Relation B/w Molarity & normality :

{ $E = \frac{M.W.}{V.F.}$ }

$N = \frac{W}{E} \times \frac{1}{V_{(l+r)}}$

$N = \frac{W}{M.W} \times V.f. \times \frac{1}{V_{(l+r)}}$

$$\boxed{N = M \cdot V.f.}$$ **

Q.1. 2M. Aq. Soln of H_2SO_4 ⇒ $N = 2 \times 2$ ⇒ $\boxed{N = 4}$ (V.f. = 2)

Q.2. 5 N Aq. Soln of Na_2SO_4 ⇒ $2Na^+ + SO_4^{2-}$ (V.f. = 2)

$5 = M \cdot 2$ ⇒ $\boxed{M = 5/2 = 2.5}$ Ans.

molality (m) :

Number of moles of Solute present in 1 kgm. or 1000 gm of solvent. is k/a molality of Soln.

$m = \dfrac{\text{no. of moles of Solute}}{\text{mass of Solvent (kgm.)}} \Rightarrow m = \dfrac{n}{W(\text{kgm.})}$

$m = \dfrac{w(\text{gm.})}{\text{m.w.}} \times \dfrac{1}{W(\text{kgm})}$ *

$m = \dfrac{w(\text{gm.})}{\text{m.w.}} \times \dfrac{1000}{W(\text{gm.})}$ *

ex. 2m Aq. Soln of H_2SO_4.

$\Rightarrow$ 2 mole of H_2SO_4 present in 1 kgm. of Solvent.

$\Rightarrow n = 2 \Rightarrow \dfrac{w}{98} = 2 \Rightarrow w = 196\ \text{gm}$ (Solute)

$\Rightarrow$ Soln. mass $= 196 + 1000$

$= 1196$ gm.

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Formality (F) :- Number of formula mass of Solute present in 1 ltr of Soln is k/a Formality of Soln.

$$F = \frac{\text{no. of Formula mass.}}{\text{Volume of Soln. (ltr)}} = \frac{w\,(gm)}{F.w.} \times \frac{1}{V(ltr)}$$

Here :- F.w. → Formula mass.

ex :- (i) Sodium chloride (NaCl) ⇒ M.w. = F = 58.5

(ii) $CH_3COOH \xrightarrow{\text{in Benzene}} (CH_3COOH)_2$

M.w. = 60 F.w. = 2×60 = 120.

(iii) $C_6H_5COOH \xrightarrow{\text{in Benzene}} (C_6H_5COOH)_6$

Benzoic Acid

M.w. = 122 F.w. = 2×122 = 244.

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Mole Fraction (X) :-

Solution =	Solute (B)	+ Solvent (A)
mass	w_B	w_A
molar mass	m_B	m_A
moles	n_B	n_A
mole Fraction	X_B	X_A

mole fraction of Solute $(X_B) = \dfrac{n_B}{n_A + n_B}$ $\{n_A + n_B = n_{Total}\}$

— " — Solvent $(X_A) = \dfrac{n_A}{n_A + n_B}$

$\boxed{X_A + X_B = 1}$ # $\boxed{0 < X \leq 1}$ **

Mole Fraction (X) :

$$\boxed{\frac{x_A}{x_B} = \frac{n_A}{n_B}}$$ **

{ H_3PO_3 — no of O-atom − 1: $3-1=2$; H_3PO_2: $2-1=1$ }

Strength (S) : Amount of Solute (in gm) present in 1 ltr of Solution is k/a Strength of Soln.

$$\boxed{S = \frac{\text{Mass of Solute (gm)}}{\text{Volume of Soln (ltr)}}} \Rightarrow \boxed{S = \frac{W(gm)}{V(ltr)}}$$

Unit : gm/ltr.

$$S = \frac{W_g}{E} \times \frac{E}{V_{(ltr)}} \Rightarrow \boxed{S = N \cdot E.}$$ **

V.f. = 3

Q.1. Cal. Strength (g/ltr) of 0.2 m. Aq. Soln of H_3PO_3

Sol: $N = m \cdot V.f. \Rightarrow N = 0.2 \times 3 = \boxed{N = 0.6}$

$$\text{m.w. of } H_3PO_4 = 1\times3+31+16\times4$$
$$= 34+64 = 98$$

$$E = \frac{98}{3}\ ; \quad S = N\cdot E \Rightarrow S = \overset{0.2}{\cancel{0.6}}\times\frac{98}{\cancel{3}}$$

$$\boxed{S = 19.6\ \text{gm/ltr}}$$

Part's Per million (P.P.M.) / Part's per Billion (P.P.b.)

$$\text{P.P.M.} = \frac{\text{Weight of Solute}}{\text{Weight of Soln}}\times10^6 = \frac{\text{Volume of Solute}}{\text{Volume of Soln}}\times10^6$$

$$\text{P.P.B.} = \frac{\text{Wt/Volume of Solute}}{\text{Wt/Volume of Soln}}\times10^9$$

Relation B/w molality (m) & mole Fraction (X)

$$\Rightarrow \frac{X_B}{X_A} = \frac{n_B}{n_A} \Rightarrow \frac{X_B}{X_A} = \frac{W_B/m_B}{W_A/m_A}$$

$$\left\{ m = \frac{W_B}{m_B} \times \frac{1000}{W_{A(gm)}} \right\}$$

$$\frac{X_B}{X_A} = \frac{W_{B(gm)}}{W_{A(gm)}} \times \frac{M_A}{M_B} \times \frac{1000}{1000}$$

$$\boxed{\frac{X_B}{X_A} = \frac{m \cdot M_A}{1000}} \Rightarrow \boxed{m = \frac{X_B}{X_A} \times \frac{1000}{M_A}}$$

Here : X_B & $X_A \Rightarrow$ mole Fraction of Solute & Solvent

$M_A \Rightarrow$ M.W. of Solvent.

Relation B/w % by mass ($\% \frac{w}{W}$) & molarity (M) or Normality (N) :-

$$\left\{ \% \frac{w}{W} = \frac{w_{(gm)}}{W_{(gm)}} \times 100 \right\}$$

$$M = \frac{w_{(gm)}}{M.w.} \times \frac{1000}{V_{(ml)}}$$

$$M = \frac{w_{(gm)}}{M.w.} \times \frac{100}{V_{(ml)\,soln}} \times \frac{W_{(soln)(gm)}}{W_{(sol)(gm)}} \times 10 \qquad \left\{ d_{soln} = \frac{W_{sol}}{V_{soln}} \right\}$$

$$M = \frac{\% \text{ by mass} \times d_{soln} \times 10}{Mw./M_B}$$

Here → d_{soln} ⇒ density of Sol^n

M.w/M_B ⇒ M.w. of Solute.

$$N = \frac{\% \text{ by mass} \times d_{soln} \times 10}{E}$$ ***