}{2240} \times \frac{10}{2} = 5$~~

$$n = \frac{112}{22400} = \frac{1}{200} = 0.5 \times 10^{-2}$$
$$5 \times 10^{-3} \text{ mol}$$

(iv) 56 cc (ml) of SO_2 gas

$$n = \frac{56}{22400} = \frac{1}{4} \times 10^{-2} = 0.25 \times 10^{-2}$$
$$= 2.5 \times 10^{-3}$$

(v) 2.8 m^3 of H_2S

$1\ m^3 = 1000$ L

$$n = \frac{2.8 \times 1000}{22.4} = 125 \text{ mol}$$

Ques A container has 5.6 L of SO_2 gas then find (i) no. of moles

(ii) no. of molecules of $SO_2 = 0.25 N_A$

(iii) no. of atoms $= 3 \times 0.25 N_A$

(iv) no. of Oxygen atom $= 2 \times 0.25 N_A$

$$n = \frac{5.6}{22.4} = \frac{1}{4} = 0.25$$

(iv) no. of e^- $32 \times 0.25 N_A$

(vi) mass of SO_2 64×0.25

Ques 280 cc NH_3 gas is given Find

(i) Total atoms $= 4/80 N_A = 1/20 N_A = 0.05 N_A$

(ii) mass of NH_3 $= 1/80 \times 17$

(iii) no. of e^- $= 10 \times 1/80 N_A$

(iv) no. of H atoms

$$n = \frac{280}{22400} = \frac{28}{2240} = \frac{1}{80}$$

Ques 1 cc NO_2 is given at STP, then

(i) $\frac{1.8}{224} \times 10^{22}$ atoms

(ii) $\frac{1.38}{224} \times 10^{23}$ electrons

(iii) $\frac{6.022}{22400} \times 10^{23}$ molecules

(iv) all

$$n = \frac{1}{22400} = \frac{10^{-3}}{22.4}$$

no. of molecules $= \frac{1}{22400} \times 6.022 \times 10^{23}$

no. of atoms $= 3 \times \frac{1}{22400} \times 6.022 \times 10^{23}$

$= \frac{18}{2240} \times 10^{22}$

$= \frac{1.8}{224} \times 10^{22}$

no. of e^- = $23 \times 10^{-3} \times \frac{1}{22400} \times 6 \times 10^{23}$

$= \frac{138 \times 10^{-3} \times 10^{23}}{22.4}$

$= \frac{1.38 \times 10^{23}}{224}$

Ques A gas has a density of $1.6\ g\ L^{-1}$ then find out (i) volume of ~~1 lit gas~~ 1 mol gas ?
Volume → 22.4 L

(ii) mass of 1 mol gas

1 mol = 22.4 L

1 L → 1.6 g

22.4 L → 1.6 × 22.4 g

$d = 1.6\ g/L$

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

$m = d \times V$

$= 1.6 \times 22.4 = 35.84\ g$

224
1.6
1344
224×
3584

Ques An unknown gas has $1.96\ g\ L^{-1}$ density then gas is

(i) CO_2 (ii) CO (iii) NO_2 (iv) SO_2

$d = 1.96\ g\ L^{-1}$

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

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

$m = d \times V$

$= 1.96 \times 22.4$

$= 44\ g$

AIEEE

Ques Find no. of moles in 1.8 ml of H_2O ?

$n = \frac{1.8}{22.4} \times 10^{-3}$ moles × only for gas

$d_{H_2O} = 1\ g/ml$ $V = 1.8\ ml$ $m = d \times V = 1 \times 1.8 = 1.8\ g$

$$n = \frac{W}{M} = \frac{N}{N_A} = \frac{V(L)}{22.4}$$

$$1\,L = 1000\,mL = 1000\,cc = 1\,dm^3 = 10^{-3}\,m^3$$

(ii) Find no. of $e^{\ominus}$

(i) $n = \frac{W}{M} = \frac{1.8}{18} = 0.1\ mol$

(ii) no. of el^- $= 10 \times 0.1\ N_A = N_A$

Ques An unknown gas having mass 8 g is present in a container of 44.8 L. Find
(i) unknown gas
(ii) no. of atoms in gas.

(i) $\frac{8}{M_W} = \frac{44.8}{22.4}\ 2$

$\frac{8}{2} = M_W = 4$

He = 4

(ii) $n = \frac{44.8}{22.4} = 2$

no. of atoms $= 2N_A$

AIIMS

Ques 2.2 g of an unknown gas is present in a container of ~~11.2 L~~ 2.24 L 1.12 L. Then unknown gas is

(i) CO_2 (ii) CO (iii) N_2O ~~(iv) both 1 & 3~~

$\frac{2.24}{22.4} \times \frac{10}{100} = \frac{1}{10} =$

$\frac{1.12}{22.4} \times \frac{10}{100} = \frac{1}{2} \times \frac{1}{10} = 0.05$

$$0.05 = \frac{2.2}{M}$$

$$M = \frac{2.2}{0.05} \times 20 = 44$$

28 + 16
44

Ques 1 mol each of He, N_2 & CO_2 is present in a container ? then find

(i) Ratio of molecules $N_A : N_A : N_A$
$1 : 1 : 1$

(ii) Ratio of atoms $N_A : 2N_A : 3N_A$
$1 : 2 : 3$

(iii) Ratio of vol. $22.4 : 22.4 : 22.4$
$1 : 1 : 1$

(iv) Ratio of no. of $e^{\ominus}$
$2N_A : 14N_A : 22N_A$
$1 : 7 : 11$
$x : y : z$

Ques The no. of molecules of O_2 present in a container is same as that no. of molecules present in 9.6 g SO_2 then Find -

(i) no. of moles of O_2 = 0.15
(ii) no. of atoms of O → $2 \times 0.15\ N_A$
(iii) Volume of O_2 → 0.15×22.4 L

no. of molecules of SO_2 : $x = \frac{3}{20} \times N_A$

$x = \frac{3}{20} \times N_A = 0.15\ N_A$

Ques No. of O-atoms present in CO is same as that of O-atoms present in 8.8 g of CO_2 then find

(i) no. of moles of CO = 0.4 mol

(ii) Total atoms = $2 \times 0.4 N_A$

(iii) Volume of CO = 22.4×0.4

$$n_{CO_2} = \frac{8.8}{44} = 0.2 \text{ mol}$$

no. of molecules CO_2 = $0.2 N_A$

no. of atom of O in CO_2 = $2 \times 0.2 N_A$

no. of O-atom in CO = $2 \times 0.2 N_A$

no. of molecules of CO = $2 \times 0.2 N_A$

$$n = \frac{N}{N_A} = \frac{0.4 N_A}{N_A} = 0.4$$

Ques The no. of molecules of O_2 present in a container is same as that no. of atoms present in 9.6 g O_3 then Find-

(i) no. of moles of O_2 → 3/5

(ii) no. of atoms of O → $2 \times \frac{3}{5} N_A$

(iii) Vol. of O_2 → $\frac{3}{5} \times 22.4 = 67.2$ $\frac{48}{5} = 13.4$

$$n = \frac{3 \times 9.6}{480} 2 N_A = \frac{6}{10} N_A$$

Ques In a mixture of gas, a gas 'X' is present 0.56 % then Find no. of moles 'x' gas present in 1L mixture.

100 L mixture contain = 0.56

$= 5.6 \times 10^{-1}$

1 L mixture contain = $\frac{5.6 \times 10^{-1}}{100}$ L

$= 5.6 \times 10^{-3}$ L

$n = \frac{5.6 \times 10^{-3}}{22.4} = \frac{1}{4} \times 10^{-3}$

$= 2.5 \times 10^{-4}$ L

$= 0.25$ mL

Ques ~~Fin~~ Which of the following has maximum no. of atoms?

(i) 27g Al (27) (ii) ~~Ag~~tte 24g C (12) (iii) 56g Fe (56)

(iv) 1.8 Ag (108)

(i) $\frac{27}{27} \times 1 \times N_A = N_A$ (ii) $\frac{24}{12} \times 1 \times N_A = 2N_A$ (iii) $\frac{56}{56} \times 1 \times N_A = N_A$

Ques which of the following has maximum no. of atoms?

(i) 16g of H_2 (ii) 132g of CO_2 (iii) 96 of O_3 (iv) 1.6g of O_2

$n = 8$ $n = 3$ $n = 2$ $n = \frac{1.6}{32} = 0.05$

no. of molecule	$8N_A$	$3N_A$	$2N_A$	$0.05N_A$
no. of atoms	$16N_A$	$9N_A$	$6N_A$	$0.1N_A$

Ques ~~Whe~~ Which has max atoms.

(i) 6.022×10^{24} atoms of C → 10 mol

(ii) 44.8 L of CO_2 $n = 2$

(iii) 12g of H_2 $n = 6$

(iv) 4 moles of O_2 $8N_A$

3/7/17

Ques 2.4 g of oxygen is present in how many mass of $CaCO_3$?

1 mole of $CaCO_3$ (= 100 g $CaCO_3$) has = 48 g oxygen

48 g oxygen is present in = 100 g $CaCO_3$

1 g " " " " = $\frac{100}{48}$ g $CaCO_3$

2.4 g " " " " = $\frac{100}{48} \times 2.4$ $CaCO_3$

= 5 g $CaCO_3$

Ques Find mass of

(i) 1 atom of C

(ii) 4 atom of C

(iii) 1 molecule of H_2

(iv) 5 molecule of CO_2

1 mole C = 12 g

6.022×10^{23} atoms of C = 12 g

(i) 1 atom = $\frac{12}{6.022 \times 10^{23}}$ g

(ii) 4 atom of C = $\frac{12 \times 4}{6.022 \times 10^{23}}$

(iii) 1 ~~mole~~ molecule of H_2

N_A molecules of H_2 ⟶ 2 g

1 molecule of H_2 ⟶ $\frac{2}{N_A}$

(iv) N_A molecule of CO_2 ⟶ 44 g

1 molecule of CO_2 ⟶ $\frac{44}{N_A}$ g

Concepts of atoms & molecules

Atom :- Atom is the smallest particle of ~~matter~~ an element which takes part in chemical reaction.

eg H, C, N, O, F, Fe, Ne

~~Formed by~~

Molecule :- It is formed by combination of two or more than two atom.

eg H_2, N_2, O_2, CO, CO_2, H_2O, H_2O_2, H_2SO_4

Standard :- C-12 atom

- easily available
- not very reactive
- not inert
- easily separable from isotopes
- $\frac{1}{12}$ of wt of C-12 atom is comparable to wt. of H-atom (lightest atom)

Atomic Mass unit (amu) : or unified mass (u)

$$\boxed{1\text{ amu} = \frac{1}{12}\,(\text{wt. of C-12 atom})}$$

wt. of 1 atom of C-12 atom = 1.992648×10^{-23} g (spectrometer)

$$1\text{ amu} = \frac{1}{12} \times 1.992648 \times 10^{-23}\text{ g}$$

$$\boxed{1\text{ amu} = 1.66056 \times 10^{-24}\text{ g}}$$

or

1.67×10^{-24} g

Wt. of H atom = $\frac{1.6736 \times 10^{-24} g}{1.66056 \times 10^{-24} g} \approx 1.008 amu$

$\simeq 1 amu$

$\simeq 1 u$

Wt. of O-atom = 15.9995 $\simeq$ 16 u

Wt of C atom $\simeq$ 12 u

wt. of N-atom = 14 u

~~Gram~~ Atomic mass (~~GMS~~ GAM) ~~or~~ :-

It is defined as the no. which represent how many times mass of 1 atom of ~~an~~ an element is heavier than ~~mass of~~ 1/12 of mass of C-12 atom.

Gram Atomic Mass (GAM) or Mass of 1g atom :

When atomic Mass is defined in ~~gram~~ grams then it is GAM.

GAM of H = 1g = mass of 1g atom of H

1g H = mass of 1 mol of H = mass of 1g atom of H

GAM of N = 14g = mass of 1g atom of N

14g N = mass of 1 mol of N = mass of 1 g atom of N

1 mol = 1 g atom

Ques Find no. of g atom in

(i) 10 Kg of Ca.

$n = \frac{10 \times 1000}{40} = 250 g$ atom

(iii) 1000 atoms of C

$\frac{1000}{N_A}$ g atom

Molecular Mass :- It is the no. which represent how many times mass of 1 molecule is heavier than 1/12 mass of C-12 atom.

MM of 1 molecule of H_2 = 2 amu = 2u
O_2 = 32 u
CO_2 = 44 u

Gram Molecular Mass (GMM) or Mass of 1g molecule :-

When molecular mass is defined in grams is c/a GMM.

GMM of 1 molecule of H_2 = 2g = mass of 1g molecule of H_2

2g of H_2 = mass of 1 mole H_2 = mass of 1g molecule of H_2

GMM of 1 molecule of N_2 = 28g = mass of 1g molecule of N_2 = mass of 1 mol of N_2

1 mol = 1 g molecule.

04/07/17

Actual Mass :- It is mass of 1 atom or 1 molecule in grams.

Actual mass of H_2 = $\frac{2g}{N_A}$ g

" " of O_2 = $\frac{32}{N_A}$ g

Average Mass :- Calculated for isotope.

Type-1 If isotopes are given in % age

^{35}Cl (75%) ^{37}Cl (25%)

Average mass = $\frac{35 \times 75 + 37 \times 25}{100}$

$= \frac{25(35 \times 3 + 37)}{100\ 4}$

$= \frac{105 + 37}{4}$

$= \frac{142}{4} = 35.5$

35 × 3 = 105

$$\text{aug. Mass} = \frac{M_1X_1 + M_2X_2 + \cdots}{X_1 + X_2}$$

Type-2 If isotopes are given in fraction

^{35}Cl (0.75) & ^{37}Cl (0.25)

Avg Mass = $M_1f_1 + M_2f_2 + M_2f_3$

Avg Mass = $35 \times 0.75 + 37 + 0.25 = 35.5$

Ques ^{200}X (90%), ^{201}X (8%), ^{202}X (2%)
Find average Mass of X

$$= \frac{200 \times 90 + 201 \times 8 + 202 \times 2}{100}$$

$$= \frac{2(200 \times 45 + 201 \times 4 + 202)}{100}$$

$$\frac{2(9000 + 802 + 202)}{50}$$

$$\frac{10004}{50} = 200.$$

9000
802
202
10004

Ques ^{199}X (90%), ^{200}X (8%), ^{202}X (2%)
find avg mass of X ? $\frac{199 \times 90 + 200 \times 8 + 202 \times 2}{100}$

$\frac{199 \times 90 + 1600 + 404}{100} = \frac{17910 + 2004}{100}$

(i) 200 u (ii) 199 u (iii) 202 u (iv) 196 u
199.05 $\frac{19914}{100} = 199.14$

Law of Chemical Combination :-

1. Law of Mass Conservation
2. Law of definite Proportion
3. Law of Multiple Proportion
4. Law of Gaseous Volume
5. Avagadro's Law

Law of mass conservation :- Lavoisier Acc^{n} to this law, mass can be neither created nor destroyed in a chemical or physical reac^{n} but can be converted into one form to another.

* This law is not follow in nuclear reactions

→ If reactant is converted into product completely.
Mass of reactant = Mass of Product

eg
$$C + O_2 \longrightarrow CO_2$$
12g 32g 44g
44g

eg
$$N_2 + 3H_2 \longrightarrow 2NH_3$$
28g 6g 34g

eg
$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$
50g 28g ? 22g

→ If reactant is not completely converted into product then
Mass of reactant = mass of product formed + mass of reactant left

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$
100g 28g 22g
↓
50g left

Law of definite proportion :- Proust Acc^{n} to this law, ratio of components by weight remains same, no ~~matter~~ matter what is the source of component or method of preparation.

eg

	H_2O	H : O
rainy water		2 : 16
sea water		2 : 16
Mineral water		2 : 16
tap water		2 : 16

C : O

$C + O_2 \longrightarrow \boxed{CO_2}$ 12 : 32

$CaCO_3 \xrightarrow{\Delta} CaO + \boxed{CO_2}$ 12 : 32

Law of Multiple Proportion :-

* not valid in isotopes.

	H	:	O	
H_2O	2	:	16	1 : 2
H_2O_2	2	:	13	

	CO	CO_2	
C	12	12	C → fix
O	16 :	32	
	1 :	2	

	N_2O	NO	N_2O_3	N_2O_4	N_2O_5
N	28	14×2=28	28	28	28
O	16 :	16×2=32 :	48 :	64 :	80
	1 :	2 :	3 :	4 :	5

Ques Which of the following prove law of multiple proportion?

(i) H_2SO_4 , H_2S

(ii) CCl_4 , CH_4

(iii) H_2O & H_2O

(iv) N_2O , NO

Ques Which of the following doesn't follow Law of Multiple Proportion?

(i) $SnCl_2$, $SnCl_4$

(ii) PbO , PbO_2

(iii) $FeCl_2$, $FeCl_3$

(iv) HCl , $NaCl$

5/7/[illegible]

Law of Gaseous Volumes Gay Lussac Law

In gaseous reactions, at same temp. & Pressure reactants combine with simple ratio of products.

$$H_2 + Cl_2 \longrightarrow 2HCl$$

1 Vol : 1 Vol : 2 Vol

1 L : 1 L : 2 L

1 ml : 1 ml : 2 ml

$$28g\ N_2 + 3H_2 \longrightarrow 2NH_3$$

($3H_2$ → 6g; $2NH_3$ → 34)

1 Vol : 3 Vol : 2 Vol

1 L : 3 L : 2 L

1 ml : 3 ml : 2 ml

$$H_2 + Cl_2 \longrightarrow 2HCl$$

2 L : excess 2 L : ? 4 L

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

excess 10 ml : 30 ml : 20 ml

Avagadro's Law :-

At same T & P, equal volume of all gases contain equal no. of molecules.

$$PV = nRT$$

$$\boxed{V \propto n}$$

H_2	+	Cl_2	⟶	$2HCl$
1 L		1 L		2 L
1 molecule		1 molecule		2 molecule
2 molecule		2 molecule		4 molecule
22.4 L		22.4 L		44.8 L
N_A molecule		N_A molecule		$2N_A$ molecule
1 mol		1 mol		2 mol
2 atom		2 atom		4 atom

Atomicity :- no. of atoms present in 1 molecules.

- O_2 → 2
- He → 1
- CO_2 → 3
- O_3 → 3
- H_2SO_4 → 7

Vapour density :-

$$V.D. = \frac{\text{density of gas}}{\text{density of } H_2 \text{ gas at same T \& P}}$$

$$= \frac{d_{gas}}{d_{H_2} \text{ at same T \& P}}$$

→ unitless

→ $d_{H_2} = 0.000089$ g/ml

$d_{H_2} = 9 \times 10^{-5}$ g/ml

$$V.D. = \frac{\text{mass of gas at Vol. V}}{\text{mass of } H_2 \text{ at same V \& same T \& P}}$$

$$V.D. = \frac{\text{mass of N molecules of gas}}{\text{mass of N molecules of } H_2 \text{ gas}}$$

$$V.D. = \frac{N \times \text{mass of 1 molecule of gas}}{N \times \text{mass of 1 molecule of } H_2}$$

$$\boxed{V.D. = \frac{Mw}{2}}$$

$$\boxed{M.W. = 2 \times V.D.}$$

$$\boxed{\text{Relative density} = \frac{(d_{gas})_A}{(d_{gas})_B}}$$

Ques $d_{gas} = 3.6 \times 10^{-3}$ g/ml Then gas is
(i) SO_2 (ii) CO_2 (iii) N_2 (iv) SO_3

[Given $d_{H_2} = 9 \times 10^{-5}$ g/ml]

48
32
80

$$Mw = V.D. \times 2$$

$$V.D. = \frac{d_{gas}}{d_{H_2}} = \frac{3.6 \times 10^{-3}}{9 \times 10^{-5}} = \frac{360}{9} = 40$$

$$M.W. = 40 \times 2 = 80$$

Ques (i) If V.D. of a gas is 14. then gas is
(i) CO (ii) NO_2 (iii) N_2 (iv) both 1 & 3

$$Mw = 2 \times 14 = 28$$

Ques V.D. of a gas w.r.t. methane is 4. Then gas is
(i) O_3 (ii) CO_2 (iii) SO_2 (iv) SO_3

$$V.D. = \frac{d_{gas}}{d_{CH_4}} = 4$$

$$\frac{Mw}{Mw \text{ of } CH_4} = 4$$

$$\frac{M.w}{16} = 4$$

$$Mw = 64$$

Ques Mass of 1L of a gas is 1.96g then Find V.D. & Mw. of gas?

1L ⟶ 1.96g

1mol = 22.4 ⟶ $1.96 \times 22.4 \approx 44g$

$Mw = 44$

$$V.D. = \frac{44}{2} = 22$$

Percentage composition :-

$$\text{mass \%} = \frac{\text{mass of element}}{\text{molar mass of comp.}} \times 100$$

$CaCO_3 = 40 + 12 + 3 \times 16 = 52 + 48 = 100$

$$Ca\ \% = \frac{40}{100} \times 100 = 40\ \%$$

$$C \rightarrow \frac{12}{100} \times 100 = 12$$

$$O \rightarrow \frac{48}{100} \times 100 = 48$$

H.W $C_6H_{12}O_6$ → Find % C, % H & % O ?

$$\% C = \frac{6 \times 12}{180} \times 100 = \frac{72 \times 100}{180} = 40\%$$

$$\% H = \frac{12}{180} \times 100 = \frac{2}{3} \times 100 = 0.66 \times 100 = 66\%$$

$$\% O = \frac{96}{180} \times 100 = \frac{16}{3} \times 10 = 5.33 \times 10 = 53.3\%$$

Ques If 3.4% Sulphur is present in insulin then find minimum Molecular Mass of insulin

$$3.4 = \frac{32}{Mw} \times 100$$

$$Mw = \frac{32}{3.4} \times 100$$

$$\frac{3200}{3.4} =$$

S → 32 g

1

For min. mol. mass at least one atom of S should be present

3.4 g ⟶ 100 insulin

1 g ⟶ $\frac{100}{3.4}$

$$32\,g \longrightarrow \frac{100}{3.4} \times 32 = 941\,g$$

Mol Empirical Formula and Molecular Formula :-

Molecular Formula :- It represent exact no. of atoms present in a molecule of compound. eg $C_6H_{12}O_6$, CH_3COOH, H_2O

Empirical Formula : It represent simplest ratio of atoms present in a molecule of compound.

M.F.	E.F
$C_6H_{12}O_6$	CH_2O
CH_3COOH	CH_2O
C_6H_6	CH
C_2H_2	CH
C_2H_4	CH_2
C_2H_6	CH_3
CH_4	CH_4
H_2O	

- M.F. = n X E.F.

n = natural no. = 1, 2, 3 - - -

n = $\frac{\text{Molecular Formula Mass}}{\text{Empirical Formula Mass}}$

	C	H	N
	48 %	10 %	42 %
% / atomic Mass ⇒	$\frac{48}{12} = 4$	$\frac{10}{1} = 10$	$\frac{42}{14} = 3$
ratio	$\frac{4}{3} = 1.33$	$\frac{10}{3} = 3.33$	$\frac{3}{3} = 1$
Simplest ratio	1	3	1

EF = CH_3N

Ques.

	C	H	O
	39 %	7 %	53 %
	$\frac{39}{12} = 3.25$	$\frac{7}{1} = 1$	$\frac{53}{16} = 3.33$
	$\frac{3.25}{3.25} = 1$	$\frac{7}{3.25} = 2.$	$\frac{3.33}{3.25} = 1.$
	1	2	1

If M.W. = 60

$\frac{48}{5}$

E.F. = CH_2O

30

$n = \frac{60}{30} = 2$

M.F. = $n \times$ E.F

= $2 \times [CH_2O]$

= $C_2H_4O_2$

Ques A hydrocarbon contain 85.7 % of C. Find Find M.F. of hydrocarbon if its V.D. is 42

C	H
85.7 %	14.3 %
$\frac{85.7}{120} = 78.14$	$\frac{14.3}{1} = 14.3$
$\frac{8.14}{14.3} = \frac{8140}{1430}$	$\frac{14.3}{14.3}$
$\frac{7.14}{7.14} = 1$	$\frac{14.3}{7.14} \simeq 2$

E.F. = CH_2

14

V.D × 2 = M.W = 42 × 2 = 84

$n = \frac{84}{14} = 6$

M.F. = $n \times$ E.F. = $6 \times CH_2 = C_6H_{12}$

Ques A hydrocarbon contain 80 % of C Find M.F. of hydrocarbon of its V.D. is 15

(i) CH_3 (ii) C_2H_4 (iii) C_2H_6 (iv) C_3H_4

C	H
$\frac{80}{12} = 6.66$	$\frac{20}{1} = 20$
$\frac{6.66}{6.66} = 1$	$\frac{20}{6.66} \simeq 3$

E.F $= CH_3$

M.W. $= 30$

$n = \frac{30}{15} = 2$

M.F. $= 2 \times CH_3$

$= C_2H_6$

Ques A & B forms a compound % of A & B is 50 each Find simplest formula of the compound : If Atomic wt. of A is 20 & B is 40.

A	B
$\frac{50}{20} = 2.5$	$\frac{50}{40} = 1.25$
$\frac{2.5}{1.25} = 2$	$\frac{1.25}{1.25} = 1$

A_2B

Ques X & Y At. wt of X → 30
40 % 60 % At. wt. of Y → 20
then compound is –

① X_3Y_4 ② X_4Y_3 ③ X_9Y_4 ④ X_4Y_9

X

40 %

30

1.33

1.33

Y

60 %

20

3

1.33

$\frac{40}{30}$: $\frac{60}{20}$

$\frac{4}{3}$: $\frac{3}{1}$

4 : 9

Ques Find Empirical formula of 4g Ca 6.022×10^{22} atom of C & 4.8g Oxygen

Ca	C	O
$\frac{4}{40}$	$\frac{6.022 \times 10^{22}}{6.022 \times 10^{23}}$	$\frac{4.8}{160}$
$\frac{1}{10}$	$\frac{1}{10}$	$\frac{3}{10}$
1	1	3

$CaCO_3$

Mole Concept - II

Solution : Homogeneous mixture of 2 or more than component.

Solution component	Solute	Solvent (always 1)
2	1	1
3	2	1
5	4	1

Solution

Solute
which has less amount
(in no. of mole)

Solvent
(Largest amount)
(in no. of moles)

H_2S + H_2O

$\frac{136}{34}$ g — 96 g

$n = 4$ mol — $n = \frac{90}{18} = 5$ mol → solvent

Solute ← Urea + Sucrose + water → Solvent

~~360~~ 360 g — 684 g — 180 g

$n = \frac{360}{60} = 6$ — $n = \frac{684}{342} = 2$ — $n = \frac{180}{18} = 10$ g

* Nature of solution depends upon nature of solvent

Solvent	Soln	
Gas	Gas	$CO_2 + N_2 + O_2$
solid	solid	Fe + Ni
liq.	liq.	H_2O + alcohol.

Concentration Terms :

↓

composition of soln

1. Molarity
2. Molality
3. Mole fraction
4. % composition
   - % w/w
   - % v/v
   - % w/v
5. Parts per million (ppm)
6. Normality

1. **Molarity** : It is the no. of moles of solute present in 1L soln

$$\text{Molarity} = \frac{\text{no. of moles of solute}}{\text{volume of soln (in L)}}$$

$$M = \frac{n}{V_{soln}\,(L)}$$

Unit : $mol\,L^{-1}$

Ques Find molarity of a 6L soln which have 180 g urea ?

$$n = \frac{180}{60} = 3\ mol$$

$$M = \frac{3}{6} = 0.5$$

Ques Find mass of 200 ml 2.5 M H_2SO_4

$$2.5 = \frac{n}{200} \times 1000$$

$$\frac{500}{1000} = n$$

$$0.5 = \frac{1}{2} = n$$

$$0.5 = \frac{w}{98}$$

$$w = 49\ g$$

III

Ques 120 g urea is present in 1L water then find Molarity of the sol^n?

[$d_{sol^n} = 1.12\ g/ml$
$d_{water} = 1\ g/ml$

$$n = \frac{120}{60} = 2$$

$$M = \frac{2}{1} = 2$$

Urea = 120 g

H_2O = 1L = 1000 ml

$d_{H_2O} = 1\ g/ml$

$m_{H_2O} = d \times V = 1 \times 1000 = 1000\ g$

$m_{sol^n} = m_{urea} + m_{H_2O} = 1120\ g$

$d_{sol^n} = 1.12\ g/ml$

$V_{sol^n} = \frac{m_{sol^n}}{d_{sol^n}} = \frac{1120}{1.12} = 1000\ ml = 1L$

$$M = \frac{n_{solute}}{V_{sol^n}(L)} = \frac{2}{1} = 2M$$

Ques 196 g of H_2SO_4 is present in 1 kg water Find molarity of sol^n if $d_{sol^n} = 1.2\ g/ml$

$H_2SO_4 \rightarrow 196\ g$

H_2O = 1kg = 1000 g

$m_{sol} = 196 + 1000 = 1196\ g$

$V_{sol} = \frac{mass\ sol}{d\ sol}$

$= \frac{1196}{1.2} =$

Ques If 6.022×10^{20} molecules of urea is present in 100 ml sol^n then find molarity of sol^n?

(a) 0.1 M (b) 0.02 M (c) 0.01 M (d) 0.001 M

$$M = \frac{6.022 \times 10^{20} / 6.022 \times 10^{23} \times 1000}{100}$$

$$= \frac{1}{10^3 \times 100} \times 1000$$

$$= \frac{1}{100}$$

$$= 0.01\ M$$

7/7/17

Dilution Law :-

→ no. of moles const.

$n = MV = \text{const.}$

$\boxed{M_1V_1 = M_2V_2}$

Ques 68.4 g urea is present in 1L sol^n find the molarity of sol^n if it is diluted 10 times?

$n \rightarrow \text{const}$

$M_1V_1 = M_2V_2$

$1.14 \times 1 = M_2 \times 10$

$M_2 = \frac{1.41}{10} = 0.141\ M$

114
684
600

1.
1L

Ques 180 g urea is present in 4L soln. Find the molarity of soln if it diluted upto to 12 L.

$$\frac{180/60}{4} \times 4 = M_2 \times 12$$

$$\frac{3}{4} \times 4 = M_2 \times 12$$

$$\frac{1}{4} = \frac{3}{12} = M_2$$

$$M_2 = 0.25\ M$$

Mixing of solutions :-

$$\boxed{M_1 \atop V_1} + \boxed{M_2 \atop V_2} = \boxed{n_1+n_2 \atop M_3 (V_1+V_2)}$$

$$\boxed{M_3 = \frac{M_1V_1 + M_2V_2}{V_1+V_2}}$$

Ques JEE Mains 2013

$$\boxed{\begin{matrix} 750\ ml\ of\ 0.5\ M\ HCl \\ + \\ 250\ ml\ of\ 2\ M\ HCl \end{matrix}}$$

Find Molarity

$$M_3 = \frac{0.5 \times 750 + 2 \times 250}{1000}$$

$$= \frac{375 + 500}{1000} = \frac{875}{1000} = 0.875$$

Ques Find the ~~Mor~~ Molarity of soln obtained by mixing of same volume of 2 M & 3 M HCl ?

$$M_3 = \frac{2 \times V + 3 \times V}{2V} = \frac{V(2+3)}{2V}$$

$$= \frac{5}{2} = 2.5M$$

Ques Find volume of 4M & 2M KOH soln to be added 3L of 2.5M KOH soln

$V_1 = V \qquad V_2 = 3 - V$

$$2.5 = \frac{4 \times V + 2 \times (3-V)}{3}$$

$$7.5 = 4V + 6 - 2V$$

$$1.5 = 2V$$

$$V_1 = V = \frac{15}{20} = \frac{3}{4} = 0.75L$$

$V_2 = 3 - V = 3 - 0.75 = 2.25L$

2. Molality : It is defined as no. of moles of solute present in 1Kg of solvent.

$$m = \frac{n_{solute}}{w(kg)}$$

Unit :- $mol\ kg^{-1}$

Ques Find molality of -

(i) 120g urea present in 500g water

$$m = \frac{120/60}{500} \times 1000$$

$$= \frac{2}{500} \times 1000 = 4\ mol\ kg^{-1}$$

(ii) 49 g H_2SO_4 present in 2.5 kg water

$$m = \frac{49/98}{2.5}$$

2+64+32
96+2
98

$$= \frac{1/2}{2.5}$$

$$= \frac{1}{2 \times 2.5} = \frac{1}{5} = 0.2 \text{ mol kg}^{-1}$$

$$= 0.2\ m$$

Ques 180 g urea is present in 1L aq. soln then find molality & molarity of soln
[Given $d_{soln} = 1.18$ g/ml]

$$M = \frac{180/60}{1} = \frac{3}{1} = 3M$$

$m_{soln} = m_{solute} + m_{solvent}$

$m_{soln} = d \times V$

$= 1.18 \times 1 = 1.18$ g/ml $\times$ 1000 ml

$= 1180$ g

$m_{solvent} = 1180 - 180$

$= 1000$ g $= 1$ kg

$$m = \frac{3}{1} = 3 \text{ mol kg}^{-1}$$

Ques 3m NaOH soln has a volume of 1L then find Molarity of soln.
$d_{soln} = 2$ g/ml given
[$V_{soln} \approx V_{solvent}$]

3m
3 mol → 1 kg solvent

$M = \frac{n}{V_{soln}}$

$m = \frac{n}{V_{soln} - V_{solute}}$

$= \frac{n}{V_{soln}} - \frac{n}{V_{solvent}}$

$M = \frac{n}{V_{soln}}$

$V = 1\ L$

$m_{soln} = 2 \times 1000$
$= 2000\ g$
$= 2\ kg$

$m = \frac{n}{W_{solvent}}$

$3 = \frac{n}{2}$

$\boxed{n = 6\ mol}$

$M = \frac{n}{V} = \frac{6}{1} = 6\ M$

Ques Find the molarity of 3m urea soln if density of solvent is 0.8 kg/L (Assume $V_{soln} \approx V_{solvent}$ as soln is very dilute)

$m = 3m$ = 3 mole in 1 kg solvent

$m_{solvent} = 1\ kg$

$d_{solvent} = 0.8\ kg/L$

$V_{solvent} = \frac{m_{solvent}}{d_{solvent}} = \frac{1\ kg}{0.8\ kg/L} = \frac{1}{0.8}$

$= \frac{10}{8} = \frac{5}{4}\ L$

$V_{soln} \approx V_{solvent} = \frac{5}{4}\ L$

$M = \frac{n}{V} = \frac{3}{5/4} = \frac{12}{5}$

3 Mole fraction :- It is the ratio of no. of moles of a ~~compound~~ component to the total moles.

Solute + Solvent

$$X_{solute} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

$$X_{solvent} = \frac{n_{solvent}}{n_{solute} + n_{solvent}}$$

$$X_{solute} + X_{solvent} = \frac{n_{solute}}{n_{solute} + n_{solvent}} + \frac{n_{solvent}}{n_{solute} + n_{solvent}}$$

$$= \frac{n_{solute} + n_{solvent}}{n_{solute} + n_{solvent}}$$

$$\boxed{X_{solute} + X_{solvent} = 1}$$

Ques 44 g CO_2 + 48 g O_2 find X_{CO_2} & X_{O_2}

$$n_{CO_2} = \frac{44}{44} = 1$$

$$n_{O_2} = \frac{48}{32} = \frac{3}{2}$$

$$X_{CO_2} = \frac{1}{2.5} = \frac{2}{5}$$

$$X_{O_2} = \frac{1.5}{2.5} = \frac{3}{5}$$

Ques 42 g N_2 + 3.011×10^{24} molecules of O_3 + 120 g SO_3

X_{N_2}, X_{O_3}, X_{SO_3} = ?

$$n_{N_2} = \frac{42}{28} = \frac{21}{14} = \frac{3}{2}$$

$$n_{O_3} = \frac{3.011 \times 10^{24}}{6.022 \times 10^{23}} = \frac{1}{2} \times 10$$

$$= 5$$

$$n_{SO_3} = \frac{120}{80} = \frac{3}{2}$$

$$X_{N_2} = \frac{3/2}{8}$$

$$X_{O_3} = 5/8$$

$$X_{SO_3} = \frac{3/2}{8}$$

Ques 6.022×10^{22} atoms of He + 13.2 g of CO_2 + 11.2 L of O_2 &

$$n_{He} = \frac{6.022 \times 10^{22}}{6.022 \times 10^{23}} = \frac{1}{10} = 0.1$$

$$n_{CO_2} = \frac{13.2}{44.0} = \frac{3}{10} = 0.3$$

$$n_{O_2} = \frac{11.2}{22.4} = \frac{1}{2} = 0.5$$

$$X_{He} = \frac{0.1}{0.9} = \frac{1}{9}$$

$$X_{CO_2} = \frac{0.3}{0.9} = \frac{3}{9}$$

$$X_{O_2} = \frac{0.5}{0.9} = \frac{5}{9}$$

AIEEE

Ques Mole fraction of urea in aq. sol^n is 0.25 then find molality of sol^n.

$$X_{urea} = \frac{n_{urea}}{n_{urea} + n_{H_2O}} = 0.25$$

$$X_{H_2O} = \frac{n_{H_2O}}{n_{urea} + n_{H_2O}} = 0.75$$

$$\frac{n_{urea}}{n_{H_2O}} = \frac{0.25}{0.75} = \frac{1}{3}$$

$$m = \frac{n_{urea}}{18 \times \left(\frac{W_{H_2O}}{18}\right)} \times 1000$$

$$m = \frac{n_{urea}}{18 \times n_{H_2O}} \times 1000$$

AIPMT - 11

Ques Find mole fraction of solute in 1 m aq. sol'n ?

① 0.0177 ② 0.107 ③ 0.177 ④ 0.288

1 m → 1 mol of solute present in 1 kg of solvent (H_2O)

$$X_{solute} = \frac{n_{solute}}{n_{solute} + n_{H_2O}} = \frac{1}{1 + n_{H_2O}} = \frac{1}{1 + 55.5}$$

$$n_{H_2O} = \frac{1000}{18} = 55.5$$

$$= \frac{1}{56.5} = \frac{10}{565} = \frac{2}{113} = 0.01$$

Concentration in terms of % :-

$$\%\ \frac{W}{W} \text{ of solute} = \frac{\text{wt. of solute}}{\text{wt. of soln}} \times 100$$

20% w/w NaOH soln
20 g NaOH present in 100 g soln

$$\%\ V/V \text{ of solute} = \frac{\text{Vol. of solute}}{\text{Vol. of soln}} \times 100$$

20% V/V HCl soln
20 ml HCl in 100 ml soln.

$$\%\ W/V \text{ of solute} = \frac{\text{wt. of solute (g)}}{\text{Vol. of soln (ml)}} \times 100$$

20% W/V NaOH soln
20 g NaOH present in 100 ml soln

Ques 120 g NaOH is present in 2 kg soln. d soln = 2 g/ml then find

(i) M

$$M = \frac{120/40}{1} = 3M$$

23 + 16 + 1 = 40

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

$$V = \frac{M}{d} = \frac{2 \times 1000}{2}$$

= 1000 ml
= 1 L

2000 − 120 = 1880 g
1.880 kg

(ii) m

$$m = \frac{3}{1.880}$$

(iii) W/W %

$$= \frac{120}{2000} \times 100$$

$$= 6\ \%\ W/W$$

(iv) $W/V\ \% = \frac{12}{1000} \times 100 = 12\ \%$

Ques Find molality & molarity (→ 1M) of 6 % W/V urea
$d_{soln} = 2\ g/ml$

6 % W/V = 6 g of urea present in 100ml of soln

$m_{urea} = 6\ g$

$m = \frac{6/60}{0.2}$

$= \frac{1/10 \times 1000}{194} = \frac{100}{194}$

$M = \frac{6/60 \times 1000}{100}$

$=$

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

$M = d \times V$

$= 2 \times 100$

$= 200\ g$

$= \frac{200}{1000}\ kg$

$= 0.2\ kg$

$200 - 6 = 194\ g$

Ques Find molality of 20 % W/W NaOH soln ?

NaOH
23+17
40

20 % W/W = 20 g of solute present in 100 g of soln

$molality = \frac{20/40}{0.08}$

$= \frac{1/2}{0.08}$

$= \frac{1}{2} \times \frac{50}{8}$

$= 6.25\ m$

$W_{solvent} = 100 - 20$

$= 80\ g$

$= \frac{80}{1000}$

$= 0.08$

Ques Find W/W% of 3m urea soln ?

3m → 3 mol of solute present in 1kg of solvent

$3 = \frac{n}{60}$

$n = 180g$

$m_{solution} = 1000 + 180 = 1180$

$W/W\% = \frac{180}{1180} \times 100$

$= \frac{1800}{118} = 15.2$

AIPMT-2013

Ques How many grams of 70% HNO_3 required to prepare 250 ml of 2.0 M HNO_3 ?

$V_{soln} = 250$ ml $M = 2$ M

$M = \frac{n}{V(L)}$

$2 = \frac{n}{0.250}$

$n = 2 \times 0.25 = 0.5$

$n = \frac{W}{M}$

$0.5 = \frac{W}{63}$

$W = 31.5g$

70 g present ⟶ 100 g

1 g ⟶ $\frac{100}{70}$ g

31.5 ⟶ $\frac{100}{70} \times 31.5$ g

Parts per million :- no. of parts of component (solute) present in 10^6 parts of soln.

ppm by mass = $\frac{\text{mass of solute}}{\text{mass of soln}} \times 10^6$

ppm by volume = $\frac{\text{volume of solute}}{\text{Volume of soln}} \times 10^6$

70 ppm NaOH ~~sol^n~~ by mass
70 g NaOH present / 10^6 g sol^n

5 ppm HCl by vol.
5 ml HCl in 10^6 ml sol^n
5 L HCl in 10^6 L sol^n

Ques 10 g $CaCO_3$ is present in 1000 g sol^n then conc^n of sol^n is —

(i) 100 ppm (ii) 10 ppm (iii) 10000 ppm
(iv) 1000 ppm

$$ppm = \frac{10}{1000} \times 10^6$$
$$= 10000 \text{ ppm}$$

Ques 0.15 W/W % urea is given Find conc^n is terms of ppm
0.15 g urea present 100 g sol^n

$$ppm = \frac{0.15}{100} \times 10^6 \text{ ppm}$$

10/07/17

Normality (N) :- It is no. of equivalent or g equivalent present in 1 L sol^n.

$$\text{Normality (N)} = \frac{\text{no. of equivalents}}{\text{volume of sol}^n \text{ (L)}}$$

$$\text{no. of equivalents} = \frac{\text{wt}}{\text{eq. wt}} = \frac{W}{E}$$

$$\text{Equivalent wt.} = \frac{\text{Molar mass}}{\text{Valency factor}}$$

$$E = \frac{M}{n\text{-factor}}$$

$$\text{no. of equivalents} = \frac{W}{\frac{M}{n\text{-factor}}} = \frac{W}{M} \times n\text{-factor}$$

$$= n \times n\text{-factor}$$

$$N = \frac{n \times n\text{-factor}}{V}$$

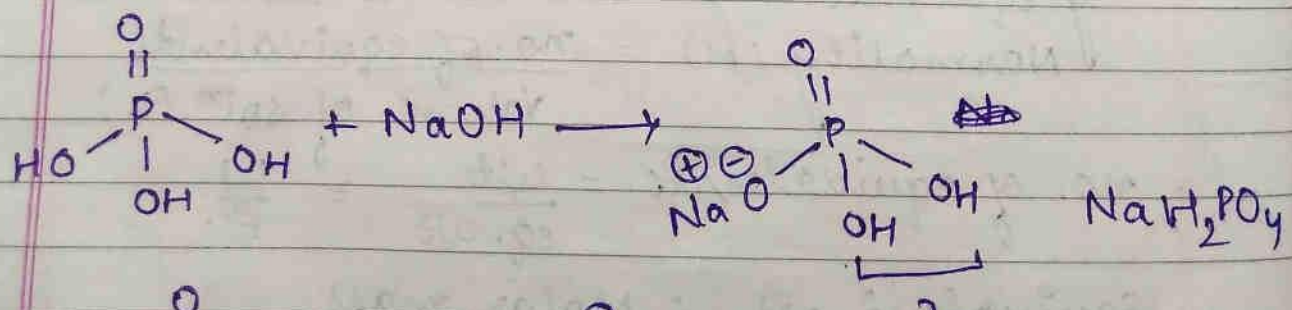
$$N = M \times n\text{-factor}$$

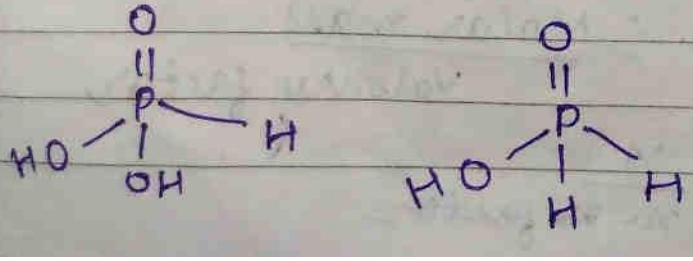
Note We never calculate Normality direct first calculate Molarity & then Normality

n-factor :-

(i) n-factor for acids = no of replaceable $H^{\oplus}$
= basicity

	n-factor
HCl	1
HNO_3	1
H_2SO_4	2
H_3PO_4	3
H_3PO_3	2
H_3PO_2	1





(ii) n-factor for base :-
no. of replaceable $OH^{\ominus}$ or no. of $H^{\oplus}$ accepted

$NaOH \longrightarrow 1$
$Ca(OH)_2 \rightarrow 2$
$Mg(OH)_2 \rightarrow 2$
$Al(OH)_3 \rightarrow 3$

(iii) n-factor for salts :- Total charge on cations
or
|Total charge on anion|

$NaCl \longrightarrow 1$
$MgCl_2 \longrightarrow 2$
$AlCl_3 \longrightarrow 3$
$FeSO_4 \longrightarrow 2$
$Al_2(SO_4)_3 \rightarrow 6$

$Al_2(SO_4)_3 \cdot K_2SO_4 \cdot MgSO_4$
$6 \cdot 2 \cdot 2 = 10$

(iv) n-factor for ion = |charge on ion|

$Na^+ \rightarrow 1$
$H^+ \rightarrow 1$
$Mg^{2+} \rightarrow 2$
$Al^{3+} \rightarrow 3$
$Fe^{2+} \rightarrow 2$
$Fe^{3+} \rightarrow 3$

$Cl^- \rightarrow 1$
$F^{\ominus} \rightarrow 1$
$O^{-2} \rightarrow 2$
$S^{-2} \rightarrow 2$

$SO_4^{2-} \rightarrow 2$
$N^{3-} \rightarrow 3$
$OH^- \rightarrow 1$
$C_2O_4^{2-} \rightarrow 2$
$MnO_4^- \rightarrow 1$

Ques Calculate no. of equivalents in

① 4 mol HNO_3 — $4 \times 1 = 4$

② 3 mol $Ca(OH)_2$ — $3 \times 2 = 6$

③ 0.5 mol $Al(OH)_3$ — $3 \times 0.5 = 1.5$

④ 0.25 mol H_2SO_4 — $0.25 \times 2 = 0.5$

⑤ 5 m mol $FeSO_4$ — $5 \times 10^{-3} \times 2 = 10 \times 10^{-3} = 10^{-2}$

⑥ 3 m mol $FeCl_3$ — $3 \times 10^{-3} \times 3 = 9 \times 10^{-3}$

⑦ 4 N 500 ml H_2SO_4 — $= \frac{^{2}\cancel{4} \times \cancel{500}}{\cancel{1000}} = 2$

⑧ $\frac{N}{5}$ 4 L NaOH — $= \frac{N}{5} \times 4 = \frac{4}{5}$

⑨ $\frac{N}{10}$ 200 ml H_3PO_4 — $= \frac{1}{10} \times \frac{\cancel{200}}{\cancel{1000}_{5}} = \frac{1}{50}$

⑩ $\frac{N}{20}$ 400 ml HCl — $\frac{1}{10\cancel{20}} \times \frac{\cancel{400}}{\cancel{1000}_{5}} = \frac{1}{50}$

⑪ 0.5 N 4 L HNO_3 — $0.5 \times 4 = 2$

Ques Calculate Normality of

① 4 M H_2SO_4 soln — $4 \times 2 = 8$

② 0.5 M H_3PO_4 soln — $0.5 \times 3 = 1.5$

③ 0.2 M NaOH soln — $0.2 \times 1 = 0.2$

④ 2M $Mg(OH)_2$ soln
$2 \times 2 = 4$

⑤ 1 M HCl
$1 \times 1 = 1$

Ques Calculate Molarity of

① 2N NaOH
$M = \frac{N}{V.F} = \frac{2}{1} = 2$

② $N/10$ H_2SO_4 $M = \frac{1}{10 \times 2} = \frac{1}{20}$

③ $\frac{N}{20}$ H_3PO_3 $M = \frac{1}{20 \times 2} = \frac{1}{40}$

④ $\frac{N}{10}$ H_3PO_2 $\frac{1}{10 \times 1} = \frac{1}{10}$

⑤ $\frac{N}{20}$ H_3PO_4 $\frac{1}{20 \times 3} = \frac{1}{60}$

⑥ 0.4N $Mg(OH)_2$ $\frac{0.4}{2} = 0.2$

⑦ 0.6N $Al(OH)_3$ $\frac{0.6}{3} = 0.2$

Ques Find Normality of 50 g $CaCO_3$ present in 500 ml soln ?

$$N = \frac{50/100 \times 2 \times 1000}{500}$$

$$= \frac{1 \times 2}{2} \times \frac{10\cancel{00}}{\cancel{500}} = 2N$$

Ques Find Normality of 4.1 g H_3PO_3 present in 100 ml soln

$$N = \frac{4.1/82 \times 2 \times 1000}{100} = \frac{41 \times 2 \times 10}{82} = 1N$$

$3 + 48 + 30 = 82$

Ques 0.5 g of a base was completely neutralised by 100 ml of 0.2 N acid Find eq. wt of the base

no. of eq. of acid = no. of eq. of base

$0.2 \times 0.1 =$ no. of eq. of base

$$0.02 = \frac{w}{E}$$

$$0.02 = \frac{0.5}{E}$$

$$E = \frac{0.5}{0.02} = 25$$

Ques 0.45 g of acid [Mol. wt. = 90) was exactly neutralised by 20 ml of 0.5 N NaOH. Find basicity of acid.

no. of eq. of acid = no. of eq. of base

$$\frac{0.45}{90} \times V.F. = 0.5 \times \frac{20}{1000}$$

$$\frac{45}{2\ 90 \times 100} \times V.F. = \frac{10}{1000}$$

$$\frac{1}{200} \times V.F. = \frac{1}{100}$$

$$\frac{1}{2} \times V.F. =$$

$$V.F. = 2$$

Ques The eq. wt. of a divalent metal is 24 The vol. of hydrogen liberated at STP by 12 g of same metal when added to excess of an acid soln is

① 2.8 L ② 5.6 L ③ 11.2 L ④ 22.4 L

$Mg + 2HCl \rightarrow MgCl + H_2$

mol. of eq. of metal = no. of eq. acid

$\frac{12}{24} = n \times 1$

$n = 1/2$ Eq. wt = $\frac{\text{Molar mass}}{\text{V.F.}}$

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

$2 \longrightarrow 1$

$1 \longrightarrow 1/2$

$1/2 \longrightarrow 1/4$ mol of H_2

$= 1/4 \times 22.4$

$= 5.6\ L$

$24 = \frac{M.M}{2}$

$M.M = 48$

Volume = $\frac{12}{48} \times 22.4 = \frac{22.4}{4} = 5.6$

Ques When an element forms an oxide in which oxygen is 20% of the oxide by mass, the eq. mass of element will be

100g → 20g O, 80g M

eq. of metal = eq. of O

$\frac{80}{E} = \frac{20}{16/2}$

$E = 32$

or

$\frac{\text{wt. of metal}}{\text{Eq. wt. of metal}} = \frac{\text{wt. of oxygen}}{\text{eq. of oxygen}}$

Mole concept in Reactions :-

(a) In Balanced reaⁿ

(b) In unbalanced reaⁿ

For balanced reaⁿ

→ by charge conservations

→ by atom conservations.

Stoichiometry

$$\text{①}N_2(g) + \text{③}H_2(g) \longrightarrow \text{②}NH_3(g)$$

1 mol	3 mol	2 mol
1 molecule	3 molecule	2 molecule
1L	3L	2L
1 ml	3 ml	2 mL
22.4 L	22.4 × 3 L	22.4 × 2 L
28 g	6 g	34 g
but 1 g	3 g	2 g ✗

Note: Solve numericals by calculating no. of moles.

Ques When 56 g N_2 reacts with 12 g H_2 then find
(i) mass of NH_3

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

$\frac{56}{28} = 2$ $\quad$ $\frac{12}{2} = 6$ $\quad$ 4 mol $\quad$ $17 \times 4 = m$, $68\,g = m$

(ii) Vol. of NH_3 at STP

$22.4 \times 4 = V = 89.6\,L$

(iii) total atoms in final product

$4 \times 4 \times N_A = 16\,N_A$

Ques When 120 g of C is completely burnt in presence of oxygen at 0°C & 1 atm. then find (i) amount of O_2 required in kg.

$$C(S) + O_2(g) \longrightarrow CO_2(g)$$

$\frac{120}{12} = 10$ mol $\quad$ 10 mol

$32 \times 10 = m$

$m = 320\ g$

$= .320\ kg$

(ii) Vol. of O_2 required

$V = 10 \times 22.4 = 224\ L$

Ques During the complete decomposition of $KClO_3$ 12.8 g O_2 is formed find initial mass of $KClO_3$?

$$KClO_3 \longrightarrow KCl + \frac{3}{2}O_2$$

0.32 mol

$\frac{12.8}{320} = \frac{4}{10}$

$= 0.4$

$0.32 \times 122.5\ g$

$=$

Ques Calculate mass of quick lime obtained by heating 400 g $CaCO_3$ which is 80 % pure ?

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

$\frac{400}{100} = 4\ x$

100 g → 80 g

1 g → $\frac{80}{100}$

400 = $\frac{80}{100} \times 400$

$= 240$

4 mol $\times \frac{80}{100}$

$= 3.2$ mol

3.2 mol

mass $= 3.2 \times 56$ g

Ques By decomposition of 50g $CaCO_3$ 11g of CO_2 is obtained then find % purity of $CaCO_3$

$$CaCO_3 \rightarrow CaO + CO_2$$

$\frac{50}{100} = \frac{1}{2}$ mol — $\frac{11}{44} = \frac{1}{4}$

0.5 mol — 0.25

1 mol → 1 mol

0.25 mol ← $\frac{11}{44} = 0.25$ mol

25g $CaCO_3$

Given : 50 g

impurity = 50 − 25 = 25g

% impurity = $\frac{25}{50} \times 100 = 50\%$

% purity = 100 − 50 = 50%

Combustion Reaction :-

Complete Combustion :- O_2 (excess)

$C \rightarrow CO_2$

$H \rightarrow H_2O$

Incomplete Combustion :- O_2 (limited)

$C \rightarrow CO$

$H \rightarrow H_2O$

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

Balancing a Combustion Reac^n :-

I Write a combustion reac^n

$C_6H_{12}O_6(l) + O_2(g) \longrightarrow CO_2(g) + H_2O(l)$

II Balance no. of C-atoms both side

$C_6H_{12}O_6 + O_2 \longrightarrow 6CO_2 + H_2O$

III Balance no. of H-atom both side

$C_6H_{12}O_6 + O_2 \longrightarrow 6CO_2 + 6H_2O$

IV Balance O-atom both side

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

Ques For the following combustion reac^n at STP

① 48 g CH_4 ② 2.8 kg C_2H_4 ③ 10 L C_3H_8

④ 3.011×10^{24} molecules of C_3H_4

(i) Find mass & volume of O_2 req.

(ii) Find mass & volume of CO_2 req.

① $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

$\frac{48}{16} = 3$ mol | 6 mol | 3 mol | 6 mol

$m = 6 \times 18 = 108$ g

$V = \frac{m}{d} = 180$ ml

$6 \times 32 =$ mass | $3 \times 44 = 132$ g = mass

192 g = mass

~~Volu~~ $V = 6 \times 22.4$ | $V = 3 \times 22.4$

$= 134.4$ L | $V = 67.2$ L

② $C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

$\frac{2.8 \times 1000}{28}$ | 300 mol | 200 mol | 200 mol

100 mol

9600 g = $300 \times 32 = m$ | $200 \times 44 = 8800$ g = m

$6720 = 22.4 \times 300 = V$ | $V = 22.4 \times 200$

$= 4480$ L

(3) $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

$\frac{100}{22.4} = 0.44$ $5 \times \frac{10}{22.4}$ $3 \times \frac{10}{22.4}$ 4×0.44

$= 2.20$ $= 1.32$ $= 1.76$ mol

mass = $32 \times$ mass = $\times 44$

$V = 22.4 \times$ $V = 22.4 \times$

(4) $C_3H_4 + 4O_2 \longrightarrow 3CO_2 + 2H_2O$

$\frac{3.011 \times 10^{24}}{6.022 \times 10^{23}}$ 4×5 5×3 10 mol

$= \frac{1}{2} \times 10 = 5$ mol $= 20$ mol 15 mol $m = 18 \times 10$

$= 180$ g

$m = 20 \times 32$ $m = 15 \times 44$ $d = 1$ g/ml

$= 640$ g $=$ $V = m/d$

$V = 22.4 \times 20$ $V = 15 \times 22.4$ $= \frac{180}{1}$

$= 224 \times 2$ $=$ $= 180$ ml

$= 448$ L

(iii) Find mass & volume of H_2O obtained

(3) $H_2O \rightarrow 1.76$ mol

$m = 1.76 \times 18 = 31.68$ g

$V = 31.68$ ml

(2) $H_2O \rightarrow 200$ mol

$m = 200 \times 18 = 3600$ g

$V = 3600$ ml

Ques Calculate the vol. of O_2 required at STP during the combustion of C_2H_6 if vol. of H_2O formed is H_2O 108 ml.

$[d_{H_2O} = 1 g/ml]$

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

108 ml

$m = d \times V$

$= 1 g/ml \times 108 ml$

$= 108 g$

$\frac{108}{18} = 6 mol$

3 mol H_2O obtained → 1 mol C_2H_6

1 → $\frac{1}{3}$

6 → $\frac{1}{3} \times 6 = 2$ mol C_2H_6

1 mol C_2H_4 react → $\frac{7}{2}$ mol of O_2

2 → $\frac{7}{2} \times 2 = 7$ mol O_2

$= 7 \times 22.4 L$

Ques Calculate the volume of air required at STP for complete combustion of 10L C_3H_4?

Note:- atmospheric air contain 20% O_2?

① 40L ② 80L ③ 120L ④ 200L

$$C_3H_4 + 4O_2 \longrightarrow 3CO_2 + 2H_2O$$

1 → 4

10L → 40L O_2

20% O_2 in air

20 L O_2 is obtained from 100 L air
1 L → $\frac{100}{20}$
40 L → $\frac{100}{20} \times 40$
= 200 L

Ques Calculate mass of Al required to required with 112 L of O_2 ?

$$2Al + \frac{3}{2}O_2 \longrightarrow Al_2O_3$$

$\frac{112}{22.4} = \frac{10}{2} = 5$ mol

$\frac{3}{2}$ mol of O_2 → 2 mol of Al
1 mol of O_2 → $\frac{2 \times 2}{3} = \frac{4}{3}$ mol of Al
5 mol of O_2 → $\frac{4}{3} \times 5$ mol of Al = $\frac{20}{3}$ mol Al

$m = \frac{20}{3} \times 27 = \frac{5^2 40}{3} = 180$ g

Ques During decomposition of $KClO_3$ 5.6 L O_2 is formed at NTP. Calculate wt. of $KClO_3$?

$\frac{5.6}{22.4} = \frac{1}{4}$

$$KClO_3 \longrightarrow KCl + 3/2\, O_2$$

$\frac{3}{2}$ mole of O_2 → 1 mol of $KClO_3$
1 → $\frac{1}{3/2} = \frac{2}{3}$ mole
$\frac{1}{4}$ → $\frac{2}{3} \times \frac{1}{4} = \frac{1}{6} \times 122.5$ g
$= \frac{122.5}{60}$
= 2.4 g

Ques During the combustion of 3 L mix of propane & butane 10 L of CO_2 is obtained. Find Vol. of propane & butane in mix also find % composition of mixture.

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

1 — 3

x — 3x

$C_4H_{10} + \frac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

3−x — 4(3−x)

$3x + 4(3-x) = 10$

$x = 2L$

$C_3H_8 \rightarrow 2L$

$C_4H_{10} \rightarrow 1L$

$C_3H_8 + C_4H_{10} \rightarrow 3L$

$C_3H_8 \rightarrow x$

$C_4H_{10} \rightarrow 3-x$

% comp. $C_3H_8 = \frac{2}{3} \times 100 = 66.6$

% comp. $C_4H_{10} = \frac{1}{3} \times 100 = 33.3$

Ques A mix of methane & ethylene in vol. ratio of X : Y has a total vol. of 30 ml. On complete combustion it gives ~~CO~~. 40 ml CO_2. If ratio had been Y : X instead of X : Y. What vol. of CO_2 had been obtained.

CH_4 X

C_2H_4 Y

$CH_4 + O_2 \longrightarrow CO_2 + 2H_2O$

X — X

$C_2H_4 + O_2 \longrightarrow 2CO_2 + H_2O$

1 — 2

Y — 2Y

$X + Y = 30ml$ — ①

$X + 2Y = 40\ ml$ — ②

$Y = 10\ ml$

$X = 20\ ml$

CH_4 : C_2H_4

Y : X

↓ ↓

CO_2 & $2CO_2$

Y L 2X

$Y + 2X = ?$

$= 10 + 2 \times 20$

$= 50$ ml

Ques 10 ml of Hydrocarbon on combustion give 40 ml CO_2 & 50 ml H_2O steam then HC is

(i) C_4H_{10} (ii) C_3H_8 (iii) C_3H_6 (iv) C_2H_4

$$C_xH_y + \left(x + \frac{y}{4}\right) O_2 \longrightarrow x\,CO_2 + \frac{y}{2}\,H_2O(g)$$

10 ml 40 ml 50 ml

$\uparrow = 4 \times 10$ ml

$\times 4$

$x = 4$

$\times 5$

$\frac{y}{2} = 5$

$y = 10$

C_4H_{10}

Q. 4L of HC required 16 L of O_2 to produce 12 L CO_2 then find HC?

(i) C_3H_6 (ii) C_3H_4 (iii) C_2H_6 (iv) C_2H_4

$$C_xH_y + \left(x + \frac{y}{4}\right) O_2 \longrightarrow x\,CO_2 + \frac{y}{2}\,H_2O$$

4L 16 L 12L

4×4

4×3

$$x = 3$$

$$x + \frac{y}{4} = 4$$

$$3 + \frac{y}{4} = 4$$

$$\frac{12 + y}{4} = 4$$

$$12 + y = 16$$

$$y = 16 - 12 = 4$$

$$C_3H_4$$

Limiting Reagent :-
The reactant which is consumed completely in reacⁿ is c/a L.R.

Excess Reagent :- The reactant which is not consumed completely in reacⁿ.

Note :- Extent of reacⁿ is decided by L.R.

$$L = \frac{\text{no. of moles of reactants}}{\text{Stoichiometry coefficient}}$$

The reactants which have least value L is c/a L.R.

Note :- Ques. solve करते समय LR जरूर check करे।

Ques $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$ at 0°C & 1 bar

40g 98g mass=? V=?

$n = \frac{40}{40} = 1$ $\frac{98}{98} = 1$ $\frac{1}{2} \times 142 = 71g$

$L \Rightarrow \boxed{\frac{1}{2} = 0.5}$ L.R. $\frac{1}{1} = 1$

2 mol NaOH → 2 mol H_2O

1 mol → 1 mol H_2O

= 18g

= 18 ml

2 mol NaOH → 1 mol Na_2SO_4

1 mol → $\frac{1}{2}$ mol Na_2SO_4

Ques 1 mol of H_2 gas react with 0.5 mol of Cl_2 gas then find no. of moles of HCl formed ?

$H_2 + Cl_2 \longrightarrow 2HCl$

1 mol 0.5 mol

L → $\frac{1}{1}$ $\frac{0.5}{1}$ → L.R. → 0.5 × 2 = 1 mol

Ques 24×10^{23} molecules of SO_2 react with 128g of O_2 find ① mass & volume of SO_3 obtained at STP

② which is L.R.

③ amount of E.R. reagent left.

$SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$

$\frac{24 \times 10^{23}}{6 \times 10^{23}} = 4$ mol $\frac{128}{32} = 4$ mol 4 mol

$m = 4 \times 80 = 320$

$V = 4 \times 22.4 = 89.6L$

L → $\frac{4}{1} = 4$ $\frac{4 \times 2}{1} = 8$

O_2 L.R.

② SO_2 → L.R.

(3) 1 mol of $SO_2 \longrightarrow \frac{1}{2}$ mol O_2

4 mol $\longrightarrow \frac{1}{2} \times 4 = 2$ mol

moles of O_2 left $= 4 - 2 = 2$ mol

$= 2 \times 32$ g

$= 64$ g

Ques 1g Mg is burnt in 0.56 g oxygen then find which reagent is left in reacⁿ mixture & How much?

$$2Mg + \frac{1}{2}O_2 \longrightarrow 2MgO$$

$\frac{1}{24}$ $\quad\quad$ $\frac{0.56}{32}$

$= 0.04$ mol $\quad\quad = 0.01$ mol

L $\rightarrow \frac{0.04}{2} \quad\quad = \frac{0.01}{1} \times 2$

$= 0.02$

L.R.

$\frac{1}{2}$ mol of O_2 react with $\rightarrow$ 1 mol Mg

$\frac{1}{1/2} = 2$ mol Mg

$\frac{0.56}{32} \longrightarrow 2 \times \frac{0.56}{32}$ mol Mg

$= 2 \times \frac{0.56}{32} \times 24$

$= 0.84$ g

Ques 30L of dinitrogen react with 30L of hydrog to give 50% of expected yield? Then end composition of reacⁿ mixture is –

$C_2H_2 + 5/2\,O_2 \longrightarrow 2CO_2 + H_2O$

8 — 5 — 4 mol

L → $\frac{8}{1}$ — $\frac{5}{5/2} = \frac{10}{5} = 2$ — $V = 4 \times 22.4$, $V = 89.6\ L$

L.R.

$5/2$ mol O_2 $\longrightarrow$ 2 mol CO_2

1 mol O_2 $\longrightarrow$ $\frac{2 \times 2}{5} = \frac{4}{5}$

5 mol O_2 $\longrightarrow$ $\frac{4}{5} \times 5 = 4$ mol CO_2

Ques 10 L of ethylene react with 56 L O_2 then find
① mass of CO_2 obtained.
② Vol. of H_2O obtained

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

10 L — 56 L

n — $\frac{100}{22.4} = 0.4$ — $\frac{56}{22.4} = \frac{10}{4} = \frac{5}{2} = 2.5$ — $0.4 \times 2 = 0.8$ mol — 0.8 mol

$m = 0.8 \times 44 = 35.2\ g$ — $m = 0.8 \times 18 = 14.4\ g$

L — $\frac{0.4}{1} = 0.4$ L.R. — $\frac{2.5}{30} = \frac{5}{6} = 0.6$ — $V = 14.4$ ml

Ques Which of the following concentration term is does not depend upon T ?
(i) Molarity (ii) Molality (iii) Normality
(iv) All of above.

T depends on →

① Molarity $= \frac{n}{V}$ · $T \uparrow M \downarrow$

② Molality $= \frac{n}{W}$

(3) Normality = $\frac{\text{no. of eq.}}{V}$

(4) w/w % no effect

(5) v/v % no effect

(6) w/v % ↑ ↑ w/v % ↓

(7) mole fraction no effect