SOLUTIONS, BOARD PAPER QUESTION: 2022-2013

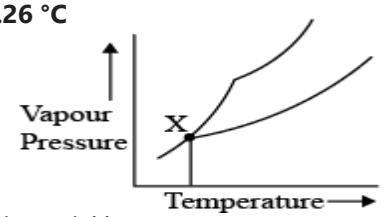
YEAR 2022

1.Which one of the following pairs will form an ideal solution?
(a)Chloroform and acetone. (b) Ethanol and acetone. (c) n-hexane and n-heptane. (d) Phenol and aniline
2. Which of the following formula represents Raoult's law for a solution containing non-volatile solute?

(a) $P_{solute} = P^{o}_{solute} \cdot X_{solute}$. (b) $P = K_{H}.X$. (c) $P_{total} = P_{solvent}$. (d) $P_{solute} = P^{0}_{solvent} X_{solvent}$

3. An azeotropic solution of two liquids has a boiling point lower than either of the two when it
(a) shows a positive deviation from Raoult's law. (b) shows a negative deviation from Raoult's law.
(c) shows no deviation from Raoult's law. (d) is saturated.
4. On mixing 20 mL of acetone with 30 mL of chloroform, the total volume of the solution is
(a) < 50 mL. (b) = 50 mL (c) > 50 mL. (d) = 10 mL
5. Elevation of boiling point is inversely proportional to
(a) molal elevation constant (K_b). (b) molality (m). (c) molar mass of solute (M). (d) weight of solute (W)
6. An unknown gas 'X' is dissolved in water at 2.5 bar pressure and has mole fraction 0.04 in solution. The molefraction of 'X' gas when the pressure of gas is doubled at the same temperature is
(a) 0.08. (b) 0.04. (c) 0.02. (d) 0.92

7. The boiling point of a 0.2 m solution of a non-electrolyte in water is (K_b for water = 0.52 K kg mol^{-1})
(a) 100 °C (b) 100.52 °C (c) 100.104 °C (c) 100.26 °C
8. In the following diagram point, 'X' represents
(a) Boiling point of solution
(b) Freezing point of solvent
(c)Boiling point of solvent
(d) Freezing point of solution



9. The question consists of two statements – **Assertion (A)** and **Reason (R).**
Assertion (A): A raw mango placed in a saline solution loses water and shrivel into pickle.
Reason (R): Through the process of reverse osmosis, raw mango shrivel into pickle.
Select the most appropriate answer from the options given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

YEAR 2020

1. Assertion (A) : 0.1 M solution of KCl has greater osmotic pressure than 0.1 M solution of glucose at same temperature,
Reason (R) : In solution, KCI dissociates to produce more number of particles.
Select the most appropriate answer from the options given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.
2.State Raoult's law for a solution containing volatile components. What is the similarity between Raoult's lawand Henry's law?
3. A 0.01 m aqueous solution of $AlCl_3$ freezes at – 0.068 °C. Calculate the percentage of dissociation.
[Given: $K_f$for Water = 1.86 K kg mol^{-1}]
4. Assertion (A) : Elevation in boiling point is a colligative property.
Reason (R) : Elevation in boiling point is directly proportional to molarity.
Select the most appropriate answer from the options given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

YEAR 2019

1. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution whichobeys Raoult's law at all concentrations.
2. A 4% solution(w/w) of sucrose (M = 342 g mol^{-1}) in water has a freezing point of 271.15 K. Calculate thefreezing point of 5% glucose (M = 180 g mol^{-1}) in water. (Given: Freezing point of pure water = 273.15 K)
3. Write two differences between an ideal solution and a non-ideal solution.
4. State Henry's law and write its two applications.

YEAR 2018

1. Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g ofwater.
(K_f of water = 1.86 K kg mol^{-1})
2. Give reasons for the following:
(i) Measurement of osmotic pressure method is preferred for the determination of molar masses ofmacromolecules such as proteins and polymers.
(ii) Aquatic animals are more comfortable in cold water than in warm water.
(iii)Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.

YEAR 2017

1. Define the following terms: **(i) Colligative properties (ii) Molality (m). (iii) Abnormal molar mass**
2. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of10% glucose in water, if freezing point of pure water is 273.15 K.
3.Define the following terms: **(i) Ideal solution. (ii) Molarity (M)**

4. 30 g of urea (M = 60 g mol^{-1}) is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23·8 mm Hg.
5. Write two differences between ideal solutions and non-ideal solutions.

YEAR 2016

1. Calculate the freezing point of solution when 1.9 g of $MgCl_2$ (M = 95 g mol^{-1}) was dissolved in 50 g of water, assuming $MgCl_2$ undergoes complete ionization. (K_f for water = 1.86 K kg mol^{-1})
2. (i) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?
   (ii) What happens when the external pressure applied becomes more than the osmotic pressure of solution?
3. When 2.56 g of sulphur was dissolved in 100 g of CS_2, the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_x). (K_f for CS_2 = 3.83 K kg mol^{-1}, Atomic mass of sulphur = 32 g mol^{-1}]
4. Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing
(i) 1.2% sodium chloride solution?
(ii) 0.4% sodium chloride solution?
5. Gas (A) is more soluble in water than Gas (B) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why?
6. In non-ideal solution, what type of deviation shows the formation of maximum boiling azeotropes?
7. Calculate the boiling point of solution when 4 g of $MgSO_4$ (M = 120 g mol^{-1}) was dissolved in 100 g of water, assuming $MgSO_4$ undergoes complete ionization. (K_b for water = 0.52 K kg mol^{-1})

YEAR 2015

1. Why does a solution containing non-volatile solute have higher boiling point than the pure solvent ? Why is elevation of boiling point a colligative property ?
2. Calculate the freezing point of the solution when 31 g of ethylene glycol ($C_2H_6O_2$) is dissolved in 500 g of water.
(K_f for water = 1.86 K kg mol^{-1})
3. What is meant by negative deviation from Raoult's law? Give an example. What is the sign of $\Delta_{mix}H$ for negative deviation?
4. Define azeotropes. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.
5. Calculate the mass of NaCl (molar mass = 58.5 g mol^{-1}) to be dissolved in 37.2 g of water to lower the freezing point by 2°C, assuming that NaCl undergoes complete dissociation. (K_f for water = 1.86 K kg mol^{-1})
6. What is meant by positive deviations from Raoult's law? Give an example. What is the sign of $\Delta_{mix}H$ for positive deviation?
7. Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law ? Give an example.
8. 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated).
(Given : Molar mass of benzoic acid = 122 g mol^{-1}, K_f for benzene = 4.9 K kg mol^{-1})

YEAR 2014

1. Define the following terms: **(i)Cryoscopic constant. (ii) Molal elevation constant (K_b)**
2. A solution containing 15 g urea (molar mass = 60 $gmol^{-1}$) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 180 $gmol^{-1}$) in water. Calculate the mass of glucose present in one litre of its solution.
3. What type of deviation is shown by a mixture of ethanol and acetone? Give reason.
4. A solution of glucose (molar mass = 180 $gmol^{-1}$) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution? (Density of solution = 1.2 gmL^{-1})
5. Some liquids on mixing form 'azeotropes'. What are 'azeotropes'?
6. State Henry's Law. What is the effect of temperature on the solubility of a gas in a liquid?
7. the mass of a compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}).
8. Calculate the mass of a compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}).
9. Define an ideal solution and write one of its characteristics.
10. What type of intermolecular attractive interaction exists in the pair of methanol and acetone?

YEAR 2013

1. State Raoult's law for a solution containing volatile components. How does Raoult's law become a special case of Henry's law?
1·00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0·40 K. Find the molar mass of the solute. (K_f for benzene = 5·12 K kg mol^{-1})
2. Define the following terms : **(i) Isotonic solution. (ii) Osmotic pressure. (iii) Reverse Osmosis**
3. A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution?
(Molar mass of glucose = 180 g mol^{-1})
4. 18 g of glucose, $C_6H_{12}O_6$ (Molar Mass = 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K)
5. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2L of water at 25°C, assuming that it is completely dissociated. (R = 0.0821 L atm K^{-1} mol^{-1}, Molar mass of K_2SO_4 = 174 g mol^{-1})
6. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 kg mol^{-1})
7. Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2K. (K_f for water = 1.86 K kg mol^{-1})