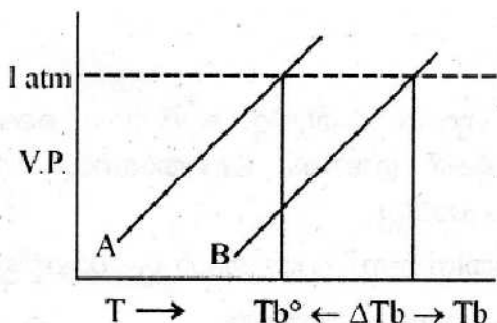


Previous HSE Questions from the chapter "SOLUTIONS"

1. Draw the vapour pressure-mole fraction curve for a non-ideal solution having positive deviation, if A and B are the two volatile components. (2)
2. Calculate the depression in freezing point of a 0.2 molal solution if k_f for water is $1.86 \text{ K kg mol}^{-1}$. (2) [SAY 2018]
3. A solution contains 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution. (2)
4. Define minimum boiling azeotropes with example. (2) [March 2018]
5. a) The mole fraction of water in a mixture containing equal number of moles of water and ethanol is:
i) 1 ii) 0.5 iii) 2 iv) 0.25 (1)
b) The following are the vapour pressure curves of a pure solvent and a solution of a non-volatile solute in it.



Based on the above curves answer the following questions.

- i) What do the curves A and B indicate? (1)
 - ii) Explain why the value of T_b is greater than that of T_b^0 . (2) [SAY 2017]
6. a) Henry's law is related to solubility of a gas in liquid.
(i) State Henry's law. (2)
(ii) Write any two applications of Henry's law. (2)
b) 1000 cm^3 of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300K is found to be $2.57 \times 10^{-3} \text{ bar}$. Calculate the molar mass of the protein. ($R = 0.083 \text{ L bar/K/mol}$). (2) [March 2017]
 7. Osmotic pressure is a colligative property.
a) What is osmotic pressure? (1)
b) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40K. The freezing point depression constant of benzene is 5.12 K kg/mol . Find the molar mass of the solute. (3) [SAY 2016]
 8. a) Number of moles of the solute per kilogram of the solvent is:
(a) Mole fraction (b) Molality (c) Molarity (d) Molar mass (1)
(b) 'The extent to which a solute is dissociated or associated can be expressed by Van't Hoff factor.' Substantiate the statement. (1)

- (c) The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A nonvolatile, non-electrolyte solid weighing 0.5 g when added to 39 g of benzene (molar mass 78 g mol^{-1}), vapour pressure becomes 0.845 bar. What is the molar mass of the solid substance? (2) [March 2016]
9. a) Draw a vapour pressure curve, by plotting vapour pressure against mole fraction of an ideal solution of two components A and B. indicate partial vapour pressure of A and B (P_A and P_B) and the total vapour pressure (P_{Total}). (2)
- b) What is an ideal solution? (1)
- c) Modify the above plot for non-ideal solution showing positive deviation. (Draw the above plot once again and modify.) (1) [SAY 2015]
10. a) Among the following, which is not a colligative property?
- i) Osmotic pressure ii) Elevation of boiling point iii) Vapour pressure iv) Depression of freezing point (1)
- b) i) 200 cm^3 of aqueous solution of a protein contains 1.26 g of protein. The osmotic pressure of the solution at 300 K is found to be $8.3 \times 10^{-2} \text{ bar}$. Calculate the molar mass of protein. ($R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$) (2)
- ii) What is the significance of Van't Hoff factor? (1) [March 2015]
11. Molarity (M), molality (m) and mole fraction (x) are some methods for expressing concentration of solutions.
- a) Which of these are temperature independent? (1)
- b) Define mole fraction? (1)
- c) A mixture contains 3.2g methanol (molecular mass = 32u) and 4.6g ethanol (molecular mass = 46u). Find the mole fraction of each component. (2) [SAY 2014]
12. Osmotic pressure is a colligative property and it is proportional to the molarity of the solution.
- a) What is osmotic pressure? (1)
- b) Molecular mass of NaCl determined by osmotic pressure measurement is found to be half of the actual value. Account for it? (1)
- c) Calculate the osmotic pressure exerted by a solution prepared by dissolving 1.5 g of a polymer of molar mass 185000 in 500ml of water at 37°C . ($R = 0.0821 \text{ L atm/K/mol}$) (2) [March 2014]
13. Liquid solutions can be classified into ideal and non-ideal solutions on the basis of Raoult's law.
- a) State Raoult's law. (1)
- b) What are ideal solutions? (1)
- c) Write any two properties of ideal solutions. (1)
- d) What type of deviation is shown by a mixture of chloroform and acetone? Give reason. (1)
- [SAY 2013]
14. Elevation of boiling point is a colligative property.
- i) What are colligative properties? (1)
- ii) Elevation of boiling point (ΔT_b) is directly proportional to molality (m) of solution. Thus $\Delta T_b = K_b \cdot m$, K_b is called the molal elevation constant. From the above relation derive an expression to obtain molar mass of the solute. (1)



iii) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11K. Calculate the molar mass of the solute. K_b for benzene is $2.53 \text{ K kg mol}^{-1}$. (1) [MARCH 2013]

15. Colligative properties are properties of solution which depend on the number of solute particles in the solution.



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i) Write the names of four important colligative properties. (2)

ii) The value of van't Hoff factor 'i', for aqueous KCl solution is close to 2, while that for ethanoic acid in benzene is nearly 0.5. Give reason. (2) [SAY 2012]

16. Vapour pressure of a solution is different from that of pure solvent.

i) Name the law which helps us to determine partial vapour pressure of a volatile component in a solution. ($\frac{1}{2}$)

ii) State the above law. (1)

iii) Vapour pressure of chloroform (CHCl_3) and dichloromethane (CH_2Cl_2) at 298K are 200 mm of Hg and 415 mm of Hg respectively. Calculate the vapour pressure of solution prepared by mixing 24g of chloroform and 17g of dichloromethane at 298K. ($2\frac{1}{2}$) [MARCH 2012]

17. Colligative properties can be used to determine the molar mass of solutes in solutions.

a) What do you mean by colligative properties? (1)

b) For determining the molecular mass of polymers, osmotic pressure is preferred to other properties. Why? (1)

c) For intravenous injections only solutions with osmotic pressure equal to that of 0.9% NaCl solution is used. Why? (2) [MARCH 2011]

18. Relative lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure are important colligative properties of dilute solutions.

a) Relative lowering of vapour pressure of an aqueous dilute solution of glucose is 0.018. What is the mole fraction of glucose in the solution? (1)

b) An aqueous dilute solution of a non-volatile solute boils at 373.052K. Find the freezing point of the solution. For water $K_b = 0.52 \text{ K kg mol}^{-1}$ and $K_f = 1.86 \text{ K kg mol}^{-1}$. Normal boiling point of water = 373K and normal freezing point = 273K. (3) [SAY 2011]

19. Colligative properties are properties of solution which depend on the number of solute particles in the solution irrespective of their nature.

a) Name the four important colligative properties. (2)

b) What happens to the colligative properties when ethanoic acid is treated with benzene? Give reason. (2) [MARCH 2010]
