# SOLUTION

➤ Defination: Solution is a homogeneous mixture of 2 or more substances in same or diff. physical phases.

- The substances forming the solution are called component of solution
- On basis of components of solution 2 component called Binary solution. [Solvent + Solute]

➤ Solute & Solvent: In a binary solution. solvent is a component which is present in large quanitity & another component called solute.

- If no. of solute is 2 then solution is known as Ternary Slution.
- If no. of solute is 3 then solution is known as Quatanary solution.

TYPES OF SOL$^n$:

| TYPE OF SOL$^n$ | SOLUTE | SOLVENT | EXAMPLES |
|---|---|---|---|
| Gaseous sol$^n$ | Gas | Gas | mixture of $O_2$ & $N_2$ |
| | Liquid | Gas | chloroform with $N_2$ |
| | solid | Gas | camphor in $N_2$ |

| | | | |
|---|---|---|---|
| Liquid solution | Gas | Liquid | $O_2$ in Water |
| | liquid | Liquid | $C_2H_5OH$ in water |
| | solid | Liquid | glucose in water |
| Solid solution | Gas | solid | sol$^n$ of $H_2$ in Pd |
| | liquid | solid | Amalgam of Hg in |
| | solid | solid | Cu dissolved in Au. |

- If water is used as a solvent then sol$^n$ called Aquous soln. & If not then sol$^n$ called Non-aquous soln.
- Depending upon the amount of solute dissolved in solvent we have:—

i. Unsaturated sol$^n$: More solute can be dissolved without raising temp. called unsaturated solution

ii. Saturated sol$^n$ : No solute can dissolve further without giving temp. called Saturated solution.

iii. Supersaturated sol$^n$: A solution which contains more solute then that would be necessary to saturate at given temp called supersaturated sol$^n$.

Date 14 03 024 Thursday

↑ (unit to measure conc.)

# concentration of soln

- %. w/w
- %. w/v
- %. v/v
- ppm
- ppb

- Mole fraction (X)
- Molarity (M)
- Molality (m)
- Normality (N)
- formality (F)

## %. W/W

5%. W/W NaOH soln.

It means 5gm NaOH available in 100gm of solution.

We have given data,:

Wt of solute = 5gm

wt of solution = 100gm

wt of solvent = 100-5 = 95gm.

Formula:

$$\%\,w/w = \frac{\text{wt of solute (gm)}}{\text{wt of solution (gm)}} \times 100$$

## %. W/V

5%. w/v it means,

5gm NaOH available in 100 ml of solution.

data given:
wt of solute = 5gm
volume of solution = 100ml

wt of solvent
soln ⇒ X

Formulae:

$$\%\ w/v = \frac{\text{wt of solute (gm)}}{\text{vol. of solution (ml)}} \times 100$$

c) % v/v

5% v/v means,
5 ml $CH_3OH$ ~~of~~ available in 100ml of solution.

data given:
volume of solute = 5 ml
volume of solution = 100 ml
volume of solvent = 95 ml

Formulae:

$$\%\ v/v = \frac{\text{vol of solute (ml)}}{\text{vol of solution (ml)}} \times 100$$

d) PPM:

We can denote PPM as w/w, w/v, & v/v.
But here mainly in % w/v,
5% PPM (w/v) NaOH soln,
It means 5gm NaOH ~~sol~~ available in one million (ml) of soln.

Formulae:

$$\%\ W/v = \frac{\text{wt of solute (gm)}}{\text{vol. of soln (ml)}} \times 10^6$$

## MOLE FRACTION

Formulae:

$$\text{Mole fraction } (X_B) = \frac{\text{No. of moles of solute } (n_B)}{\text{No. of moles of solute } (n_B) + \text{No. of moles of solvent } (n_A)}$$

$$(X_B) = \frac{n_B}{n_B + n_A} = \frac{W_B / M.W_B}{\frac{W_B}{M.W_B} + \frac{W_A}{M.W_A}}$$

Where $W_B$ = Mass of solute (B)
$M_B$ = Molar mass of solute (B)
$W_A$ = given mass of solvent (A)
$M_A$ = given molar mass of solvent (A)

## MOLARITY

No. of moles of solute present in 1 litr of solution. ($1\ l = d m^3$)

Molarity varies with temperature due to change in volume of solution.

Formulae:

$$M = \frac{\text{No. of moles of solute}}{\text{volume of solution (litre)}}$$

$$M. = \frac{\text{(gm) Mass of solute} \times 1000}{\text{Mol. wt of solute (gm)} \times \text{Vol of sol}^{n}\text{ (ml)}}$$

5 M or 5 molar solution (NaOH) it means 5 moles of NaOH present in 1 litre of solution.

## MOLALITY (m)

No. of moles of solute present in per kg solvent.

Formulae:

$$m = \frac{\text{Moles of solute}}{\text{Mass of solvent (kg)}} = \text{mol/kg}$$

5m or 5 molal solution (NaOH), It means 5 moles of NaOH available in 1 kg of solvent.

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Q) Find out the following conc. term in 4% w/w of NaOH soln. (Density of solution 1.1 gm/ml)

(a) Molarity
(b) Molality
(c) Mole fraction NaOH.

(a) $M = \frac{\text{Moles of solute}}{\text{M.wt of solute} \times \text{vol. of soln}} \times 1000$

$= \frac{4 \times 1000}{40 \times 100}$

Molarity = 1 M

(b) $m = \frac{\text{moles of solute}}{\text{Mass of solvent (kg)}}$

moles = 0.1

? = mass of solvent

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

$1 \times 100 \times 1.1 = m$

110 = mass of solution

106 = mass of solvent

put the values

$= \frac{0.1}{106} \times 1000$

$= \frac{100}{106} \frac{50}{53}$

$= 0.9\ m$.

Mole fraction $= \frac{nB}{nB + nA}$

$= \frac{\text{wt}}{\text{m.wt}}$ ] solute

solute $\left[\frac{\text{wt.}}{\text{m.wt}} + \frac{\text{wt}}{\text{m.wt}}\right]$ solvent

$= \frac{0.1}{0.1 + \frac{106}{18}}$

$= \frac{1.8 + 106}{18}$

$= \frac{0.1}{\frac{52 + 4240}{720}}$

$= \frac{4292}{720}$

$=$

$= \frac{4}{\frac{4}{40} + \frac{106}{180}}$

$= \frac{0.1}{\frac{52 + 4240}{720}}$

$= \frac{4292}{720}$

$=$

0.01 m = molality → 18 → m.wt of solvent

Find = mole fraction

urea

$NH_2CONH_2$

$X_{\text{urea}} = \frac{nB}{nB + nA}$

$= \frac{0.01}{0.01 + \frac{1000}{18}}$

$= \frac{0.01}{0.01 + 55.5}$

$= \frac{0.01}{55.5}$ $= \frac{1 \times 100}{555 \times 100}$ $= 0.016$