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⟹ Molality :- (m)

- mole of solute available in 1kg of solvent
- unit = mole per Kg (mol/Kg)

$$m = \frac{\text{mole of solute}}{\text{wt. of solvent (Kg)}}$$

$$\Rightarrow m = \frac{\text{wt. of solute} \times 1000}{\text{mol. wt. of solute} \times \text{wt. of solvent (gm)}}.$$

- molality is not temperature effective.

⟹ formality :- (f) (F)

- for ionic solute ; use term 'formulae weight' instead of molecular weight.

eg:- formulae of NaCl is 58.5 gm.

- 'formality' term is used to measure consentration for ionic solute.

$$F = \frac{\text{wt. of solute (grm)}}{\text{formula wt. of solute} \times \text{volume of solution (ltr)}}$$

- unit is mole per litre (mol/ltr)
- formality in temperature effective.
  $\left(\text{temp} \propto \frac{1}{F}\right)$

Q: 20gm of NaOH present in 100 ml of aqueous solution, if density of solution is 1.1 (gm/ml) than find out following:

a) % w/w of solution.
b) % w/v of solution.
c) molarity
d) molality
e) mole fraction of NaOH.

$\left(\rho = \frac{m}{v}\right)$

$\Rightarrow$ NaOH = 20gm volume = 100 ml density = 1.1

$\Rightarrow \rho = \frac{m}{vol.} \longrightarrow 1.1 = \frac{m}{100} \quad \therefore$ mass = 110gm.

mole of NaOH = $\frac{\cancel{20}\,1}{\cancel{40}\,2} = 0.5$ mol.

a) % w/w = $\frac{20}{11\cancel{0}} \times 10\cancel{0} \longrightarrow \frac{200}{11} \rightarrow (18.18)\%$

b) % w/v = $\frac{20}{\cancel{100}} \times \cancel{100} \longrightarrow \boxed{20\%}$

c) $M = \frac{mole}{vol.\ (ltr)}$

$= \frac{\frac{1}{2}}{\frac{100\ (ml)}{1000}} \longrightarrow \frac{1}{\cancel{2}} \times \frac{\overset{5}{\cancel{1000}}}{\cancel{100}} \longrightarrow \boxed{5\ mol/ltr}$

$\frac{0.5}{0.1}$ = 5 mol/ltr

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d) $m = \frac{\text{mole}}{\text{mass (Kg)}}$

$H_2O = 110 - 20 = 90$

$= \frac{1}{\cancel{2}} \times \frac{\overset{50}{\cancel{1000}}}{\cancel{90}} \longrightarrow \frac{50}{9} = \boxed{5.5 \text{ mol/Kg}}$

e) mole fraction of NaOH $= \frac{1/2}{1/2 + 5}$

mole of water $= \frac{\cancel{90}\ \cancel{30}\ 5}{\cancel{18}\ 6}$

$= \frac{1/2}{\frac{11}{2}} \longrightarrow \frac{1}{\cancel{2}} \times \frac{\cancel{2}}{11}$

$\boxed{= \frac{1}{11}}$

normality:- (N)

$N = \frac{\text{gm equivalent of solute}}{\text{volume of solution (ltr)}}$

$N = \frac{\text{wt. of solute (gm)}}{\text{equivalent wt. of solute} \times \text{volume of solution (ltr)}}$

- number of gram equivalent of solute is available in '1 litre' of solution is known as 'normality'.
- unit of normality is gram equivalent per litre (gm eq/ltr)
- normality is temperature effective.

mole : gm atom = gm molecule

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* Relation between normality and molarity :-

Normality = Molarity × n factor.

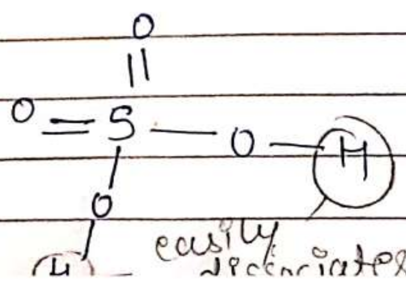
$\boxed{N = M \times n}$ ([illegible])

(i) Equivalent weight and 'n' factor:

Molecule	M. weight	n factor	Eq. wt. $\left(\frac{M.wt}{n\,fact}\right)$
HCl	36.5	1	36.5
H_2SO_4	98	2	49
H_3PO_4	98	3	32.6
H_3PO_2	66	1	66
H_3PO_3	82	2	41
$NaOH$	40	1	40
$Ca(OH)_2$	74	2	37

(ii) Oxo acid and 'n' factor:

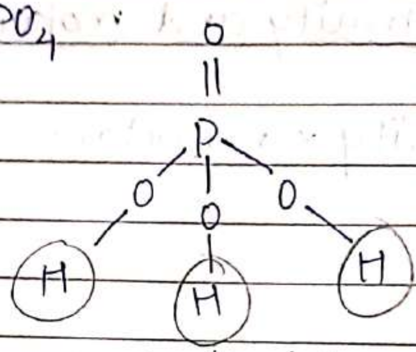
(a) H_2SO_4



basicity = 2.

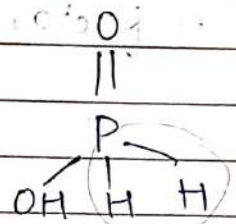
$\therefore$ n factor = $\boxed{2}$

(b) H_3PO_4



n factor $\boxed{=3}$

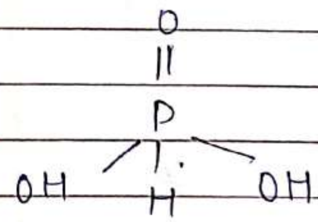
(c) H_3PO_2



n factor $\boxed{=1}$

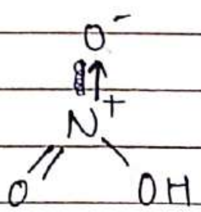
(not easily breakable) (directly attached)

(d) H_3PO_3



n factor $\boxed{=2}$

(e) HNO_3



n factor $\boxed{=1}$

valency = combining capacity   covalency =

Q: Find normality of following solutions:

(a) 0.02 M H_2SO_4

m. imp. (b) 0.05 M H_3PO_2

(c) 0.01 M NaOH

$\Rightarrow$ (a) $N = M \times n$

$= 0.02 \times 2$

$= \boxed{0.04N}$

(b) $N = M \times n$

$= 0.05 \times 1$

$= \boxed{0.05N}$

(c) $N = M \times n$

$= 0.01 \times 1$

$= \boxed{0.01N}$

Q: Find normality of following solutions:

(a) 19.6 gm of H_2SO_4 (250 ml)

(b) 6.02×10^{20} molecules of $Ca(OH)_2$ (400 ml)

(c) 10 gm of H_3PO_2 (500 ml)

$\Rightarrow$ (a) $N = \dfrac{1.96 \times 1\cancel{000}}{49 \times 25\cancel{0} \times 1\cancel{00}}$

(b) $\dfrac{\cancel{6.02} \times 10^{20}}{\cancel{6.02} \times 10^{23}} = 10^{-3}$

$M = \dfrac{\cancel{10^{-3} \times 1000}}{400}$

$\therefore$ $N = \dfrac{1}{\cancel{400}} \cancel{\times 2}$ $\boxed{= \dfrac{1}{200}}$ or 5×10^{-3}

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(c) 10gm H_3PO_2 (500ml)

→ wt. = 66 wt. eq. = 66.

⇒ demal :- (D)

- molarity at 0°C temperature is known as DEMAL.
- unit = mole / liter
- it is temperature effective.

Q: Find out mole fraction of NaOH in 0.01 molal (molality) solution.

→ $m = \frac{\text{mole}}{\text{wt of solvent (kg)}}$

$m \text{ of NaOH} = \underline{0.01}$

$m \text{ of water} = \frac{\cancel{9000}\ 500}{\cancel{18}\ 9} = \frac{500}{9} \rightarrow \underline{55.55}$

∴ $\text{mole fraction} = \frac{0.01}{0.01 + 55.55}$

$\boxed{\rightarrow \frac{0.01}{55.56}}$

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Mixing of Solution:

- the molarity (M) of any solution after dilution can be calculated by following.

$$M_1V_1 = M_2V_2$$

$$N_1V_1 = N_2V_2$$

Q:1 If 0.02M NaOH solution (250 ml) diluted by 350 ml water then find molarity of final solution.

→ $0.02 \times 250 = x \times 600$

$$x = \frac{2}{\cancel{100}_{12}} \times \frac{\cancel{250}}{\cancel{600}} \quad \boxed{= \frac{1}{120}}$$

Q:2 If 0.05N H_2SO_4 solution (400 ml) is diluted by 300 ml of water. Find out M of final solution:

→ $N_1 \times V_1 = N_2 \times V_2$

$0.05 \times 400 = N_2 \times 700$

$$N_2 = \frac{5}{\cancel{100}_{20}} \times \frac{\cancel{400}}{\cancel{700}} = \frac{5}{140} \quad \boxed{\frac{1}{35}}$$

$$N_2 = M_2 \times n$$

$$\frac{1}{35} = M_2 \times 2$$

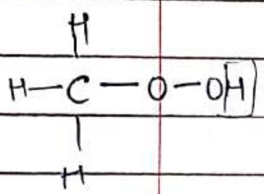
$$\boxed{M_2 = \frac{1}{70}}$$

Q:3. 3mg of activated charcoal was added to 50ml of acetic acid solution (0.06N) in flask. After one hour conc. of acetic acid is found out 0.042N. Find out amount of acetic acid absorbed by per gram of charcoal.

→

CH_3COOH
$= 24+32+4$
$= 28+32$
$= 60$ gm ∴ n fact = 1

$N = \frac{\text{gm. eq. of solute}}{V}$



$N = M \times n$
$M = N$
$\underline{M = 0.06}$

∴ $M = \frac{\text{mole}}{\text{V. of sol}^n}$

$0.06 \times 50 = \text{mole}$
∴ mole acet = 300 mole.
∴ wt. of acet acid = 300×60
$= \underline{\underline{1800 \text{ gm}}}$

$M_2 = 0.042 \quad (M = N \times n)$
$M = \frac{\text{mole}}{V}$
∴ mole = 0.042×50
$= 2.100.$ → $\underline{2.1 \text{ mole}}$

∴ wt. of acet. acid = 2.1×60
$= \underline{\underline{126 \text{ mg}}}$

∴ wt. absorbed = $180 - 126$
$= \underline{\underline{54 \text{ mg}}}$.

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3gm ⟶ ~~54~~ 15 gm

per gm = $\boxed{18 \text{ mg}}$

OR.

m mole CH_3COOH in starting − m mole CH_3COOH in ending.

$0.06 \times 50 - 0.042 \times 50$ m mole

$3 - 2.1$
$= 0.9$

∴, wt. of $CH_3COOH = 0.9 \times 60$
$= 54$ mg.

∴, $\frac{54}{3}$ $\boxed{= 18 \text{ mg}}$

☆ # laws of chemical combination :-

⇒ 1) law of conservation of mass:

Lavoisier

→ it states that during chemical reaction, the mass of products and reactants will always be EQUAL.

⇒ 2) law of definite proportion:

Proust.

→ it states that every chemical compound will contain fixed and constant proportion by mass, of its constituent elements.

(Joseph Proust proved this law.)

5. law. chem. comb.

Richter ⟶ reciprocal proportion / law of equivalent w...

⟹ 3) law of multiple proportion:

Dalton → rule of stoichiometry proved by John Dalton (1803).

eg: $CH_2 + 2O_2 \longrightarrow 2H_2O + CO_2$

coefficient 2 of O_2 & H_2O

⟹ 4) Gay Lussac's law of gaseous volume:

→ Gay lussac gave this law in 1808. This law was properly explained by Avogadro.

⟹ 5) Avogadro law:

→ it states that when temperature and pressure conditions are same, gases of equal volumes contains same number of molecules.

05/06

Q:1 Find molality of 3M NaCl solution if density of solution is 1.2 gm/ml.

⟹ molality = $\frac{\text{mole}}{\text{wt. of solvent (Kg)}}$

3M NaCl ⟶ vol. sol^n = 1 ltr

⟶ mole = 3.

⟹ wt. of solute = 3×58.5 → 175.5

1.2 gm/ml × 1000 = 1200 vol. of solvent = 1200 − 175.5

= 1024.5.

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$$\text{molality} = \frac{\cancel{3} \times 1000 \times 10}{\cancel{10245}\ 3415}.$$

Q:2 36.5% w/w of HCl has density equal to 1.20 gm/ml. Find molarity and molality?

sol^n = 100. ~~(H_2O)~~

→ 36.5 w/w → 36.5 gm HCl. → solvent = 63.5. (H_2O)

mole HCl = $\frac{\cancel{36.5}}{\cancel{36.5}} = 1\ N_A$.

$\rho = \frac{m}{v}$

$$\text{molality (m)} = \frac{\text{mole}}{\text{wt (kg)}} \longrightarrow \frac{1 \times 1000 \times 10}{63.5}$$

$\boxed{= 15.7}$

$1.2 = \frac{100}{v}$

$v = \frac{100}{1.2}$

$$\text{molarity (M)} = \frac{\text{mole}}{\text{vol. sol}^n\text{ (ltr)}} \longrightarrow \frac{1 \times 1000 \times}{\frac{100}{1.2} \times 1000}$$

$$\Rightarrow \frac{\cancel{1000} \times 12}{10\cancel{00} \times \cancel{100}}$$

$\boxed{= 12}$

1. Molarity (M); mole fraction (x) & Density of sol^n (D):

$$M = \frac{x_2\, d \times 1000}{x_1\,(\text{Mol. wt solvent}) + (\text{Mol. wt. solute})\,x_2}$$

2. Molality (m); mole fraction (x):

$$m = \frac{x_2 \times 1000}{x_1 \times (\text{mol. wt})\ \text{solvent}}.$$

3. Molality (m); Molarity (M) & Density (D):

$$M = \frac{m \cdot D \times 1000}{1000 + m\,(\text{mol. wt. of solvent})}.$$

⇛ Law of Conservation of mass:

Antoine Lavoisier (1789)

- it states that during a chemical reaction, the mass of the products and reactants will always be equal.

⇛ Law of Definite proportions:

- it states that every chemical compound will contain a fixed and constant proportion by mass, of its constituent elements.
- Joseph Proust proposed this law.

⇛ Law of Multiple proportions:

- rule of stochiometry formulated by John Dalton. (1803)

eg: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.
coeff. 2 : for O_2 & H_2O.

⇛ Gay Lussac's law of Gaseous volumes:

- Gay Lussac gave this law in the year 1808. This law was properly explained by Avogadro.

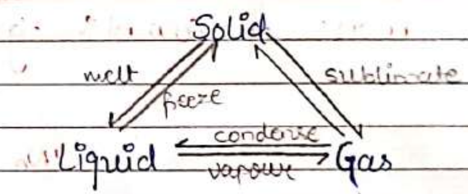
⇛ Avogadro law:

(1811)

- it states that when the temperature and pressure conditions are same, gases of equal volumes contain the same number of molecules.

Extra:

- Mass:- dimensionless quantity representing amount of matter in a particle or objects.
  SI ⇒ Kg. (Kilogram.



- Units:-

(i) Length: metre (m)
(ii) mass: Kilogram (Kg)
(iii) time: second (sec)
(iv) current: ampere (amp)
(v) thermodynamic temperature : kelvin (K)
(vi) amount of substance: mole (mol)
(vii) luminous intensity: candela (cd)

- Density = $\frac{mass}{volume}$ $\left[\rho = \frac{Kg}{m^3} \right]$ ∴ $\rho = Kg\,m^{-3}$

- $°F = \frac{9}{5}(°C) + 32$

- $K = °C + 273.15$

$1mg = 1 \times 10^{-6} Kg$
$1gm = 1 \times 10^{-3} Kg$
$1Kg = 1 \times 10^{6} mg$
$= 1 \times 10^{3} gm$