Solutions

Que 1: The principle behind the desalination of sea water using a semi-permeablemembrane is:Marks :(1)

a) Diffusion b) reverse osmosis c) elevation of boiling point d) depression of freezing point

Ans: Reverse osmosis

Que 2: The most suitable concentration term used when the solute is present in trace amount is: Marks :(1)

a) Molality b) Molarity c) Parts per million d) mass percent

Ans: c) Parts per million

Que 3: Acetic acid undergoes dimerisation in benzene. If there is 100% association, the value of van't Hoff factor (i) becomes: *Marks :(1)*

Ans: i = (normal molar mass)/(observed molar mass)

= M/2M

=1/2

Que 4: Our blood cells are isotonic with 0.9% (mass/volume) NaCl solution.

a. What are isotonic solutions?

b. What happens when the blood cells are placed in a solution containing more than 0.9% (mass/volume) NaCl solution? *Marks :(*2)

Ans:

- a. Solutions having same osmotic pressure at a given temperature.
- b. Blood cells will shrinkas water flows out of the cell due to osmosis.

Que 5: Solubility of a gas in a liquid is affected by many factors like temperature, pressure, nature of the gas etc. *Marks :(4)*

- a. 'Aquatic species are more comfortable in cold waters rather than in warm waters.' Account for this statement.
- b. What is the effect of pressure in the solubility of a gas in a liquid?
- c. Name the law which relates solubility of a gas in a liquid and its partial pressure and state it?

Ans:

- a. When temperature decreases, solubility of O₂ in water increases/ cold water contains more dissolved oxygen than warm water.
- b. When pressure increases, solubility of the gas also increases/ solubility of a gas in a liquid is directly proportional to the pressure of the gas.
- c. Henry's law (1 score) Statement

Que 6: The components of a mixture of 68% by mass of Nitric acid in water cannot be separated by fractional distillation. *Marks :(2)*

a) Give reason for the above observation.

b) Which type of deviation from Raoult's law is shown by the above mixture?

Ans: a) formation of an azeotropic mixture/constant boiling mixture/same composition in liquid and vapour phase when the mass% of HNO₃ is 68%

b) negative deviation from Raoult's law.

Que 7: The principle behind the desalination of sea water using a semi-permeable membrane is: *Marks :(1)*

a) Diffusion b) reverse osmosis c) elevation of boiling point d) depression of freezing point

Ans: b) reverse osmosis

Que 8: a) Mention the conditions to be satisfied for an ideal solution.

b) Heptane and octane form an ideal solution. At 373K, the vapour pressures of the pure liquids are 105.2 kPa and 46.8 kPa respectively. What will be the vapour pressure of a mixture of 26g of heptanes and 35g of octane? *Marks :(4)*

Ans:

- a. Obey Raoult's law (P₁ = P⁰₁x₁, P₂ = P⁰₂x₂), $\Delta H_{mix} = 0$ and $\Delta V_{mix} = 0$ [Any 2 characteristics)
- b. No. of moles of hexane and octane (1 score) Mole fraction of hexane and octane Total pressure of the mixture

Que 9: In which of the following solvent NaCl dissolves – water or kerosene? Why? Marks :(2)

Ans: Water due to similar inter molecular interactions/like dissolves like/high dielectric constant of water/polar nature of NaCl and water/ kerosene on the other hand is polar

Que 10: A mixture of ethanol and acetone form non-ideal solution with positive deviation from Raoult's law. Give reason and represent the deviation graphically. *Marks :(3)*

Ans: Due to decrease in inter molecular attraction/A-B interaction is weaker than A-A interaction or B-B interaction/due to weakening of H-bonding in ethanol.

Graphical representation

Que 11: Define molarity and molality. *Marks :(1)*

Among molarity and molality which depends on temperature ? Explain.

Ans: Number of moles per litre of solution is called Molarity and number of moles per kilogram of solvent is molality. As temperature changes volume also changes

Que 12: Molarity (M), Molality (m) and mole fraction (x) are some methods for expressing concentration of solutions. *Marks :(4)*

a) Which of these are temperature independence

b) define molarity

c) A mixture containing 3.2 gram methanol (molecular mass = 32u) and 4.6 gram ethanol

(molecular mass = 46u). Find the mole fraction of each component

Ans: a) Molality and Mole fractionb) Molarity is the number of moles of solute per litre of solution.

c) Molecular mass of methanol = 32 u
No. of moles of methanol = 3.2 / 32 = 0.1 moles

Molecular mass of ethanol = 46No. of moles of ethanol = 4.6 / 46 = 0.1

Total no. of moles of all the components = 0.1 + 0.1 = 0.2mole fraction of methanol = 0.1 / 0.2 = 0.5mole fraction of ethanol = 0.1 / 0.2 = 0.5

Que 13: In a solution of two liquid components A & B, at molecular level, A-B attractions are weaker than those between A-A and B-B. Then the type of deviation shown by this solution is *Marks :(1)*

Ans: Positive Deviation

Que 14: What are Ideal Solutions? Give the condition for their formation. *Marks :(1)*

Ans: The solutions which obey Raoult's Law over the entire range of concentration and temperature are called Ideal Solutions.

 $DH_{mix}=0$ and $DV_{mix}=0$

Que 15: What are colligative properties? Marks :(2)

Ans: Properties of dilute solutions which depend on the relative number of solute particles are called colligative properties.

Eg. Osmotic pressure

Que 16: Write one application of reverse osmosis Marks :(1)

Ans: Desalination of sea water

Que 17: Derive an expression to find molar mass of an unknown solute by elevation of boiling point method. *Marks :(2)*

Ans: $\Delta T_b = K_b.m$

 $\Delta T_b = (K_b. w_2 \times 1000) / M_2.w_1$

Or, $M_2 = (K_b. w_2 \times 1000) / \Delta T_b. w_1$

Que 18: Which of the following concentration terms depends on temperature? *Marks :(1)*

- a. Mole fraction
- b. Molarity
- c. Molality
- d. Mass percent

Ans: c. Molarity

Que 19: a. Define colligative properties.

b. Write an expression for the calculation of molar mass of a solute from its osmotic pressure.

c. At 298K, the osmotic pressure of 100 mL solution containing 3.002g of an unknown solute is found as 2.55atm. Calculate the molar mass of the solute. *Marks :(4)*

Ans: a. Properties of dilute solutions which depend only on the relative number of solute particles are called colligative properties

b. $M_2 = w_2 RT / \pi V$

C. $M_2 = w_2 RT / \pi V$

= $(3.002 \text{ g} \times 0.0821 \text{ L} \text{ atm } \text{K}^{-1} \text{ mol}^{-1} \times 298 \text{ K}) / (2.55 \text{ atm } \times 0.1 \text{ L})$

= 288 g mol⁻¹

Que 20: Which colligative property is preferred for the molar mass determination of macromolecules and why ? Marks :(2)

Ans: Osmotic pressure measurement is preferred over all other colligative properties because,

(i) even in dilute solutions, the osmotic pressure values are high and can be measured accurately.

(ii) Osmotic pressure is measured even at room temperature while elevation in boiling point is determined at high temperature where the solute may decompose or denatured.

Que 21: a) What is meant by Non-ideal solution? *Marks :(3)*

b) Which type of deviation shown by the mixture of ethanol and water. Explain?

Ans: a) Does not obey Raoults law. Change in enthalpy of mixing and change in volume of mixing not equal to zero.

b) positive deviation. Attraction between water and ethanol molecule is lower than the attraction between two water molecules and two ethanol molecules.

Que 22: Why is ethylene glycol added to the water used in the radiator of a car while driving in a hill station? *Marks :(2)*

Ans: Ethylene glycol acts as an antifreeze. It does not allow the water to freeze in the radiator. When a non-volatile solute is added to a solvent, freezing point decreases

Que 23: Explain why sodium chloride or anhydrous calcium chloride is used to clear snow on roads. *Marks :(2)*

Ans: Both NaCl and CaCl₂, being non-volatile solutes, bring depression in the freezing point of water. This helps to melt snow even below 0^o C.

Que 24: When two liquids are mixed, the resulting solution is found to be cooler. What do you conclude about deviation from ideal behaviour? *Marks :(1)*

Ans: As the heat energy is absorbed, i.e., $\Delta H = + ve$, there will be positive deviation from ideal behaviour.

Que 25: Mixing of acetone with chloroform takes place with reduction in volume. What type of deviation from Raoult's law is shown in this case? *Marks :(2)*

Ans: On mixing the two liquids, the formation of intermolecular hydrogen bonding takes place, i.e., the molecules of the two constituents come closer to each other and hence, reduction in volume. i.e., $\Delta V_{mix} < 0$. Thus, it shows negative deviation.

Que 26: Arrange the following in increasing order of their boiling points: 0.001 MNaCl, 0.001 M urea, 0.01 M MgCl₂, 0.01 M NaCl.Marks :(2)

Ans: 0.001 M urea < 0.001 M NaCl < 0.01 M NaCl < 0.01 M MgCl₂.