CHAPTER -2

SOLUTIONS

No. of Questions: 73

MM :157

1	State the main advantage of molality over molarity as the unit of concentration.	1
2	10 mL of liquid A was mixed with 10 mL of liquid B. The volume of the resulting solution was found to be 19.9 mL. What do you conclude?	1
3	Give reason when 30 mL of ethyl alcohol and 30 mL of water are mixed, the volume of resulting solution is more than 60 mL.	1
4	Two liquids A and B boil at 145 °C and 190 °C respectively. Which of them has a higher vapour pressure at 80 °C?	1
5	What are the values of ΔH and ΔV for an ideal solution of two liquids?	1
6	Which has the highest freezing point? (a) 1 M glucose (b) 1 M NaCl (c) 1 M $CaCl_2$ (d) 1 M AlF_3	1
7	Measurement of which colligative property is preferred for determination of molar mass.	1
8	Give an example of a material used for making semipermeable membrane for carrying out reverse osmosis.	1
9	A 10% solution of urea is isotonic with 20% solution of 'x' at same temperature. Calculate molecular weight of x.	1
10	What is expected value of van't Hoff factor for $K_3[Fe(CN)_6]$.	1
11	Why do doctors advise gargles by saline water in case of sore throat?	1
12	When outer shell of two eggs are removed, one of the eggs is placed in pure water and other is placed in saturated solution of NaCl, what will be observed and why?	1
13	What is the cause of anoxia?	1
14	What is expected van't Hoff factor for K4[Fe(CN)6]?	1
15	What is the value of *i* for Na2SO4.10 H2O assuming complete ionisation?	1
16	Why is osmotic pressure of 1 M KCl is higher than that of 1 M urea solution?	1

17 State Raoult's Law for a solution containing volatile components. How does Raoult's law become a special case of Henry's Law? 2

18 A solution is prepared by dissolving 10 g of non-volatile solute in 200 g of water. It has a vapour pressure of 31.84 mm Hg at 308 K. Calculate the molar mass of the solute. (Vapour pressure of pure water at 308 K = 32 mm Hg) 2

19 The vapour pressure of pure benzene at a certain temperature is 0.85 bar. A non-volatile, non-electrolyte solid weighing 0.5 g is added to 39.0 g of benzene (molar mass 78 g mol^{-1}). Vapour pressure of the solution, then, is 0.845 bar. What is the molar mass of the solid substance? 2

20 Derive expression for Raoult's law when the solute is non-volatile. 2

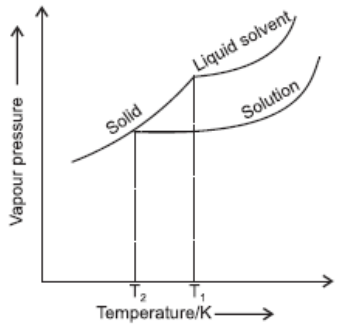
21 18 g of glucose, $C_6H_{12}O_6$, is dissolved in 1 kg of water in a saucepan. At what temperature will water boil at 1.103 bar? (K_b for H_2O is 0.52 k kg mol^{-1}) 2

22 Find the boiling point of a solution containing 0.520 g of glucose ($C_6H_{12}O_6$) dissolved in 80.2 g of water. [Given: K_b for water = 0.52 K/m] 2

23 The boiling point of benzene is 353.23 K. When 1.80 g of non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K Calculate the molar mass of solute. K_b for benzene is 2.53 K kg mol^{-1}. 2

24 1.0 g of a non-electrolyte solute dissolved in 50.0 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is 5.12 K kg mol^{-1}. Find the molar mass of the solute. 2

25 An aqueous solution of solidum chloride freezes below 273 K. Explain the lowering in freezing points of water with the help of a suitable diagram.



2

26 200 cm^3 of an aqueous solution of protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 K is found to be 2.57×10^{-3} bar. Calculate the molar mass of the protein. 2

27 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 K kg mol^{-1}) 2

28 A 0.561m solution of an unknown electrolyte depresses the freezing point of water by 2.93 °C. What is van't Hoff factor for this electrolyte? The freezing point depression constant (K_f) for water is 1.86 °C kg mol^{-1}. 2

29 The elevation in boiling point of 0.1 molal solution of X in water is 0.1536 °C. What conclusion do you draw about the molecular state of X? [Given: K_b = 0.512 K kg mol^{-1}] 2

30 What is meant by positive deviations from Raoult's law? Give an example. What is the sign of $\Delta_{mix}H$ for positive deviation? 2

31 (i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?
(ii) What happens when we place the blood cell in water (hypotonic solution)? Give reason. 2

32 What is meant by negative deviation from Raoult's law? Give an example. What is the sign of $\Delta_{mix}H$ for negative deviation? 2

33 Calculate the boiling pt. of 1 molar solution of solute (Molar mass 74.5 g mol^{-1}).Density of solution is 1.04 g mL^{-1} and K_b for water is 0.52 K kg mol^{-1}. 2

34 The freezing point of a solution composed of 5.85 g of NaCl in 100 g of water is –3.348 °C. Calculate the van't Hoff factor 'i' for this solution. K_f (water) = 1.86 K kg mol^{-1}. 2

35 At 25 °C the saturated vapour pressure of water is 3.165 kPa (23.75 mm Hg). Find the saturated vapour pressure of a 5% aqueous solution of urea (carbamide) at the same temperature. (Molar mass of urea = 60.05 g mol^{-1}) 3

36 Some ethylene glycol, $HOCH_2—CH_2OH$ is added to your car's cooling system along with 5 kg of water. If the freezing point of water glycol solution is –15 °C, what is the boiling point of the solution? [K_b = 0.52 K kg mol^{-1}, K_f = 1.86 K kg mol^{-1}] 3

37 15 g of an unknown molecular substance was dissolved in 450 g of water. The resulting solution freezes at – 0.34 °C. What is the molar mass of the substance? (K_f for water = 1.86 K kg mol^{-1}) 3

38 Calculate the mass of compound (molar mass = 256 g mol^{-1}) to dissolved in 75 g of benzene to lower freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}). 3

39 Calculate the amount of sodium chloride which must be added to one kilogram of water so that the freezing point of water is depressed by 3 K. [Given: K_f = 1.86 K kg mol^{-1}, Atomic mass: Na = 23.0, Cl = 35.5] 3

40 0.1 mole of acetic acid was dissolved in 1 kg of benzene. Depression in freezing point of benzene was determined to be 0.256 K. What conclusion can you draw about the state of the solute in solution? [Given: K_f for benzene = 5.12 K/m] 3

41 0.6 mL of acetic acid (CH_3COOH), having density 1.06 g mL^{-1}, is dissolved in 1 litre of water. The depression in freezing point observed for this strength of acid was 0.0205 °C. Calculate the van't Hoff factor and the dissociation constant of acid. 3

42 Calculate the amount of $CaCl_2$ (molar mass 111 g mol^{-1}) which must be added to 500 g of water to lower the freezing point by 2K, assuming $CaCl_2$ is completely dissociated. (K_f = 1.86 K kg mol^{-1}) 3

43 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}) 3

44 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}) 3

45 A 5% solution by mass of cane sugar, $C_{12}H_{22}O_{11}$ (molecular weight 342) is isotonic with 0.877% solution of substance 'X'. Find the molecular weight of substance X. 3

46 6.90 M solution of KOH in water contains 30% by mass of KOH. Calculate density and molality of KOH solution. [K = 39, O = 16, H = 1] 3

47 What is the mass of precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50 mL of 5.8% solution of NaCl? [Ag = 108.0, N = 14, O = 16, Na = 23, Cl = 35.5] 3

48 How does mole fraction of HCl gas in its solution in cyclohexane varies with partial pressure of HCl(g)? Show with the help of graph? How can we calculate K_H with the help of graph? Name two factors which affect the value of K_H? 3

49 Vapour pressure of water at 20 °C is 17.5 mm Hg, Calculate the vapour pressure of water at 20 °C when 15 g glucose (molecular weight 180 g mol^{-1}) is dissolved in 150 g of water. 3

50 An aqueous solution of 3.12 g of $BaCl_2$ in 250 g of water is found to boil at 100.0832 °C. Calculate the degree of dissociation of $BaCl_2$. [K_b (H_2O) = 0.52 K/m.] 3

51 Calculate the freezing point of 1 molar aqueous solution of KCl. (Density of soln = 1.04 g cm^{-3}, K_f = 1.86 K kg mol^{-1}, At. Wt. of K = 39 and Cl = 35.5) 3

52 (a) A sample of water was found to contain dissolved oxygen (O_2) to the extent of 5 ppm and hardness due to Mg^{2+} is 15 ppm. Calculate the amount of O_2 and number of Mg^{2+} in 1 litre of water (density of water = 1g/mL). (b) What volume of 98% sulphuric acid (d = 1.84 g cm^{-3}) and what mass of water must be required to prepare 500 cm3 of 15% solution of H_2SO_4 (d = 1.10 g cm^{-3})? [H = 1, S = 32, O = 16 u] 5

53 (a) Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?
(b) Calculate the freezing point of an aqueous solution containing 10.50 g of $MgBr_2$ in 200 g of water. (Molar mass of $MgBr_2$ = 184 g) (K_f for water = 1.86 K kg mol^{-1}) 5

54 (a) List any four factors on which the colligative properties of a solution depend.
(b) Calculate the boiling point of one molar aqueous solution (density 1.06 gmL^{-1}) of KBr. 5
[Given: K_b for H_2O = 0.52 K kg mol^{-1}, Atomic mass: K = 39, Br = 80]

55 (a) Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and how are they caused?
(b) What mass of NaCl (molar mass = 58.5 g mol^{-1}) must be dissolved in 65 g of water to lower the freezing point by 7.50 °C? The freezing point depression constant, K_f for water is 1.86 K kg mol^{-1}. Assume van't Hoff factor for NaCl is 1.87. 5

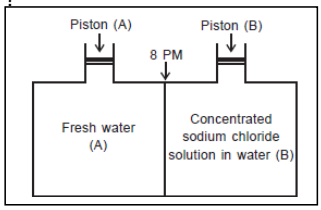
56 (a) Explain why a solution of chloroform and acetone shows negative deviation from Raoult's law.
(b) Phenol associates in benzene to certain extent to form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerised. [Given K_f for benzene = 5.1 Km^{-1}] 5

57 (a) Define the terms osmosis and osmotic pressure. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions?
(b) A solution prepared from 1.25 g of oil of wintergreen (methyl salicylate) in 90.0 g of benzene has a boiling point of 80.31 °C. Determine the molar mass of this compound. (Boiling point of pure benzene = 80.10 °C and K_b for benzene = 2.53 °C kg mol^{-1}) 5

58 (a) Differentiate between molarity and molality of a solution. How can we change molality value to a solution into molarity value.
(b) What is the mole fraction of the solute in a 1.00 m aqueous solution 5

59 (a) Assuming complete ionisation, calculate the expected freezing point of solution prepared by dissolving 6.00 g of Glauber's salt, $Na_2SO_4.10H_2O$ in 0.1 kg of H_2O. (K_f for H_2O = 1.86 K kg mol^{-1}) [At. mass of Na = 23, S = 32, O = 16, H = 1 u]. 5
(b) Two liquids X and Y boil at 110 °C and 130 °C respectively. Which of them has higher vapour pressure at 50 °C ?

60 Consider the figure and mark the correct option. (a) water will move from side (A) to side (B) if a pressure lower than osmotic pressure is applied on piston (B).
(b) water will move from side (B) to side (A) if a pressure greater than osmotic pressure is applied on piston (B). 1
(c) water will move from side (B) to side (A) if a pressure equal to osmotic pressure is applied on piston (B).
(d) water will move from side (A) to side (B) if pressure equal to osmotic pressure is applied on piston (A).



61 When 1 mole of benzene is mixed with 1 mole of toluene (vapour pressure of benzene = 12.8 kPa, Toluene = 3.85 kPa)
(a) The vapour will contain equal amount of benzene and toluene.
(b) Not enough information is given for prediction. 1
(c) The vapour will contain a higher percentage of benzene.
(d) The vapour will contain higher percentage of toluene.

62 Which of the following is incorrect for an ideal solution?
(a) $\Delta H_{mix} = 0$ (b) $\Delta V_{mix} = 0$
(c) $\Delta P = P_{obs} - P_{calculated} = 0$ 1
(d) $\Delta G_{mix} = 0$

63 The temperature at which 10% aqueous solution of (W/V) of glucose will show the osmotic pressure of 16.4 atom is (R = 0.082 L atom K^{-1} mol^{-1})
(a) 360°C (b) 180 K 1
(c) 300 K (d) 360 K

64 Benzoic acid, when dissolved in benzene, which of the following is correct.
(a) The benzoic acid will undergo dissociation.
(b) The benzoic acid will undergo association. 1
(c) Observed molar mass of benzoic acid in benzene will less than normal molar mass.
(d) Observed molar mass of benzoic acid in benzene is more than normal molar mass.

65 Match the items given in Column I with the type of solutions given in Column II.

Column I	Column II
(a) Soda water	(i) A solution of gas in solid
(b) Sugar solution	(ii) A solution of gas in gas
(c) German silver	(iii) A solution of solid in liquid
(d) Air	(iv) A solution of solid in solid
(e) Hydrogen gas in palladium	(v) A solution of gas in liquid
	(vi) A solution of liquid in solid

1

66 In the following question a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement. 1
(d) Assertion and reason both are incorrect statements.
(e) Assertion is wrong statement but reason is correct statement. Assertion: When methyl alcohol is added to water, boiling point of water increases. Reason: When a volatile solute is added to a volatile solvent elevation in boiling point is observed.

67 On the basis of information given below mark the correct option. Information:
(A) In bromoethane and chloroethane mixture intermolecular interactions of A–A and B–B type are nearly same as A–B type interactions.
(B) In ethanol and acetone mixture A–A or B–B type intermolecular interactions are stronger than A–B type interactions.
(C) In chloroform and acetone mixture A–A or B–B type intermolecular interactions are weaker than A–B type interactions. 1
(a) Solution (B) and (C) will follow Raoult's law.
(b) Solution (A) will follow Raoult's law.
(c) Solution (B) will show negative deviation from Raoult's law.
(d) Solution (C) will show positive deviation from Raoult's law.

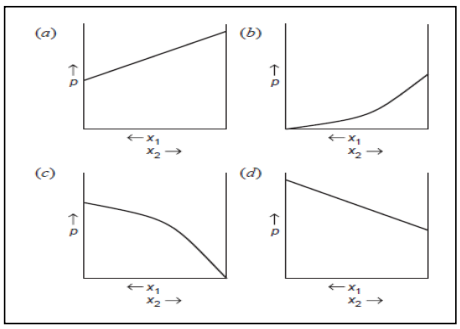
68 K_H value for Ar(g), CO_2(g), HCHO(g) and CH_4(g) are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility. [NCERT Exemplar Problem] 1
(a) HCHO < CH_4 < CO_2 < Ar

(b) $HCHO < CO_2 < CH_4 < Ar$
(c) $Ar < CO_2 < CH_4 < HCHO$
(d) $Ar < CH_4 < CO_2 < HCHO$

69 If $P^{\circ}_A = 100$ mm, $P^{\circ}_B = 200$ mm and mole fraction $x_A = 0.4$, what will be y_A (mole fraction) in vapour phase?
(a) 0.25 (b) 0.30
(c) 0.75 (d) 0.50 1

70 Out of 1m solution of following dissolved in water. Which one will have lowest freezing point (assuming all are fuel, ionised)
(a) Urea (b) NaCl
(c) Na_2SO_4 (d) $Al_2(SO_4)_3$ 1

71 For a binary ideal liquid solution, the variation in total vapour pressure versus composition of solution is given by which of the curves? 1



72 Match the laws given in Column I with expresions given in Column II. 1

Column I	Column II
(a) Raoult's law	(i) $\Delta T_f = K_f m$
(b) Henry's law	(ii) $\prod = CRT$
(c) Elevation of boiling point	(iii) $p = x_1 p_1^{\circ} + x_2 p_2^{\circ}$
(d) Depression in freezing point	(iv) $\Delta T_b = K_b m$
(e) Osmotic pressure	(v) $p = K_H.x$

73 In the following question a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
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(e) Assertion is wrong statement but reason is correct statement. 1

Assertion: When a solution is separated from the pure solvent by a semipermeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.
Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.