Solution

→ Solution is a homogeneous mixture of two or more substance in same or different physical phases. The substances forming solution are called component of solution ie solute and solvent. Solvent is the component which is present in large quantity while the other component is known as solute.

→ If H_2O is used as a solvent the solution is called aqueous soln. and if not solution is called non-aqueous solution. Depending upon the amount of solute dissolved in it solvent we have the following types of solution.

(1) Unsaturated solution:-
A solution in which more solute can be dissolved without raising temperature is called an unsaturated solution.

(2) Saturated solution:-
A solution in which no solute can be dissolved further at a given temperature is called a saturated solution.

(3) Super-saturated solution:-
A solution which contain more solute than that would be necessary to saturate it at a given temperature is called super-saturated solution.

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*Methods of expressing concentration of solution

(1) %/weight:- It is defined as the amount of solute present in 100g of solution.

(2) * $W/W\% = \frac{\text{wt. of solute}}{\text{wt. of solvent}} \times 100$

(2) %/volume:-
It is defined as the volume of solute in ml present in 100 ml solution

* $V/V\% = \frac{\text{volume of solute}}{\text{vol. of solution}} \times 100$

(3) % mass/volume:-
It is defined as the mass of solute in 100 ml of solution.

* $\%\ w/V = \frac{\text{mass of solute}}{\text{vol. of solution}} \times 100$

(4) Strength or Concentration (g/l):-

→ It is defined as the amount of the solute in gram present in one litre of solution.

* $\text{Conc}^{n}\text{ of solution} = \frac{\text{Solute in gram}}{\text{Vol. of soln in litres}}$

(5) Parts per million (ppm):-
When the solute is present in trace quantities. It is convinient to express the concentration in parts per million. It is defined as the quantity of solute in gram present in 10^{-6} gram of the soln.

* $\text{ppm} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 10^{6}$

Mole fraction:-
It is defined as the ratio of the no. of moles of a component to the total no. of moles of the component.

$n_A + n_B \longrightarrow n_c$

$X_A = \frac{n_A}{n_A + n_B}$ $\quad X_B = \frac{n_B}{n_A + n_B}$

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* Molality:-
It is defined as the no. of moles of the solute present in 1 kg of solvent it is denoted by "m"

* $\text{Molality} = \frac{\text{no. of moles of solute}}{\text{wt (kg) of solution}}$

* Molarity:-
It is defined as the no. of moles of the solute present in 1 litre of solvent it is denoted by "M".

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$CaSO_4 \rightarrow Ca^{(++)} + SO_4^{(--)}$ molwt $\frac{100}{x} = 50$

100 — molecular weight

* $\text{Molarity} = \frac{\text{no. of moles of solute}}{\text{Volume of solution in (litre)}}$

* Normality:-
It is defined as no. of gram equivalent of solute per litre of solution. It is ~~labeled~~ denoted by "N".

* $\text{Normality} = \frac{\text{no. of gram equivalent}}{\text{no. of volume of solution}}$

* Ideal Solution:-
An ideal solution is one in which the molecule attract one another with equal force irrespective to their nature thus a solution composed of two components A and B will be an ideal (1) if the forces b/w A & A, B & B should be same.

→ An ideal solution passes the following characteristics

(1)* volume change of mixing should be zero (0).

$\Delta V_{mix} = 0$

(2)* Heat change on mixing should be zero (0).

$\Delta H_{mix} = 0$

(3)* There should be no chemical rxn b/w solvent

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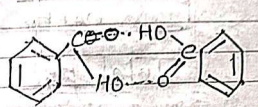
and solute.

(4)* Solute molecules should not dissociate in the ideal solution.

(5)* Solute molecules should not associate in ideal solution.

2  Dissolve in Benzene (Association) 

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Ideal solution must obey Raoult's law at all concentration the following are the some of the binary mixture which show the properties of ideal solution.

(A) Benzene & Toulene
(B) Carbontetra chloride & silium tetrachloride

Raoult's law :-

According to this law the partial pressure of any volatile constituents of a solution at a constant temperature is equal to the vapour pressure of pure constituent multiplied by the mole fraction of that constituent in ~~that~~ this solution.

→ Let a mixture (solution) be prepared by mixing n_A mole of liquid 'A' and n_B mole of liquid B. let P_A and P_B be the partial pressure of two constituent A & B. In solution and P°_A and P°_B the vapour pressure in pure state respectively.

Thus according to Raoult's law

* $P_A = \frac{n_A}{n_A + n_B} P^\circ_A$ = mole fraction of $A \times P^\circ_A = X_A P^\circ_A$

* $P_B = \frac{n_B}{n_A + n_B} P^\circ_B$ mole fraction of $B \times P^\circ_B = X_B P^\circ_B$

Total pressure

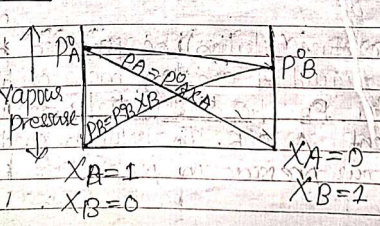
$P = P_A + P_B$

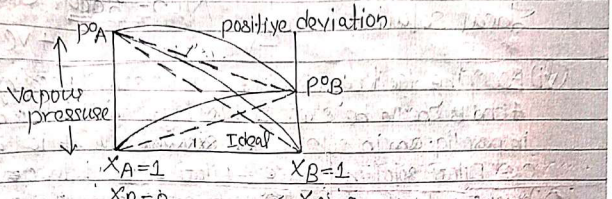
* $P = X_A P^\circ_A + X_B P^\circ_B$

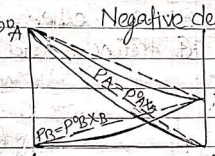
→ This law infact is the mayor desiding factor weather a solution will be ideal or non-ideal. Ideal solution obey Raoult's law at every range of concentration. Non-ideal solution don't obey Raoult's law, they show either +ve or -ve deviation from Raoult's law.

Ideal or Non-Ideal Solution :-

Ideal deviation :-







Ideal solution	Non-ideal solution +ve	Non-ideal solution -ve
(i) obey Raoult's law every range of concentration	Don't obey Raoult's law.	Don't obey Raoult's law.
(ii) $\Delta H_{mix} = 0$ either heat is evolved or released	$\Delta H_{mix} > 0$, Endothermic, dissociation heat is absorbed	$\Delta H_{mix} < 0$, Exothermic dissociation heat is released.
(iii) $\Delta V_{mix} = 0$ total volume of soln is equal to some of value of the component.	$\Delta V_{mix} > 0$ volume increases after dissolution.	$\Delta V_{mix} < 0$ volume decreases after dissolution.
(iv) $P = P_A + P_B = P^\circ_A X_A + P^\circ_B X_B$ ie $P_A = P^\circ_A X_A$ - $P_B = P^\circ_B X_B$	$P_A > P^\circ_A X_A$ $P_B > P^\circ_B X_B$ $P_A + P_B > P^\circ_A X_A + P^\circ_B X_B$	$P_A < P^\circ_A X_A$, $P_B < P^\circ_B X_B$ $P_A + P_B < P^\circ_A X_A + P^\circ_B X_B$
(v) A-A, A-B, B-B attractive forces or interaction should be same that is A & B are identical and same size and character.	A, B attractive force should be weaker than A-B, B-B attractive force A & B have different size, shape & character	AB attractive force should be greater than A-A, B-B attractive force A & B have different size, shape and character.

Ideal solution	Non-Ideal solution -ve	Non-Ideal solution +ve
(vi) Escaping tendency of A and B should be same in pure liq. and in soln. eg:- Dilute solution.	A & B escape easily showing higher than the expected value eg:- Dilute solns.	Escaping tendency both components A & B is lowered. show lower vapour pressure than the expected value eg:-
① Benzene + Toulene	① Acetone + Ethanol	① Acetone + Aniline
② N-Hexane + N-Heptane	② coates + Methanol	② Acetone + Chloroform
③ Chlorobenzene + Bromobenzene	③ coates + ethanol	③ coates + HCl
④ Ethyl bromide-ethyl iodide	④ Acetone + coates	④ Acetic acid pyridine.

* Solution of gases in liquid :-

→ The solubility of gas in a liquid represent the concentration of dissolved gas in a liquid when it is in equilibrium with some of the pure gas about this solution.
Eg:- Pharmaceutical aerosols containing hydrogen also be considered as solution of the gases in liquid.

* Factors affecting solubility of gases in liquid :-

→ This solubility of gas in a solvent depend on temperature, pressure, presence of salts and chemical reaction. If any between the gas and the solvent.