DCAM classes
Dynamic Classes for Academic Mastery

Solutions: very important questions

(1)

1 Mark Questions

1. Give reason for the following.
Aquatic animals are more comfortable in cold water than in warm water.
2. Define the term mole fraction.
3. Explain the Henry's law about dissolution of a gas in a liquid.
4. State the main advantage of molality over molarity as the unit of concentration.

2 Marks Questions

5. Give reasons for the following.
   (a) Aquatic species are more comfortable in cold water than warm water.
   (b) At higher altitudes people suffer from anoxia resulting in inability to think.
6. Define the following terms:
   (i) Mole fraction (χ)
   (ii) Molality of a solution (m)
7. Calculate the molarity of 9.8% (w/w) solution of H_2SO_4 if the density of the solution is 1.02 g mL^{-1}.
[Molar mass of H_2SO_4 = 98 $gmol^{-1}$]
8. Differentiate between molarity and molality of a solution. How can we change molality value of a solution into molarity value?
9. 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 $gmol^{-1}$).
10. If the density of water of a lake is 1.25 g mL^{-1} and 1 kg of lake water contains 92 g of Na^+ ions, calculate the molarity of Na^+ ions in this lake water. (Atomic mass of Na = 23 g mol^{-1}).
11. Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?
12. Explain why aquatic species are more comfortable in cold water rather than in warm water.
13. State Henry's law and mention its two important applications.

3 Marks Questions

14. A solution of glucose (molar mass = 180 g mol^{-1}) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution? (Density of solution = 1.2 g mL^{-1}).
15. The partial pressure of ethane over a saturated solution containing 6.56×10^{-2} g of ethane is 1 bar. If the solution contains 5.0×10^{-2}g of ethane, then what will be the partial pressure of the gas?
16. If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 L of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 K bar.

1 Mark Questions

1. Define an ideal solution and write one of its characteristics.

Or Define ideal solution.

2. Some liquids on mixing form azeotropes. What are azeotropes?

Or Define the term azeotrope.

3. State Raoult's law.

Or Define Raoult's law in its general form in reference to solutions.

Or State Raoult's law for a solution of volatile liquids.

2 Marks Questions

4. What type of azeotropic mixture will be formed by a solution of acetone and chloroform? Justify on the basis of strength of intermolecular interactions that develop in the solution.

5. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations.

6. Write two differences between an ideal solution and a non-ideal solution.

7. Why a mixture of carbon disulphide and acetone shows positive deviation from Raoult's law? What type of azeotrope is formed by this mixture?

8. Define the following.
   (i) Ideal solution
   (ii) Molarity (M)

9. (i) 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?
   (ii) In non-ideal solution, what type of deviation shows the formation of maximum boiling azeotropes?

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

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

Or Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type.

11. Define azeotropes. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.

Or Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law? Give an example.

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

Or State Raoult's law for the solution containing volatile components. What is the similarity between Raoult's law and Henry's law?

13. Explain why a solution of chloroform and acetone shows negative deviation from Raoult's law?

3 Marks Question

14. The vapour pressure of pure liquids *A* and *B* are 450 mm and 700 mm of Hg respectively at 350K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also, find the composition in the vapour phase.

1 Mark Questions

1. What are isotonic solutions?

2. Define the term osmotic pressure.

3. What is meant by reverse osmosis?

4. Define the following terms.
   (i) Isotonic solutions
   (ii) van't Hoff factor

5. Explain boiling point elevation constant for a solvent or ebullioscopic constant.

2 Marks Questions

6. Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g of water. (K_f of water = 1.86 K kg mol^{-1})

7. Give reasons for the following:
   (i) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.
   (ii) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution.

8. Define the following terms:
   (i) Colligative properties
   (ii) Molality (m)

9. Define the following terms:
   (i) Abnormal molar mass
   (ii) van't Hoff factor

10. Define osmotic pressure of a solution. How is the osmotic pressure related to the concentration of a solute in a solution?

11. (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 (hypertonic solution)? Give reason.

12. 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?

13. Calculate the mass of 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}).

14. How is the vapour pressure of a solvent affected when a non-volatile solute is dissolved in it?

15. An aqueous solution of sodium chloride freezes below 273 K. Explain the lowering in freezing point of water with the help of a suitable diagram.

16. 18 g 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).

17. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point 100.18° C. Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1}).

18. Define the terms: Osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.

19. What is van't Hoff factor? What possible values can it have if the solute molecules undergo dissociation?

20. The molecular masses of polymers are determined by osmotic pressure method and not by measuring other colligative properties. Give two reasons.

21. 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?

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 Km^{-1}].

23. Find the freezing point of a solution containing 0.520 g glucose ($C_6H_{12}O_6$) dissolved in 80.2 g of water [Given, K_f for water = 1.86 Km^{-1}].

24. Outer hard shells of two eggs are removed. One of the egg is placed in pure water and the other is placed in saturated solution of sodium chloride. What will be observed and why?

3 Marks Questions

25. At 300 K, 30 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of a glucose solution is 1.52 bar at the same temperature, what would be its concentration?

26. A 4% solution (*w/w*) of sucrose (M = 342 g mol^{-1}) in water has a freezing point of 271.15 K. Calculate the freezing point of 5% glucose (M = 180 g mol^{-1}) in water.
(Given : Freezing point of pure water = 273.15 K)

27. Calculate the freezing point of an aqueous solution containing 10.5 g of magnesium bromide in 200 g of water, assuming complete dissociation of magnesium bromide. (Molar mass of magnesium bromide = 184 g mol^{-1}, K_f for water = 1.86 K kg mol^{-1})

28. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water, if freezing point of pure water is 273.15 K.
[Given : molar mass of sucrose = 342 g mol^{-1} and molar mass of glucose = 180 g mol^{-1}]

29. 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 ionisation. (K_b for water = 0.52 K kg mol^{-1})

30. 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})

Or What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50°C? The freezing point depression constant (K_f) for water is 1.86°C/m. Assume van't Hoff factor for NaCl is 1.87. (Molar mass of NaCl = 58.5 g mol^{-1})

31. 45 g of ethylene glycol ($C_2H_6O_2$) is mixed with 600 g of water. Calculate
(i) the freezing point depression and
(ii) the freezing point of the solution.
(Given, K_f of water = 1.86 K kg mol^{-1})

32. A 5% solution (by mass) of cane sugar ($M \cdot W$ 342 g mol^{-1}) is isotonic with 0.877% solution of substance X. Find the molecular weight of X.

33. 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})

34. 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 of Hg at 308 K. Calculate the molar mass of the solute. (Vapour pressure of pure water at 308 K = 32 mm Hg)

35. Calculate the boiling point elevation for a solution prepared by adding 10 g of $CaCl_2$ to 200 g of water. (K_b for water = 0.512 K kg mol^{-1}, molar mass of $CaCl_2$ = 111 g mol^{-1}).

36. Some ethylene glycol, $HOCH_2CH_2OH$, is added to your car's cooling system along with 5 kg of water. If the freezing point of water-glycol solution is –15.0° C, what is the boiling point of the solution? (K_b = 0.52 K kg mol^{-1} and K_f = 1.86 K kg mol^{-1} for water)

37. 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}).

38. 1.00 g of a non-electrolyte solute when 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})

39. A 5% solution (by mass) of cane-sugar in water has freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water if the freezing point of pure water is 273.15 K. [Molecular masses glucose ($C_6H_{12}O_6$) = 180 amu or g mol^{-1} and cane-sugar ($C_{12}H_{22}O_{11}$) = 342 amu or g mol^{-1}]

40. At 25°C, the saturated vapour pressure of water is 3.165 k Pa (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}).

41. 15.0 g of unknown molecular material is dissolved in 450 g of water. The resulting solution freezes at – 0.34°C. What is the molar mass of the material? (K_f for water = 1.86 K kg mol^{-1}).

42. A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42°C, what mass of glycerol was dissolved to make this solution? (K_b for water = 0.512 K kg mol^{-1}).

43. 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 mol^{-1}, K_f for water is 1.86 K kg mol^{-1}).

44. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.0 g of water. (K_b for water = 0.512 K kg mol^{-1}, molar mass of NaCl= 58.44 g mol^{-1}).

45. What would be the molar mass of a compound if 6.21 g of it is dissolved in 24.0 g of chloroform form a solution that has a boiling point of 68.04°C. The boiling point of pure chloroform is 61.7°C and the boiling point elevation constant, K_b for chloroform is 3.63°C/m.

46. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at 25°C. Assuming the gene fragment is non-electrolyte, determine its molar mass.

47. A 0.561 m solution of 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}.

48. Phenol associates in benzene to a 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 K kg mol^{-1}).

49. An aqueous solution containing 12.48 g 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 K kg mol^{-1}, molar mass of $BaCl_2$ = 208.34 g mol^{-1}).

50. At 300 K, 36 g of glucose, $C_6H_{12}O_6$ present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of the other solution.

51. Calculate the boiling point of one molar aqueous solution. Density of KBr solution is 1.06 g mL^{-1} (K_b for H_2O = 0.52 K kg mol^{-1}, atomic mass of K = 39, Br = 80).

52. A solution prepared by dissolving 1.25 g of oil of wintergreen (methyl salicylate) in 99.0 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}).

53. What mass of ethylene glycol (molar mass 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0°C to – 10.0°C?
(K_f for water = 1.86 K kg mol^{-1}).

54. 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 kg mol^{-1}).

55. Calculate the mass of ascorbic acid ($C_6H_8O_6$) to be dissolved in 75 g of acetic acid to lower its melting point by 1.5°C (K_f for acetic acid is 3.9 K kg mol^{-1}).

5 Marks Questions

56. (i) A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K.
(Given, molar mass of sucrose = 342 g mol^{-1} and molar mass of glucose = 180 g mol^{-1})

(ii) Define the following terms :
(a) Molality (m)
(b) Abnormal molar mass

57. (i) 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 ionisation.
(K_f for water = 1.86 K kg mol^{-1})

(ii) (a) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?
(b) What happens when the external pressure applied becomes more than the osmotic pressure of the solution?

58. (i) When 2.56 g of sulphur was dissolved in 100 g of CS_2, the freezing point gets 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})

(ii) 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?

Objectives

1 Mark Questions

1. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is

(a) 0.02 M (b) 0.01 M

(c) 0.001 M (d) 0.1 M

2. Molarity of a given orthophosphoric acid solution is 3 M. Its normality is

(a) 9 N (b) 0.3 N

(c) 3 N (d) 1 N

3. Mole fraction of the solute in a 1.00 molal aqueous solution is

(a) 1.7700 (b) 0.1770

(c) 0.0177 (d) 0.0344

4. What is the molarity of 0.2 N Na_2CO_3 solution?

(a) 0.1 M (b) 0 M

(c) 0.4 M (d) 0.2 M

5. The molarity of a solution containing 5.0 g of NaOH in 250 mL solution is

(a) 0.1 M (b) 0.5 M

(c) 1.0 M (d) 2.0 M

6. In which case Raoult's law is not applicable?

(a) 1 M NaCl (b) 1 M urea

(c) 1 M glucose (d) 1 M sucrose

7. Which of the following will show a negative deviation from Raoult's law?

(a) Acetone-benzene (b) Acetone-ethanol

(c) Benzene-methanol (d) Acetone-chloroform

8. At a constant temperature, which of the following aqueous solutions will have the maximum vapour pressure?
(Molecular weight : NaCl = 58.5, H_2SO_4 = 98.0 g mol^{-1})
(a) 1 molal NaCl (*aq*) (b) 1 molar NaCl (*aq*)
(c) 1 molal H_2SO_4 (*aq*) (d) 1 molar H_2SO_4 (*aq*)

9. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression?
(a) KCl (b) $C_6H_{12}O_6$
(c) $Al_2(SO_4)_3$ (d) K_2SO_4

10. To observe an elevation of boiling point of 0.05°C, the amount of a solute (molecular weight = 100) to be added to 100 g of water (K_b = 0.5) is
(a) 2 g (b) 0.05 g
(c) 1 g (d) 0.75 g

11. The unit of ebullioscopic constant is
(a) K kg mol^{-1} (b) mol kg K^{-1}
(c) kg mol^{-1} K^{-1} (d) K mol kg^{-1}

12. Which of the following is not a colligative property
(a) Depression in freezing point
(b) Osmotic pressure
(c) Elevation in boiling point
(d) Increase in freezing point

13. A solution has higher osmotic pressure than its standard solution. Which of the following term will be used for this solution?
(a) Isotonic (b) Hypertonic
(c) Dilute (d) Hypotonic

14. Which has the least freezing point?
(a) 1% sucrose (b) 1% NaCl
(c) 1% $CaCl_2$ (d) 1% glucose