CHEMISTRY

SOLUTIONS

VERY SHORT ANSWER QUESTIONS :

1. State Raoult's Law.

Ans:

Raoult's law states that "At a given temperature the relative lowering of vapour pressure of dilute solution containing non – volatile solute is equal to the mole fraction of solute in the solution".

$$\frac{P^0 - P_s}{P^0} = X_2 ;$$

Where P^0 = Vapour pressure of pure solvent

P_s = Vapour pressure of solution of non volatile solute

X_2 = Mole fraction of solute

2. State Henry's Law.

Ans:

Henry's law states that "At a given temperature the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas(x) in the solution".

$P = K_H x$

Where P = partial pressure of the gas in vapour phase

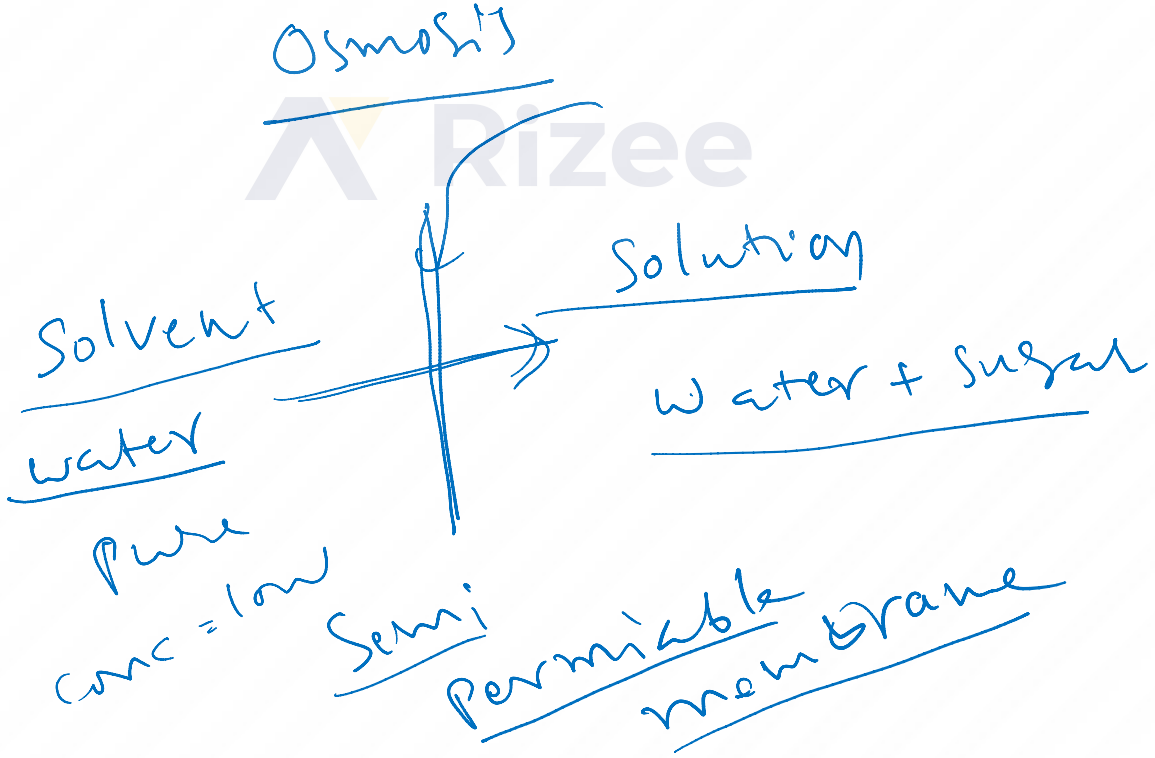
x = Mole fraction of the gas

K_H = Henry's law constant

3. Define osmotic pressure.

Ans:

The pressure required to just stop osmosis is called osmotic pressure.



4. What are isotonic solutions?

Ans:

The solutions having same osmotic pressure at a given temperature are called Isotonic solutions.

Ex: Blood is isotonic with saline solution

$\left(0.9\%\left(\frac{w}{v}\right)NaCl\right)$

5. Define Molarity?

Ans:

The number of moles of the solute present in one litre of solution

$$M = \frac{w}{GMW} \times \frac{1000}{V(mL)}$$

solute — solution

mole = 6.023×10^{23}

6.023×10^{23}

2 × 6.023×10^{23} each

1 mole = 2 moles

Dozen = 12

Pair = 2

$100 = (10)^2$

$10 \times 10 \times 10^5$

6. Define Molality?

Ans:

The number of moles of the solute present in 1 kg of solvent is called molality of the solution.

$$\text{Molality} = \frac{w}{GMW} \times \frac{1000}{\text{wt.of solvent in gm}}$$

No. of solution in litr

1 X 6.023X1023

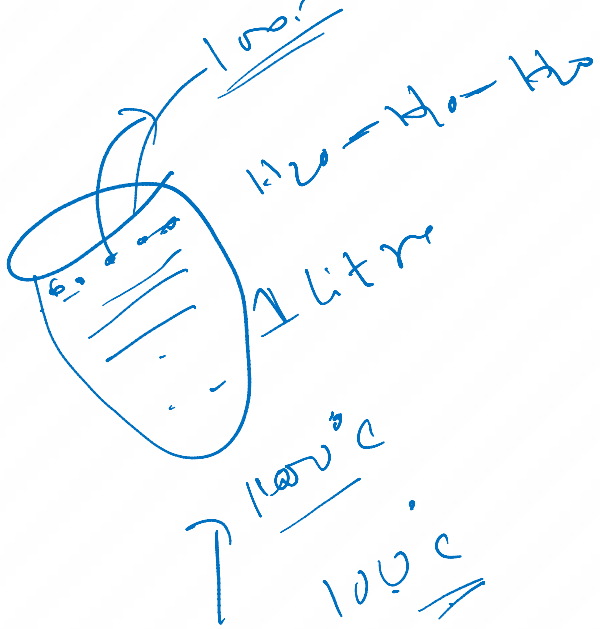
Vol solvn = M

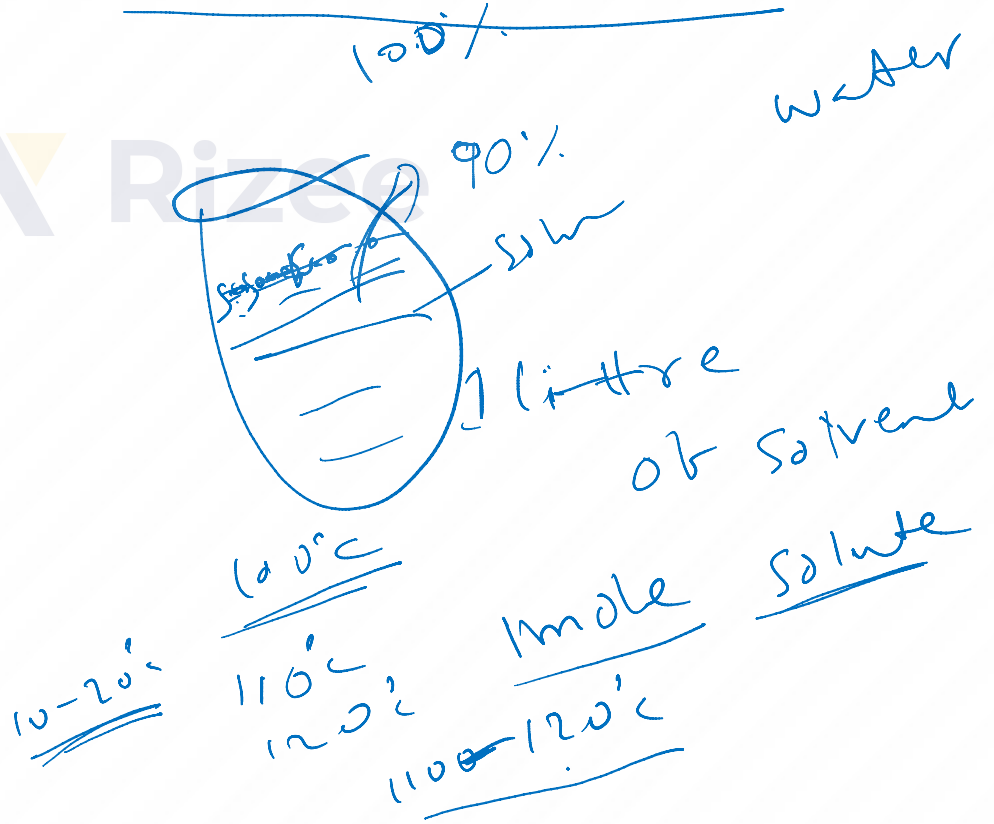
Kg of Solvent = m

7. What is ebullioscopic constant?

Ans:

The elevation in boiling point produced when 1 mole of solute is dissolved in 1000g of solvent is called Ebullioscopic constant.





8. What is cryoscopic constant?

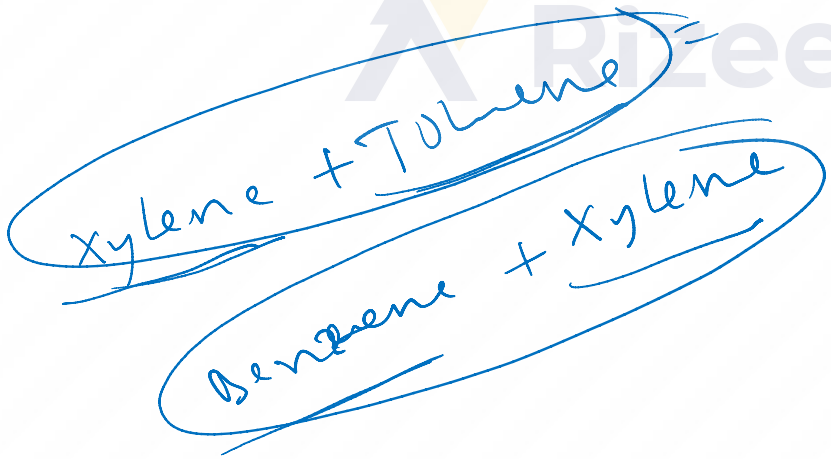
Ans:

The depression in freezing point produced when 1 mole of solute is dissolved in 1000g of solvent is called cryoscopic constant.

9. What are meant by Azeotrope's?

Ans:

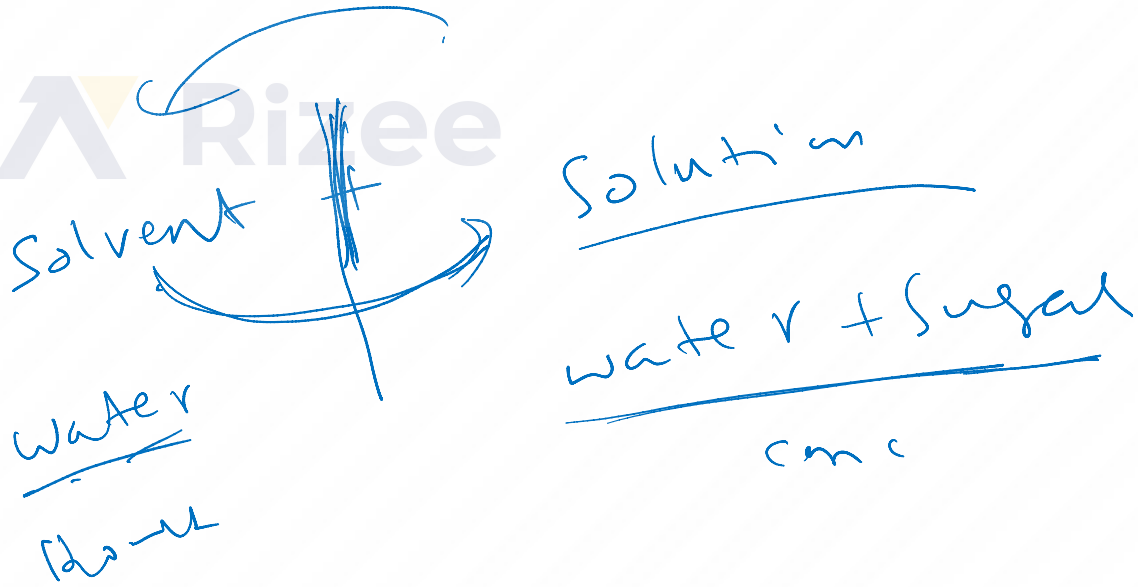
Azeotrope's are the binary mixtures having same composition in liquid, vapours phase & boils at a constant temperature.



10. What is osmosis?

Ans:

The flow of solvent molecules from pure solvent to the solution, when they are separated by a semi – permeable membrane is known as osmosis.



11. Calculate the mole fraction of H_2SO_4 in a solution containing 98% H_2SO_4 by mass.

Ans:

98% H_2SO_4 means 98 parts of H_2SO_4 is present in 100 parts of solution.

wt. of $H_2SO_4 = 98$; Molar mass of $H_2SO_4 = 98$

No. of moles of $H_2SO_4 = \frac{98}{98} = 1$

Wt. of $H_2O = 100 - 98 = 2$ gm; M.w of $H_2O = 18$

No. of moles of $H_2O = \frac{2}{18} = 0.1$

Total moles in solution $= 1 + 0.1 = 1.1$

Mole fraction of $H_2SO_4 = \frac{\text{No. of moles of } H_2SO_4}{\text{Total moles of solution}} = \frac{1}{1.1} = 0.9$

12. A solution of glucose in water is labelled as 10% w/w. What would be the molarity of the solution?

Ans: $10\%\left(\frac{w}{W}\right)$ glucose solution means

100gms of solution contains 10gm of glucose

$\therefore$ weight of glucose $(w) = 10\ gms$

weight of water $(w) = 90\ gms$

$\therefore$ Volume of solution = 90 ml

$$\therefore \text{Molarity} = \frac{w}{gmw} \times \frac{1000}{v \text{ in ml}}$$

$$= \frac{10}{180} \times \frac{1000}{100} = 0.617\ M$$

13. A solution of sucrose in water is labelled as 20% w/w. What would be the mole fraction of each component in the solution?

Ans: $20\%\left(\frac{w}{w}\right)$ sucrose solution means

20gms of sucrose present in 100gm of solution

$\therefore$ weight of sucrose $(w) = 20$ gms

Sucrose : $w_1 = 20;\ n_1 = \frac{w_1}{m_1} = \frac{20}{342} = 0.05848$

Water : $w_2 = 80(100 - 20);\ n_2 = \frac{w_2}{m_2} = \frac{80}{18} = 4.45$

Mole fraction sucrose : $(X_1) = \frac{n_1}{n_1+n_2} = \frac{0.05848}{4.503} = 0.013$

Mole fraction water : $(X_2) = 1 - X_1 = 1 - 0.013 = 0.987$

mole fraction = no. of moles of one component / no. of moles of all components

$C_{12}H_{22}O_{11}$

14. If the osmotic pressure of glucose solution is 1.52 bar at 300K. What would be its concentration if $R = 0.083\ L\ bar\ mol^{-1}\ K^{-1}$?

Ans:

Given Osmotic pressure $\pi = 1.52$ bar

Absolute temp $T = 300\ K$

$R = 0.083\ L\ bar\ mol^{-1}\ K^{-1}$

$C = ?\ ;\ \pi = CRT$,

$1.52 = C \times 0.083 \times 300$

$\therefore C = 0.061\ M$

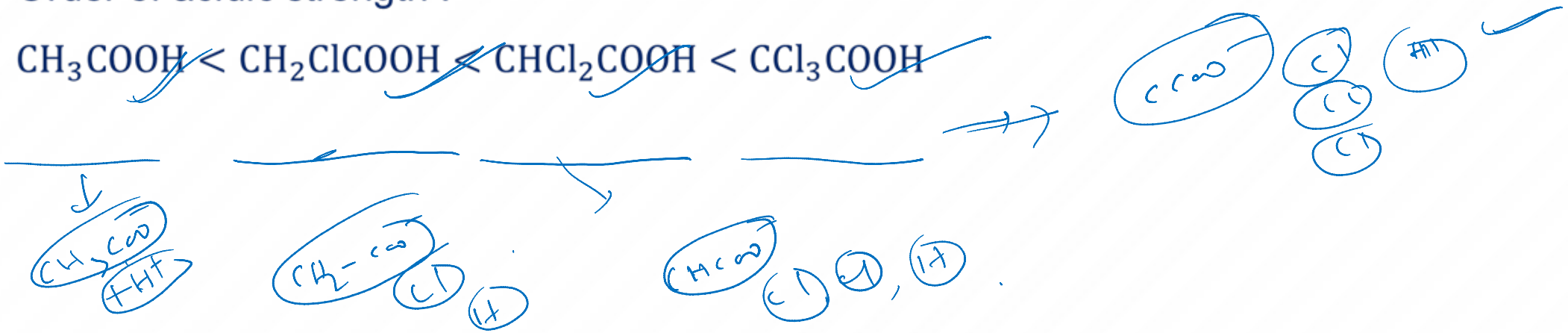
15. The depression in freezing point of water observed for the same amount of acetic acid, dichloroacetic acid and trichloro acetic acid increases in the order given above. Explain briefly.

Ans:

As we move from CH_3COOH to CCl_3COOH the degree of dissociation (α) increases. So no. of particles increases. As no. of the particles increases depression in freezing point also increases.

Order of acidic strength :

$$CH_3COOH < CH_2ClCOOH < CHCl_2COOH < CCl_3COOH$$

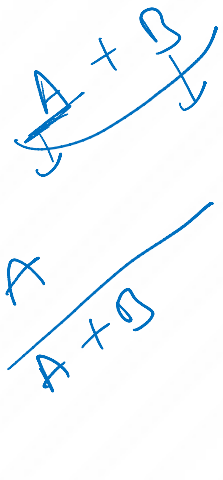


16. Define mole fraction.

Ans:

Mole fraction is the ratio of number of moles of one component to the total number of moles of all components

$$\text{Mole fraction of solute} = \frac{\text{No. of moles of component}}{\text{Total no. of moles of all components in solution}}$$



SHORT ANSWER QUESTIONS :

1. **What is relative lowering of vapour pressure? How is it useful to determine the molar mass of a solute?**

Ans:

i. The ratio of lowering of vapour pressure $(p^0 - p_s)$ to the vapour pressure of the pure solvent (p^0) is known as the relative lowering of vapour pressure $\left(\frac{p^0 - p_s}{p^0}\right)$

ii. According to Raoult's law the relative lowering of vapour pressure of a dilute solution containing non – volatile solute is equal to the mole fraction of the solute.

iii. The molecular weight of solute can be calculated as follows. i.e. $\frac{p^0-p_s}{p^0}=\frac{n_2}{n_1+n_2}$ $\left(\text{Since } x_2=\frac{n_2}{n_1+n_2}\right)$. Where n_1 and n_2 are the number of moles of solvent and solute respectively present in the solution. For dilute solutions $n_2 \ll n_1$, hence n_2 can be neglected in the denominator.

$$\frac{p^0-p_s}{p^0}=\frac{n_2}{n_1}\,;\,\frac{p^0-p_s}{p^0}=\frac{w_2}{M_2}\times\frac{M_1}{w_1}\Rightarrow M_2=\frac{w_2\times M_1\times p^0}{w_1(p^0-p_s)}$$

Where; w_1 = wt. of solvent; w_2 = wt. of solute;

M_1 = Molecular weight of solvent

p_0 =V.P of pure solvent; p_s = V.P of solution;

M_2 = Molecular weight of unknown solute

Solution
Solvent = n_1
Solute = n_2

$n_2 = \frac{w_2}{\text{gmwt}}$

$n_1 = \frac{w_1}{\text{gmwt}}$

2. How many types of solutions are formed ? Give an example for type of solution.

Ans :

There are three types of solutions. They are

(a) Gaseous Solutions : The solutions in which solvent is a gas and solute can be either solid, liquid or gas are known as gaseous solutions.

(b) Liquid Solutions : The solutions in which solvent is a liquid and solute can be either solid, liquid or gas are known as liquid solutions.

(C) Solid Solutions : The solutions in which solvent is a solid and solute can be either solid, liquid or gas are known as solid solutions.

SOLUTIONS

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	
	Solid	Gas	Chloroform mixed with nitrogen gas
	Gas	Liquid	Camphor in nitrogen gas
Liquid Solutions	Liquid	Liquid	Oxygen dissolved in water
	Solid	Liquid	Ethanol dissolved in water
	Gas	Solid	Glucose dissolved in water
Solid Solutions	Liquid	Solid	Solution of hydrogen in palladium
	Solid	Solid	Amalgam of mercury with sodium
			Copper dissolved in gold

THANK YOU