Subject : Chemistry

MLL Questions (Solution)

Q1. Define the following terms:

(a)Mole Fraction (b) Isotonic Solution

(c) Van't Hoff Factor. (d) Ideal Solution

Ans (a) Mole Fraction : It is the ratio of number of moles of a particular component to the total number of moles of all the components.

Example : Mole Fraction of Component A

$X_A = n_A / (n_A + n_B)$ where n_A and n_B are the number of moles of components A and B respectively.

(b) Isotonic Solution: Two Solutions are call Isotonic when they exert some osmotic pressure. All Intravenous injections must be isotonic with body fluids.

(c) Van't Hoff Factor – The ratio of experimental value of a colligative Property to the theoretical value is known as Van't Hoff Factor. It is denoted by i.

i = Experimental Value/ Calculated Value

(d) Ideal Solution : The solution which obey Raoult's Law over the entire range of concentration are known as ideal solution. Ideal solutions have two important properties.

$$\Delta H_{mixing} = 0, \Delta V_{mixing} = 0$$

where forces of attraction between A-A, B-B molecules are similar to A-B then A and B form Ideal Solution.

Q2. Explain Henry's Law about that the solubility of a gas in Liquid is directly proportional to the pressure of the gas.

Ans <u>Henry's Law</u> : It states that the solubility of a gas in Liquid is directly proportional to the pressure of the gas.

$P = K_{H}.x$ where P = Pressure of Gas, X = Mole Fraction of Gas.
K_{H} = Henry's Constant

Q3. State Raoult's Law in its general form in reference to solution
Ans The relative lowering of vapour pressure for a solution is equal to the mole fraction of solute when solvent alone is volatile.

$(P^0_A - P_A)/P^0_A = X_B$
P^0_A = Vapour Pressure of pure Component A.
P_A = Vapour Pressure of Component A in solution.
X_B = Mole Fraction Of Solute

$(P^0_A - P_A)/P^0_A$ = Relative Lowering Of Vapour Pressure
$P^0_A - P_A$ = Lowering Of Vapour Pressure

Q4. Differentiate between molarity and molality for a solution. How does a change in temperation influence their values.

Ans. Molarity : It is defined as the number of moles of solute per litre of solution. It changes by changing the temperature. It is denoted by M.
Molality : It is defined as the number of moles of solute per kg of solvent. It is not affected by temperature. It is denoted by 'm'.

Q5. What is meant by colligative property?

Ans Those properties of solution which depend upon the number of particles of solute and solvent but not on the nature of solute are called Colligative Properties.

Q6. List any four factors on which the Colligative Properties of a solution depends.

Ans (a) Number Of particles of solute

(b) Association / Dissociation

(c) Concentration of solution

(d) Temperature.

Q7. What is Ebullioscopic Constant?

Ans It is equal to the elevation in boiling point of one molal solution.

$\Delta T_b = K_b \times m$, when m = 1

$\Delta T_b = K_b$

The unit of K_b is $K.Kg.mol^{-1}$.

Q8. An aqueous solution containing 12.48 gm of Barium Chloride in 1.0 Kg of water boils at 373.0832 K. Calculate the degree of dissociation of Barium Chloride. (Given K_b for H_2O = 0.52 $KM^{-1.}$ Molar mass of $BaCl_2$ = 208.34 gm mol^{-1})

Ans $\Delta T_f = 0.69K.$ $K_f = 5.1$ K/m

$W_B = 20$ gm, $W_A = 1$ Kg = 1000 gm

$\Delta T_f = i \times W_A / M_B \times 1000/ W_A \times K_f$

or $0.69 = i \times 20/94 \times 1000/1000 \times 5.1$

$i = \frac{0.69 \times 94}{20 \times 5.1} = \frac{64.86}{102} = 0.635$

Now, $\alpha = 1\text{-}i/ 1\text{-}\frac{1}{n} = (1 - 0.635)/1\text{-}\frac{1}{2} = 0.365 / \frac{1}{2} = 0.730$

A = Degree of dissociation = 0.73 x 100 = 73%

Q9. Determine the amount of $CaCl_2$ (I =2.47) dissolved in 2.5 litres of water such that its osmotic pressure is 0.75 atm at 27^0C.

Ans $\pi = i\ CRT$

$\pi = i \times \frac{nRT}{V}$

$\pi\ v = i\ nRT$

$\pi\ v = i \times W_A / M_B\ RT$

$0.75 \times 2.5 = 2.47 \times W_B / 111 \times 0.082 \times 300$

$W_B = \frac{0.75\ x\ 2.5\ x\ 111}{2.47\ x\ 24.6} = 3.425$ grams

W_B = Mass of solute $CaCl_2$

M_B = GMM of solute

π = Osmotic Pressure = 0.75 atm

v = Volume of Solution