2011
1. Dissolving 120 g of urea (mol. wt. 60) in 1000 g of water gave a solution of density 1.15 g/mL. The molarity of the solution is [IIT JEE]
(a) 1.78 M (b) 2.00 M (c) 2.05 M (d) 2.22 M
2. A 5.2 molal aqueous solution of methyl alcohol, CH₃OH, is supplied. What is the mole fraction of methyl alcohol in the solution? [AIEEE]
(a) 1.100 (b) 0.190 (c) 0.086 (d) 0.050
3. The molality of a urea solution in which 0.0100 g of urea, [(NH₄)₂CO₃] is added to 0.3000 dm³ of water at STP is [AIEEE]
(a) 0.555 m (b) 5.55 x 10⁻⁴ m (c) 33.3 m (d) 3.3 x 10⁻² m
4. A mixture of ethane and ethene occupies 41 L at 1 atm and 500 K. The mixture reacts completely with \( \frac{10}{3} \) mole of O₂ to produce CO₂ and H₂O. The mole fraction of ethane and ethene in the mixture are [Kerala CEE]
(a) 0.50, 0.50 (b) 0.75, 0.25 (c) 0.67, 0.33 (d) 0.25, 0.75
(e) 0.33, 0.67
5. The sum of mole fractions of A, B and C in an aqueous solution containing 0.2 moles of each A, B and C is [KCET]
(a) 0.6 (b) 0.2 (c) 1.0 (d) 1.2
6. How many grams of sulphuric acid is to be dissolved to prepare 200 mL aqueous solution having concentration of \([H₂O⁺]\) ions 1 M at 25°C temperature. [Guj CET]
(a) 4.9 g (b) 19.6 g (c) 9.8 g (d) 0.98 g

2010
7. 50 cm³ of 0.2 N HCl is titrated against 0.1 N NaOH solution. The titration is discontinued after adding 50 cm³ of NaOH. The remaining titration is completed by adding 0.5 N KOH. The volume of KOH required for completing the titration is [KCET]
(a) 12 cm³ (b) 10 cm³ (c) 25 cm³ (d) 10.5 cm³
8. In which ratio of volume 0.4 M HCl and 0.9 M HCl are to be mixed such that the concentration of the resultant solution becomes 0.7 M ? [MP PET]
(a) 4 : 9 (b) 2 : 3 (c) 3 : 2 (d) 1 : 1
9. Out of the following which one is not an example of a solution? [MP PET]
(a) Air (b) Brass (c) Amalgam (d) Benzene in water
10. What is the molarity of 0.2 N Na₂CO₃ solution? [JCECE]
(a) 0.1 M (b) 0 M (c) 0.4 M (d) 0.2 M
11. Calculate the normality of 250 mL aqueous solution of H₂SO₄ having pH = 0.00. [Guj CET]
   (a) 0.25 N (b) 0.50 N (c) 1 N (d) 2 N

2009
12. The Henry’s law constant for the solubility of N₂ gas in water at 298 K is 1.0 x 10⁵ atm. The mole fraction of N₂ in air is 0.8. The number of moles of N₂ from air dissolved in 10 moles of water of 298 K and 5 atm pressure is [IIT JEE]
   (a) 4 x 10⁻⁴ (b) 4.0 x 10⁻³ (c) 5.0 x 10⁻⁴ (d) 4.0 x 10⁻⁶

13. 2.5 L of NaCl solution contain 5 moles of the solute. What is the molarity? [UP SEE]
   (a) 5 M (b) 2 M (c) 2.5 M (d) 12.5 M

14. What is the total number of moles of H₂SO₄ needed to prepare 5.0 L of a 2.0 M solution of H₂SO₄? [UP SEE]
   (a) 2.5 (b) 5.0 (c) 10 (d) 20

15. How many grams of NaOH will be required to prepare 500 g solution containing 10% w/w NaOH solution? [Guj CET]
   (a) 100 g (b) 50 g (c) 0.5 g (d) 5.0 g

2008
16. 10 cm³ of 0.1 N monobasic acid requires 15 cm³ of sodium hydroxide solution whose normality is [KCET]
   (a) 1.5 N (b) 0.15 N (c) 0.066 N (d) 0.66 N

17. What is the molality of pure water? [OJEE]
   (a) 1 (b) 18 (c) 55.5 (d) None of these

18. 2 N HCl solution will have same molar concentration as a [WB JEE]
   (a) 4.0 N H₂SO₄ (b) 0.5 N H₂SO₄ (c) 1 N H₂SO₄ (d) 2 N H₂SO₄

19. The volume of water to be added to 100 cm³ of 0.5 N H₂SO₄ to get decinormal concentration is [BCECE]
   (a) 400 cm³ (b) 450 cm³ (c) 500 cm³ (d) 100 cm³

20. Which of the following concentration factors is affected by change in temperature? [MHT CET]
   (a) Molarity (b) Molality (c) Mole fraction (d) Weight fraction

21. Two bottles A and B contains 1M and 1m aqueous solution of sulphuric acid respectively [Manipal]
   (a) A is more concentrated than B (b) B is more concentrated than A
   (c) Concentration of A is equal to concentration of B (d) it is not possible to compare the concentrations

22. Molarity is expressed as [MP PET]
   (a) L/mol (b) mol/L (c) mol/1000 g (d) g/L

23. Which one of the following concentration units is independent of temperature? [J&K CET]
   (a) Normality (b) Molality (c) Molality (d) ppm

2007
24. The density (in g mL⁻¹) of a 3.60 M sulphuric acid solution that is 29% H₂SO₄ (molar mass = 98 g mol⁻¹) by mass will be [AIEEE]
   (a) 1.64 (b) 1.88 (c) 1.22 (d) 1.45

25. 40% by weight solution will contain how much mass of the solute in 1L solution, density of the solution is 1.2 g/mL? [DCE]
   (a) 480 g (b) 48 g (c) 38 g (d) 380 g

26. Which one is correct? [DCE]
   (a) Molality changes with temperature.
   (b) Molality does not change with temperature.
   (c) Molarity does not change with temperature.
   (d) Normality does not change with temperature.

27. Molality of a given orthophosphoric acid solution is 3 M. It’s normality is [KCET]
   (a) 9 N (b) 0.3 N (c) 3 N (d) 1 N

28. The volume of 10 N and 4 N HCl required to make 1L of 7 N HCl are [KCET]
   (a) 0.50 L of 10 N HCl and 0.50 L of 4 N HCl
   (b) 0.60 L of 10 N HCl and 0.40 L of 4 N HCl
   (c) 0.80 L of 10 N HCl and 0.20 L of 4 N HCl
   (d) 0.75 L of 10 N HCl and 0.25 L of 4 N HCl

29. Volume of 0.6 M NaOH required to neutralise 30 cm³ of 0.4 M HCl is [AMU]
   (a) 20 cm³ (b) 40 cm³ (c) 45 cm³ (d) 30 cm³

30. 138 g of ethyl alcohol is mixed with 72 g of water. The ratio of mole fraction of alcohol to water is [EAMCET]
   (a) 3:4 (b) 1:2 (c) 1:4 (d) 1:1

31. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H₃PO₄), the volume of 0.1 M aqueous KOH solution required is [Jamia Millia Islamia]
   (a) 10 mL (b) 20 mL (c) 40 mL (d) 60 mL
27. 25 mL of a solution of barium hydroxide on titration with 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was

(a) 0.07 (b) 0.14 (c) 0.28 (d) 0.35

[MP PET]

33. One part of solute in one million parts of solvent is expressed as

(a) ppm (b) mg/100 cc (c) g/L (d) g/100 cc

[J&K CET]

34. The molarity of the solution obtained by dissolving 25 g of NaCl in 100 mL of water is

(a) 0.00428 moles (b) 428 moles (c) 0.428 moles (d) 0.0428 moles

[J&K CET]

2006

35. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is

(a) 1.14 mol kg\(^{-1}\) (b) 3.28 mol kg\(^{-1}\) (c) 2.28 mol kg\(^{-1}\) (d) 0.44 mol kg\(^{-1}\)

[AIEEE]

36. An aqueous solution of glucose is 20% in strength. The volume in which 1 g-mole of it is dissolved will be

(a) 9 L (b) 1.8 L (c) 8 L (d) 0.9 L

[UP SEE]

37. Equal moles of water and urea are taken in a flask. What is mass percentage of urea in the solution?

(a) 23.077% (b) 230.77% (c) 2.3077% (d) 0.23077%

[UP SEE]

38. Volume of water needed to mix with 10 mL 0.1 N HCl to get 0.01 N HCl is

(a) 900 mL (b) 9 mL (c) 90 mL (d) 100 mL

[UP SEE]

39. Which of the following concentration terms is/are independent of temperature?

(a) Molarity (b) Molarity and mole fraction (c) Mole fraction and molality (d) Molality and normality (e) Only molality

[Kerala CEE]

40. A solution contains \(1.2046 \times 10^{24}\) hydrochloric acid molecules in 1 dm\(^3\) of the solution. The strength of the solution is

(a) 6 N (b) 2 N (c) 4 N (d) 8 N

[AMU]

41. 35.4 mL of HCl is required for the neutralisation of a solution containing 0.275 g of sodium hydroxide. The normality of hydrochloric acid is

(a) 0.97 N (b) 0.142 N (c) 0.194 N (d) 0.244 N

[WBJEE]

42. How many grams of dibasic acid (mol. wt. 200) should be present in 100 mL of the aqueous solution to give 0.1 N?

(a) 10 g (b) 20 g (c) 2 g (d) 1 g

[MHT CET]

43. At STP, a container has 1 mole of Ar, 2 moles of CO\(_2\), 3 moles of O\(_2\) and 4 moles of N\(_2\). Without changing the total pressure if one mole of O\(_2\) is removed, the partial pressure of O\(_2\) is

(a) changed by about 16% (b) halved (c) changed by 26% (d) unchanged

[MHT CET]

44. A 5 molar solution of H\(_2\)SO\(_4\) is diluted from 1 L to 10 L. What is the normality of the solution?

(a) 0.25 N (b) 1 N (c) 2 N (d) 7 N

[MP PET]

45. 5 L of a solution contains 25 mg of CaCO\(_3\). What is its concentration in ppm? (mol. wt. of CaCO\(_3\) is 100)

(a) 25 (b) 1 (c) 5 (d) 2500

[J&K CET]

46. What is molality of K\(^+\) in aqueous solution that contains 17.4 ppm of K\(_2\)SO\(_4\) (174 g mol\(^{-1}\))?

(a) 2 \times 10^{-2} M (b) 2 \times 10^{-3} M (c) 4 \times 10^{-4} M (d) 2 \times 10^{-5} M

[Guj CET]

47. Assuming that sea water is a 3.50 weight per cent aqueous solution of NaCl. What is the molality of sea water?

(a) 0.062 m (b) 0.0062 m (c) 0.62 m (d) 6.2 m

[Guj CET]

2005

48. Two solutions of a substance (non-electrolyte) are mixed in the following manner.

480 mL of 1.5 M first solution + 520 mL of 1.2 M second solution.

What is the molarity of the final mixture?

(a) 2.70 M (b) 1.344 M (c) 1.50 M (d) 2.0 M

[AIEEE]

49. How many moles of Al\(_2\)(SO\(_4\))\(_3\) would be in 50 g of the substance?

(a) 0.083 mol (b) 0.952 mol (c) 0.481 mol (d) 0.14 mol

[UP SEE]

50. Molarity of 0.2 N H\(_2\)SO\(_4\) is

(a) 0.2 (b) 0.4 (c) 0.6 (d) 0.1

[KCET]
51. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1 L solution. The molarity of NaOH in the solution is

\[ \text{(Given, that molar mass of NaOH} = 40.0 \text{g mol}^{-1}) \]

(a) 0.2450 M (b) 0.6125 M
(c) 0.9800 M (d) 1.6326 M

52. Molar solution means 1 mole of solute present in

\[ \text{BCECE} \]

(a) 1000 g of solvent (b) 1 L of solvent
(c) 1 L of solution (d) 1000 g of solution

53. The volume of water to be added to \( \frac{N}{2} \) HCl to prepare 500 cm\(^3\) of \( \frac{N}{10} \) solution is

\[ \text{RPET} \]

(a) 450 cm\(^3\) (b) 100 cm\(^3\)
(c) 45 cm\(^3\) (d) 400 cm\(^3\)

2004

54. 6.02 \times 10^{23} \text{ molecules of urea are present in 100 mL of}
its solution. The concentration of urea solution is

\[ \text{(Avogadro constant,} N_A = 6.02 \times 10^{23} \text{ mol}^{-1}) \]

\[ \text{AIEEE} \]

(a) 0.001 M (b) 0.01 M
(c) 0.02 M (d) 0.1 M

55. x grams of water is mixed in 69 g of ethanol. Mole fraction of ethanol in the resultant solution is 0.6. What is the value of x in grams?

\[ \text{EAMCET} \]

(a) 54 (b) 36
(c) 180 (d) 18

56. Mole fraction of a solute in benzene is 0.2 then find molality of solute

\[ \text{BCECE} \]

(a) 3.2 (b) 2
(c) 4 (d) 3.6

57. What amount of water is added in 40 mL of NaOH

\[ \text{(0.1 N) which is neutralised by 50 mL of HCl (0.2 N)?} \]

\[ \text{BCECE} \]

(a) 80 mL (b) 60 mL
(c) 40 mL (d) 90 mL

58. The normality of mixture obtained by mixing 100 mL of 0.2 M \( \text{H}_2\text{SO}_4 \) and 100 mL of 0.2 M NaOH is

\[ \text{BCECE} \]

(a) 0.2 (b) 0.01
(c) 0.1 (d) 0.3

59. The solubility of gas in liquid depends upon

\[ \text{BCECE} \]

(a) the nature of gas (b) the temperature
(c) the nature of the solvent (d) All of the above

60. The unit of molality is

\[ \text{Jamia Millia Islamia} \]

(a) mol L\(^{-1}\) (b) mol kg\(^{-1}\)
(c) mol \(^{-1}\) L\(^{-1}\) (d) mol L

61. Volume of 0.1 M \( K_2\text{Cr}_2\text{O}_7 \) required to oxidise

35 mL of 0.5 M \( \text{FeSO}_4 \) solution is

\[ \text{J\&K CET} \]

(a) 29.2 mL (b) 17.5 mL
(c) 175 mL (d) 145 mL

62. 100 cc of 0.6 N \( \text{H}_2\text{SO}_4 \) and 200 cc of 0.3 N HCl were mixed together. The normality of the solution will be

\[ \text{J\&K CET} \]

(a) 0.2 N (b) 0.4 N (c) 0.8 N (d) 0.6 N

2003

63. What is the molarity of \( \text{H}_2\text{SO}_4 \) solution if 25 mL is

exactly neutralised with 32.63 mL of 0.164 M \( \text{NaOH} \)?

\[ \text{DCE} \]

(a) 0.107 M (b) 0.126 M
(c) 0.214 M (d) 0.428 M

64. Volume of water needed to mix with 10 mL 10 N \( \text{HNO}_3 \) to get 0.1 N \( \text{HNO}_3 \) is

\[ \text{UP SEE} \]

(a) 1000 mL (b) 990 mL
(c) 1010 mL (d) 10 mL

65. If 117 g NaCl is dissolved in 1000 g of water the concentration of the solution is said to be \( \text{Kerala CEE} \)

(a) 2 molar (b) 2 molal
(c) 1 normal (d) 1 molal
(e) 2 normal

66. How much \( K_2\text{Cr}_2\text{O}_7 \) (Mol. wt. = 294.19) is required to prepare one litre of 0.1 N solution?

\[ \text{OJEE} \]

(a) 9.8063 g (b) 7.3548 g
(c) 3.6774 g (d) 4.903 g

67. The ionic strength of a solution containing 0.1 mol/kg of \( \text{KCl} \) and 0.2 mol/kg of \( \text{CuSO}_4 \) is

\[ \text{OJEE} \]

(a) 0.3 (b) 0.6 (c) 0.9 (d) 0.2

68. 1 kg of \( \text{NaOH} \) solution contains 4 g of \( \text{NaOH} \). The approximate concentration of the solution is \( \text{Manipal} \)

(a) about 0.1 N (b) decinormal
(c) 0.1 molar (d) 0.1 molar

69. How much of 0.1 M \( \text{H}_2\text{SO}_4 \) solution is required to

neutralise 50 mL of 0.2 M \( \text{NaOH} \) solution?

\[ \text{Manipal} \]

(a) 50 mL (b) 50 mL (c) 50 mL (d) 100 mL

70. What is molality of a solution in which

(18 g glucose mol. wt. = 180) is dissolved in 500 g of water?

\[ \text{MP PET} \]

(a) 1 m (b) 0.5 m (c) 0.2 m (d) 2 m

71. An aqueous solution of 6.3 g oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N sodium hydroxide required to completely neutralise 10 mL of this solution is

\[ \text{J\&K CET} \]

(a) 40 mL (b) 20 mL (c) 10 mL (d) 4 mL

72. Normality of 2 M \( \text{H}_2\text{SO}_4 \) is

\[ \text{J\&K CET} \]

(a) 2 N (b) 4 N (c) \( \frac{N}{2} \) (d) \( \frac{N}{4} \)
Topic 2
Vapour Pressure of Liquid Solutions
(Raoult’s Law)
Ideal and Non-ideal Solutions

2011
1. A solution of two liquids boils at a temperature more than the boiling point of either. Hence, the binary solution shows
(a) negative deviation from Raoult’s law
(b) positive deviation from Raoult’s law
(c) no deviation from Raoult’s law
(d) positive or negative deviation from Raoult’s law depending upon the composition.

2010
2. On mixing, heptane and octane form an ideal solution. At 373 K, the vapour pressures of the two liquid components (heptane and octane) are 105 kPa and 45 kPa respectively. Vapour pressure of the solution obtained by mixing 25 g of heptane and 35 g of octane will be (molar mass of heptane = 100 g mol⁻¹ and of octane = 114 g mol⁻¹).
(a) 72.0 kPa
(b) 36.1 kPa
(c) 96.2 kPa
(d) 144.5 kPa

3. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in a solution with liquid B is 32 mm Hg. What is the mole fraction of A in the solution if it obeys the Raoult’s law?
(a) 0.5
(b) 0.6
(c) 0.7
(d) 0.8

2009
4. Two liquids X and Y form an ideal solution at 300 K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mmHg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mmHg. Vapour pressure (in mmHg) of X and Y in their pure states will be, respectively
(a) 200 and 300
(b) 300 and 400
(c) 400 and 600
(d) 500 and 600

5. A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution?
(a) The solution formed is an ideal solution
(b) The solution is non-ideal, showing positive deviation from Raoult’s law
(c) The solution is non-ideal, showing negative deviation from Raoult’s law
(d) n-heptane shows positive deviation while ethanol show negative deviation from Raoult’s law

6. One component of a solution follows Raoult’s law over the entire range 0 ≤ x₁ ≤ 1. The second component must follow Raoult’s law in the range when x₂ is
(a) close to zero
(b) close to 1
(c) 0 ≤ x₂ ≤ 0.5
(d) 0 ≤ x₂ ≤ 1

7. The vapour pressure of two liquids X and Y are 80 and 60 Torr respectively. The total vapour pressure of the ideal solution obtained by mixing 3 moles of X and 2 moles of Y would be
(a) 68 Torr
(b) 140 Torr
(c) 48 Torr
(d) 72 Torr
(e) 54 Torr

2008
8. Vapour pressure of pure ‘A’ is 70 mm of Hg at 25°C. It forms an ideal solution with ‘B’ in which mole fraction of A is 0.8. If the vapour pressure of the solution is 84 mm of Hg at 25°C, the vapour pressure of pure ‘B’ at 25°C is
(a) 28 mm
(b) 56 mm
(c) 70 mm
(d) 140 mm

9. At 80°C, the vapour pressure of pure liquid ‘A’ is 520 mm Hg and that of pure liquid ‘B’ is 1000 mm Hg. If a mixture solution of ‘A’ and ‘B’ boils at 80°C and 1 atm pressure, the amount of ‘A’ in the mixture is (1 atm = 760 mm Hg)
(a) 52 mole per cent
(b) 34 mole per cent
(c) 48 mole per cent
(d) 50 mole per cent

10. Two liquids X and Y form an ideal solution. The mixture has a vapour pressure of 400 mm at 300 K when mixed in the molar ratio of 1 : 1 and a vapour pressure of 350 mm when mixed in the molar ratio of 1 : 2 at the same temperature. The vapour pressures of the two pure liquids X and Y respectively are
(a) 250 mm, 550 mm
(b) 350 mm, 450 mm
(c) 350 mm, 700 mm
(d) 500 mm, 500 mm
(e) 550 mm, 250 mm
11. Vapour pressure of pure \( A \) = 100 torr, moles = 2; vapour pressure of pure \( B \) = 80 torr, moles = 3. Total vapour pressure of the mixture is

(a) 440 torr  
(b) 460 torr  
(c) 180 torr  
(d) 88 torr

2007

12. Equal masses of methane and oxygen are mixed in an empty container at 25°C. The fraction of the total pressure exerted by oxygen is

(a) \( \frac{2}{3} \)  
(b) \( \frac{1}{3} \times \frac{273}{298} \)  
(c) \( \frac{1}{3} \)  
(d) \( \frac{1}{2} \)

13. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be

(a) 350  
(b) 300  
(c) 700  
(d) 360

14. Formation of a solution from two components can be considered as:

1. pure solvent \( \rightarrow \) separated solvent molecules, \( \Delta H_1 \)
2. pure solute \( \rightarrow \) separated solute molecules, \( \Delta H_2 \)
3. separated solvent and solute molecules \( \rightarrow \) solution, \( \Delta H_3 \)

Solution so formed will be ideal if

(a) \( \Delta H_{\text{soln}} = \Delta H_1 - \Delta H_2 - \Delta H_3 \)  
(b) \( \Delta H_{\text{soln}} = \Delta H_1 - \Delta H_2 - \Delta H_3 \)  
(c) \( \Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 + \Delta H_3 \)  
(d) \( \Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 - \Delta H_3 \)

2006

15. On a humid day in summer, the mole fraction of gaseous \( H_2O \) (water vapour) in the air at 25°C can be as high as 0.0287. Assuming a total pressure of 0.977 atm. What is the partial pressure of dry air? [Kerala CEE]

(a) 94.9 atm  
(b) 0.949 atm  
(c) 949 atm  
(d) 0.648 atm  
(e) 1.248 atm

16. Which one of the following is not correct for an ideal solution?

(a) It must obey Raoult’s law  
(b) \( \Delta H = 0 \)  
(c) \( \Delta V = 0 \)  
(d) \( \Delta H = \Delta V \neq 0 \)

2005

18. Benzene and toluene form nearly ideal solutions. At 20°C, the vapour pressure of benzene is 75 torr and that of toluene is 22 torr. The partial vapour pressure of benzene at 20°C for a solution containing 78 g of benzene and 46 g of toluene in torr is

(a) 52.5  
(b) 37.5  
(c) 25  
(d) 50

19. \( A \) and \( B \) are ideal gases. The molecular weights of \( A \) and \( B \) are in the ratio of 1:4. The pressure of a gas mixture containing equal weights of \( A \) and \( B \) is \( p \) atm. What is the partial pressure (in atm) of \( B \) in the mixture?

(a) \( \frac{p}{5} \)  
(b) \( \frac{p}{2} \)  
(c) \( \frac{3p}{2} \)  
(d) \( \frac{3p}{4} \)

20. In a mixture of \( A \) and \( B \), components show negative deviation when

(a) \( A \rightarrow B \) interaction is stronger than \( A \rightarrow A \) and \( B \rightarrow B \) interaction  
(b) \( A \rightarrow B \) interaction is weaker than \( A \rightarrow A \) and \( B \rightarrow B \) interaction  
(c) \( \Delta V_{\text{mix}} > 0 \), \( \Delta S_{\text{mix}} < 0 \)  
(d) \( \Delta V_{\text{mix}} = 0 \), \( \Delta S_{\text{mix}} > 0 \)

2004

21. Which of the following liquid pairs shows a positive deviation from Raoult’s law?

(a) Water-hydrochloric acid  
(b) Benzene-methanol  
(c) Water-nitric acid  
(d) Acetone-chloroform

22. A non-ideal solution was prepared by mixing 30 mL chloroform and 50 mL acetone. The volume of mixture will be

(a) > 80 mL  
(b) < 80 mL  
(c) = 80 mL  
(d) ≥ 80 mL

23. Azeotropic mixture of \( HCl \) and water has

(a) 48% \( HCl \)  
(b) 22.2% \( HCl \)  
(c) 36% \( HCl \)  
(d) 20.2% \( HCl \)

2003

24. If liquids \( A \) and \( B \) form an ideal solution, the

(a) enthalpy of mixing is zero  
(b) entropy of mixing is zero  
(c) free energy of mixing is zero  
(d) free energy as well as the entropy of mixing are zero
An azeotropic mixture of two liquids has boiling point lower than either of them, when it (a) shows a negative deviation from Raoult’s law (b) shows no deviation from Raoult’s law (c) shows positive deviation from Raoult’s law (d) is saturated

Which of the following mixture does not show positive deviation from the Raoult’s law? (a) Benzene + acetone (b) Acetone + ethanol (c) Acetone + chloroform (d) Water + ethanol

Topic 3
Colligative Properties and Determination of Molar Mass

2011
1. The freezing point (in °C) of solution containing 0.1 g of K₃[Fe(CN)₆] (mol. wt. 329) in 100 g of water (K_f = 1.86 K kg mol⁻¹) is
(a) −2.3 × 10⁻² (b) −5.7 × 10⁻³ (c) −5.7 × 10⁻³ (d) −1.2 × 10⁻²

2. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at −6°C will be (K_f for water = 1.86 K kg mol⁻¹) and molar mass of ethylene glycol = 62 g mol⁻¹)
(a) 804.32 g (b) 204.30 g (c) 400.00 g (d) 304.60 g

3. A 5% solution of cane sugar (molar mass 342) is isotonic with 1% of a solution of an unknown solute. The molar mass of unknown solute in g/mol is
(a) 136.2 (b) 171.2 (c) 68.4 (d) 34.2

4. A solution containing 1.8 g of a compound (empirical formula CH₁O) in 40 g of water is observed to freeze at −0.465°C. The molecular formula of the compound is (K_f of water = 1.86 kg K mol⁻¹)
(a) C₂H₄O₂ (b) C₃H₆O₃ (c) C₄H₈O₄ (d) C₅H₁₀O₅ (e) C₆H₁₂O₆

5. At 25°C a 5% aqueous solution of glucose (molecular weight = 180 g mol⁻¹) is isotonic with 2% aqueous solution containing an unknown solute. What is the molecular weight of the unknown solute?

6. The empirical formula of a nonelectrolyte is CH₂O. A solution containing 3 g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution. The molecular formula of the compound is
(a) CH₂O (b) C₂H₄O₂ (c) C₄H₈O₄ (d) C₁H₆O₃

7. Choose the correct statement.
When concentration of a salt solution is increased
(a) Boiling point increases while vapour pressure decreases.
(b) Boiling point decreases while vapour pressure increases.
(c) Freezing point decreases while vapour pressure increases.
(d) Freezing point increases while vapour pressure decreases.

8. The empirical formula of a non-electrolyte is CH₂O. A solution containing 6g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution at the same temperature. The molecular formula of the compound is
(a) C₂H₄O₂ (b) C₃H₆O₃ (c) C₅H₁₀O₅ (d) C₄H₈O₄

9. The relative lowering of vapour pressure of a dilute aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is about
(a) 0.70 (b) 0.50 (c) 0.90 (d) 0.80

10. At 25°C, the highest osmotic pressure is exhibited by 0.1 M solution of
(a) urea (b) glucose (c) KCl (d) CaCl₂
11. Which of the following would exert maximum osmotic pressure? [RPET]
   (a) Decinormal aluminium sulphate
   (b) Decinormal barium chloride
   (c) Decinormal sodium chloride
   (d) A solution obtained by mixing equal volumes of (b) and (c) and filtering

12. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionised? \( k_f \) for wt. = 1.86 K mol\(^{-1}\) [JCECE]
   (a) 0.85°C
   (b) -3.53°C
   (c) 0°C
   (d) -0.35°C

13. At a constant temperature, which of the following aqueous solutions will have the maximum vapour pressure? (Mol. wt. NaCl = 58.5, H\(_2\)SO\(_4\) = 98.0 g.mol\(^{-1}\)) [Guj CET]
   (a) 1 molal NaCl (aq)
   (b) 1 molal NaCl (aq)
   (c) 1 molal H\(_2\)SO\(_4\) (aq)
   (d) 1 molal H\(_2\)SO\(_4\) (aq)

14. Coligative properties of a solution depends upon [Punjab CET]
   (a) nature of both solvent and solute
   (b) nature of solute only
   (c) number of solvent particles
   (d) the number of solute particles

2009

15. A 5% solution of sugarcane (mol. wt. = 342) is isotonic with 1% solution of X under similar conditions. The molecular weight of X is [DCE]
   (a) 136.2
   (b) 689.4
   (c) 34.2
   (d) 171.2

16. If 0.1 M solutions of each electrolyte are taken and if all electrolytes are completely dissociated, then whose boiling point will be highest? [Indraprastha CET]
   (a) Glucose
   (b) KCl
   (c) BaCl\(_2\)
   (d) \( K_f [Fe(CN)_6] \)

17. Which of the following is not a colligative property? [UP SEE]
   (a) Optical activity
   (b) Osmotic pressure
   (c) Depression of freezing point
   (d) Elevation of boiling point

18. An 1% solution of KCl (I), NaCl (II), BaCl\(_2\) (III) and urea (IV) have their osmotic pressure at the same temperature in the ascending order (molar masses of NaCl, KCl, BaCl\(_2\) and urea are respectively 58.5, 74.5, 208.4 and 60 g.mol\(^{-1}\)). Assume 100% ionisation of the electrolytes at this temperature [Kerala CEE]
   (a) I < III < II < IV
   (b) III < I < II < IV
   (c) I < III < II < IV
   (d) I < III < IV < II
   (e) III < IV < I < II

19. The difference between the boiling point and freezing point of an aqueous solution containing sucrose (mol. wt. = 342 g.mol\(^{-1}\)) in 100 g water at 105.5°C. If \( K_f \) and \( K_b \) of water are 1.86 and 0.51 K kg.mol\(^{-1}\) respectively, the weight of sucrose in the solution is about [Kerala CEE]
   (a) 34.2 g
   (b) 342 g
   (c) 7.2 g
   (d) 72 g
   (e) 68.4 g

20. A 6% solution of urea is isotonic with [Manipal]
   (a) 1 M solution of glucose
   (b) 0.05 M solution of glucose
   (c) 6% solution of glucose
   (d) 25% solution of glucose

21. In countries nearer to the polar region, the roads are sprinkled with CaCl\(_2\). This is [Manipal]
   (a) to minimise the wear and tear of the roads
   (b) to minimise the snow fall
   (c) to minimise pollution
   (d) to minimise the accumulation of dust on the road

22. The increase in boiling point of a solution containing 0.6 g urea in 200 g water is 0.5°C. Find the molal elevation constant. [Guj CET]
   (a) 10 K kg mol\(^{-1}\)
   (b) 10 K g mol\(^{-1}\)
   (c) 10 K Kg mol\(^{-1}\)
   (d) 1.0 K Kg mol\(^{-1}\)

2008

23. The vapour pressure of water at 20°C is 17.5 mmHg. If 18 g of glucose (C\(_6\)H\(_{12}\)O\(_6\)) is added to 178.2 g of water at 20°C, the vapour pressure of the resulting solution will be [AIEEE]
   (a) 17.675 mmHg
   (b) 15.750 mmHg
   (c) 16.500 mmHg
   (d) 17.325 mmHg

24. What is the amount of urea dissolved per litre if its aqueous solution is isotonic with 10% cane sugar solution? (mol. wt. of urea = 60) [DCE]
   (a) 200 g/L
   (b) 19.2 g/L
   (c) 17.54 g/L
   (d) 16.7 g/L

25. When 25 g of a non-volatile solute is dissolved in 100 g of water, the vapour pressure is lowered by 2.25×10\(^{-1}\) mm. If the vapour pressure of water at 20°C is 17.5 mm, what is the molecular weight of the solute? [BITSAT, AMU, EAMCET]
   (a) 206
   (b) 302
   (c) 350
   (d) 276

26. The vapour pressure of pure liquid A is 0.80 atm. When a non-volatile B is added to A its vapour pressure drops to 0.60 atm. The mole fraction of B in the solution is [UP SEE]
   (a) 0.125
   (b) 0.25
   (c) 0.5
   (d) 0.75
27. Osmotic pressure of a solution at a given temperature
(a) increases with concentration
(b) decreases with concentration
(c) remains same
(d) initially increases and then decreases

28. The osmotic pressure (At 27°C) of an aqueous solution (200 mL) containing 6 g of a protein is $2 \times 10^{-3}$ atm. If $R = 0.080$ L atm mol$^{-1}$K$^{-1}$, the molecular weight of protein is
(a) $7.2 \times 10^5$
(b) $3.6 \times 10^5$
(c) $1.8 \times 10^5$
(d) $1.0 \times 10^5$

29. On adding 1 g arsenic to 80 g benzene, the freezing point of benzene is lowered by 0.19°C. The formula of arsenic is
(a) As
(b) As$_2$
(c) As$_3$
(d) As$_4$

30. Which of the following can be measured by the Ostwald-Walker dynamic method?
(a) Relative lowering of vapour pressure
(b) Lowering of vapour pressure
(c) Vapour pressure of the solvent
(d) All of the above

31. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is
(a) 0.70
(b) 0.50
(c) 0.60
(d) 0.80
(e) 0.40

32. Isotropic solutions have equal
(a) vapour pressure
(b) osmotic pressure
(c) boiling point
(d) freezing point

33. Highest boiling point is found in
(a) 0.1 M NaCl
(b) 0.1 M BaCl$_2$
(c) 0.1 M sucrose
(d) 0.1 M KCl

34. The freezing point of water is depressed by 0.37°C in a 0.01 mol NaCl solution. The freezing point of 0.02 molal solution of urea is depressed by
(a) 0.37°C
(b) 0.74°C
(c) 0.185°C
(d) 0°C

35. Blood cells do not shrink in blood because blood is
(a) hypotonic
(b) isotonic
(c) equimolar
(d) hypertonic

36. The mass of glucose that should be dissolved in 50 g of water in order to produce the same lowering of vapour pressure as is produced by dissolving 1 g of urea in the same quantity of water is
(a) 1 g
(b) 3 g
(c) 6 g
(d) 18 g

37. Solutions A, B, C and D are respectively 0.1 M glucose, 0.05 M NaCl, 0.05 M BaCl$_2$ and 0.1 M AlCl$_3$. Which one of the following pairs is isotonic?
(a) A and B
(b) B and C
(c) A and D
(d) A and C

38. The vapour pressure of benzene at a certain temperature is 640 mm of Hg. A non-volatile and non-electrolyte solid weighing 2.175 g is added to 35.08 g of benzene. If the vapour pressure of the solution is 600 mm of Hg, what is the molecular weight of solid substance?
(a) 49.50
(b) 59.60
(c) 69.60
(d) 79.82

39. Which of the following solutions will have highest boiling point?
(a) 0.1 M FeCl$_3$
(b) 0.1 M BaCl$_2$
(c) 0.1 M NaCl
(d) 0.1 M urea (NH$_2$CONH$_2$)

40. Which is not a colligative property in the following?
(a) pH of a buffer solution
(b) Boiling point elevation
(c) Freezing point depression
(d) Vapour pressure lowering

41. Maximum lowering of vapour pressure is observed in the case of
(a) 0.1 M glucose
(b) 0.1 M BaCl$_2$
(c) 0.1 M MgSO$_4$
(d) 0.1 NaCl

42. A solution containing 4 g of polyvinyl chloride polymer in one litre of dioxane was found to have an osmotic pressure of $4.1 \times 10^{-4}$ atm at 27°C. The approximate molecular weight of the polymer is
(a) $1.5 \times 10^3$
(b) $2.4 \times 10^5$
(c) $1.0 \times 10^4$
(d) $2 \times 10^{12}$

43. Consider the following aqueous solutions and assume 100% ionisation in electrolytes
I. 0.1 M urea

II. 0.04 M Al$_2$(SO$_4$)$_3$

III. 0.05 M CaCl$_2$

IV. 0.005 M NaCl

The correct statement regarding the above solutions is
(a) freezing point will be lowest for solution I
(b) freezing point will be highest for solution IV
(c) boiling point will be highest for solution IV
(d) vapour pressure will be highest for solution II

2007
44. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mole$^{-1}$) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 g cm$^{-3}$, molar mass of the substance will be
(a) 90.0 g mole$^{-1}$
(b) 115.0 g mole$^{-1}$
(c) 105.0 g mole$^{-1}$
(d) 210.0 g mole$^{-1}$
45. At temperature 327°C and concentration C osmotic pressure of a solution is \( p \), the same solutions at concentration C/2 and a temperature 427°C shows osmotic pressure 2 atm, value of \( p \) will be \[ \text{(DCE)} \]
(a) \( \frac{12}{7} \) atm  
(b) \( \frac{24}{7} \) atm  
(c) \( \frac{6}{5} \) atm  
(d) \( \frac{5}{6} \) atm

46. A solution of sucrose (Molar mass = 342 g/mol) is prepared by dissolving 6.84 g of it per litre of solution, what is its osmotic pressure \( (R = 0.082 L \text{ atm K}^{-1} \text{ mol}^{-1}) \) at 273 K? \[ \text{(BITSAT)} \]
(a) 3.92 atm  
(b) 4.48 atm  
(c) 5.92 atm  
(d) 29.4 atm

47. Which one of the following aqueous solutions will exhibit highest boiling point? \[ \text{(UP SEE)} \]
(a) 0.01 M \( \text{Na}_2\text{SO}_4 \)  
(b) 0.01 M \( \text{KNO}_3 \)  
(c) 0.015 M urea  
(d) 0.015 M glucose

48. The relative lowering of vapour pressure of a dilute aqueous solution containing non-volatile solute is 0.0125. The molality of the solution is about \[ \text{(Kerala CEE)} \]
(a) 0.70  
(b) 0.50  
(c) 0.90  
(d) 0.80  
(e) 0.60

49. If the elevation in boiling point of a solution of 10 g of solute (mol. wt. = 100) in 100 g of water is \( \Delta T_b \), the ebullioscopic constant of water is \[ \text{(Kerala CEE)} \]
(a) 10 \( \Delta T_b \)  
(b) \( \frac{100 \Delta T_b}{b} \)  
(c) \( \Delta T_b \)  
(d) \( \frac{\Delta T_b}{10} \)  
(e) 10 \( \Delta T_b \)

50. Which one is a colligative property? \[ \text{(OJEE)} \]
(a) Boiling point  
(b) Vapour pressure  
(c) Osmotic pressure  
(d) Freezing point

51. Which one of the following statements is false? \[ \text{(Jamia Millia Islamia)} \]
(a) Raoult’s law states that the vapour pressure of a component over a solution is proportional to its mole fraction
(b) The osmotic pressure \( (\pi) \) of a solution is given by the equation \( \pi = MR_T \), where, \( M \) is the molality of the solution
(c) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is \( \text{BaCl}_2 > \text{KCl} > \text{CH}_3\text{COOH} > \text{sucrose} \)
(d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

52. In a 0.2 molal aqueous solution of a weak acid \( \text{H}_2\text{A} \), the degree of ionisation is 0.3. Taking \( k_f \) for water as 1.86, the freezing point of the solution will be nearest to \[ \text{(MP PET)} \]
(a) –0.480°C  
(b) –0.360°C  
(c) –0.260°C  
(d) +0.480°C

53. The osmotic pressure is expressed in the units of \[ \text{(J&K CE)} \]
(a) MeV  
(b) cal  
(c) cm/s  
(d) atm

54. 18 g of glucose (\( \text{C}_6\text{H}_{12}\text{O}_6 \)) is added to 1782 g of water. The vapour pressure of water for this aqueous solution at 100°C is \[ \text{(LAERB)} \]
(a) 759.00 torr  
(b) 7.60 torr  
(c) 76.00 torr  
(d) 752.40 torr

55. Depression in freezing point is 6 K for \( \text{NaCl} \) solution if \( k_f \) for water is 1.86 K/kg mol, amount of \( \text{NaCl} \) dissolved in 1 kg water is \[ \text{(DCE)} \]
(a) 3.42  
(b) 1.62  
(c) 3.24  
(d) 1.71

56. Osmotic pressure of 0.4% urea solution is 1.64 atm and that of 3.42% cane sugar is 2.46 atm. When the above two solutions are mixed, the osmotic pressure of the resulting solution is \[ \text{(UP SEE)} \]
(a) 0.82 atm (b) 2.46 atm (c) 1.64 atm (d) 4.10 atm

57. At certain temperature a 5.12% solution of cane sugar is isotonic with a 0.9% solution of an unknown solute. The molar mass of solute is \[ \text{(Kerala CEE)} \]
(a) 60  
(b) 46.17  
(c) 120  
(d) 90  
(e) 92.34

58. By dissolving 5g substance in 50 g of water, the decrease in freezing point is 1.2°C. The gram molal depression is 1.85°C. The molecular weight of substance is \[ \text{(WB JEE)} \]
(a) 105.4  
(b) 118.2  
(c) 137.2  
(d) 154.2

59. The vapour pressure will be lowest for \[ \text{(WB JEE)} \]
(a) 0.1 M sugar solution  
(b) 0.1 M KCl solution  
(c) 0.1 M Cu(NO₃)₂ solution  
(d) 0.1 M AgNO₃ solution

60. Blood cells will remain as such in \[ \text{(WB JEE)} \]
(a) hypertonie solution  
(b) hypotonic solution  
(c) isotonic solution  
(d) None of the above

61. Which has the minimum freezing point? \[ \text{(Jamia Millia Islamia)} \]
(a) One molal NaCl aqueous solution  
(b) One molal CaCl₂ aqueous solution  
(c) One molal KCl aqueous solution  
(d) One molal urea aqueous solution
62. If a solution containing 0.072 g atom of sulphur in 100 g of
a solvent (k_f = 7.0) gave a freezing point depression of 0.84°C, the molecular formula of sulphur in the
solution is [Jamia Millia Islamia]
(a) S_6  (b) S_2  (c) S_4  (d) S_3

63. The freezing point of a 0.05 molal solution of a non-electrolyte in water is [MHT CET]
(a) -0.093°C  (b) 1.86°C  (c) 0.93°C  (d) 0.093°C

64. The freezing point of 1% solution of lead nitrate in
water will be [Manipal]
(a) 2°C  (b) 1°C  (c) 0°C  (d) below 0°C

65. The amount of urea to be dissolved in 500 cc of water
(K_f = 1.86°C) to produce a depression of 0.186°C in
the freezing point is [Manipal]
(a) 9 g  (b) 6 g  (c) 3 g  (d) 0.3 g

66. Which is a colligative property? [MP PET, Guj CET]
(a) Osmotic pressure  (b) Free energy  (c) Heat of vaporisation  (d) Change in pressure

67. Relative lowering of vapour pressure of a dilute solution is 0.2. What is the mole fraction of the
non-volatile solute? [J&K CET]
(a) 0.8  (b) 0.5  (c) 0.3  (d) 0.2

68. Equimolar solution in the same solvent have [AIEEE]
(a) different boiling and different freezing points
(b) same boiling and same freezing points
(c) same freezing point but different boiling point
(d) same boiling point but different freezing point

69. X is dissolved in water. Maximum boiling point is
observed when X is ... (0.1 M each) [DCE]
(a) CaSO_4  (b) BaCl_2  (c) NaCl  (d) urea

70. Which has minimum osmotic pressure? [DCE]
(a) 200 mL of 2 M NaCl solution
(b) 200 mL of 1 M glucose solution
(c) 200 mL of 2 M urea solution
(d) All have same osmotic pressure

71. Solution A contains 7 g/L of MgCl_2 and solution B
contains 7 g/L of NaCl. At room temperature, the
osmotic pressure of
(a) solution A is greater than B
(b) both have same osmotic pressure
(c) solution B is greater than A
(d) cannot be determined

72. Dry air is passed through a solution containing 10 g of a
solute in 90 g of water and then through pure water. The
loss in weight of solution is 2.5 g and that of pure
solvent is 0.05 g. Calculate the molecular weight of the
solute. [Kerala CEE]
(a) 50  (b) 180  (c) 102  (d) 25

73. In an osmotic pressure measurement experiment, a 5% solution of compound ‘X’ is found to be isotonic with a
2% acetic acid solution. The gram molecular mass of
‘X’ is [AMU]
(a) 24  (b) 60  (c) 150  (d) 300

74. The vapour pressure of water at 23°C is 19.8 mm. 0.1
mole of glucose is dissolved in 178.2 g of water. What is the
vapour pressure (in mm) of the resultant solution? [EAMCET]
(a) 19.0  (b) 19.602  (c) 19.402  (d) 19.202

75. Calculate the molar depression constant of a solvent which has freezing point 16.6°C and latent heat of
fusion 180.75 Jg^{-1}. [OJEE]
(a) 2.68  (b) 3.86  (c) 4.68  (d) 2.86

76. Which of the following shows maximum depression in
freezing point? [BCECE]
(a) K_2SO_4  (b) NaCl  (c) Urea  (d) Glucose

77. For an aqueous solution, freezing point is -0.186°C.
Elevation of the boiling point of the same solution is
(K_f = 1.86°C mol^{-1} kg and K_b = 0.512°C mol^{-1} kg)
[Jamia Millia Islamia]
(a) 0.186°C  (b) 0.0512°C  (c) 1.86°C  (d) 5.12°C

78. The molar freezing point constant for water is
1.86°C/mol. If 342 g of cane sugar (C_{12}H_{22}O_{11}) is
dissolved in 1000 g of water, the solution will freeze at
[Manipal]
(a) -1.86°C  (b) 1.86°C  (c) -3.92°C  (d) 2.42°C

79. The movement of solvent molecules through a
semipermeable membrane is called [Manipal]
(a) electrolysis  (b) electrophoresis  (c) osmosis  (d) cataphoresis

80. The osmotic pressure of 0.2 molar solution of urea at
27°C (R = 0.082 L atm mol^{-1} K^{-1}) is [MP PET]
(a) 4.92 atm (b) 1 atm  (c) 0.2 atm  (d) 27 atm

81. Which of the following is incorrect? [J&K CET]
(a) Relative lowering of vapour pressure is independent of the nature of the solute and the
solvent.
(b) The relative lowering of vapour pressure is a
colligative property.
(c) Vapour pressure of a solution is lower than the
vapour pressure of the solvent.
(d) The relative lowering of vapour pressure is directly
proportional to the original pressure.
82. Which of the following has the lowest freezing point?
(a) 0.1 m sucrose  (b) 0.1 m urea  
(c) 0.1 m ethanol  (d) 0.1 m glucose

83. The statement “the relative lowering of the vapour pressure is equal to the ratio of the moles of the solute to the total number of the moles in the solution” refers to [Kerala CEE]
(a) Hess’s law  (b) Dalton’s law 
(c) Raoult’s law  (d) Charles’ law  
(e) Boyle’s law

84. Ethylene glycol is added to water as antifreeze. It will [Kerala CEE]
(a) decrease the freezing point of water in the winter and increase the boiling point of water in the summer  
(b) only decrease the freezing point of water  
(c) only increase the boiling point of water  
(d) be used for cleaning the radiator in a car  
(e) prevent corrosion of automobile parts

85. The molal elevation constant for water is 0.52. What will be the boiling point of 2 molar sucrose solution at 1 atm pressure? (Assume b.p. of pure water is 100°C) [AMU]
(a) 101.04°C  (b) 100.26°C  
(c) 100.52°C  (d) 99.74°C

86. After adding a solute freezing point of solution decreases to –0.186. Calculate \( \Delta T_b \) if \( k_f = 1.86 \) and \( k_b = 0.521 \) [OJEE]
(a) 0.521  (b) 0.0521  
(c) 1.86  (d) 0.0186

87. For determination of molar mass of colloids, polymers and proteins, which property is used? [OJEE]
(a) Diffusion pressure  (b) Atmospheric pressure  
(c) Osmotic pressure  (d) Turgor pressure

88. The freezing point depression constant for water is 1.86 K kg mol\(^{-1}\). If 45 g of ethylene glycol is mixed with 600 g of water, the freezing point of the solution is [BCECE]
(a) 2.2 K  (b) 270.95 K  
(c) 273 K  (d) 275.35 K

89. For a dilute solution Raoult’s law states that [MP PET]
(a) the relative lowering of vapour pressure is equal to mole fraction of solute  
(b) the lowering of vapour pressure is equal to the mole fraction of solute  
(c) the vapour pressure of the solution is equal to mole fraction of the solvent  
(d) the relative lowering of vapour pressure is proportional to amount of solute in solution

90. Which of the following solutions will have the highest boiling point? [J&K CET]
(a) 0.1 M FeCl\(_3\)  (b) 0.1 M NaCl  
(c) 0.1 M NaCl  (d) 0.1 M urea

91. Maximum freezing point falls in [J&K CET]
(a) camphor  (b) naphthalene  
(c) benzene  (d) water

92. Vapour pressure of dilute aqueous solution of glucose is 750 mm of mercury at 373 K. The mole fraction of solute is
(a) \( \frac{1}{76} \)  (b) \( \frac{1}{7.6} \)  
(c) \( \frac{1}{38} \)  (d) \( \frac{1}{10} \)

2003
93. The relationship between the values of osmotic pressure of 0.1 M solutions of KNO\(_3\) \((p_1)\) and CH\(_3\)COOH \((p_2)\) is [DCE]
(a) \( \frac{p_1}{p_1 + p_2} = \frac{p_2}{p_1 + p_2} \)  (b) \( p_1 > p_2 \)  
(c) \( p_2 > p_1 \)  (d) \( p_1 = p_2 \)

94. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionised? \( k_f \) for water = 1.86 K mol\(^{-1}\) [DCE]
(a) 0.85°C  (b) –3.53°C  
(c) 0°C  (d) –0.35°C

95. On adding a solute to a solvent having vapour pressure 0.80 atm, vapour pressure reduces to 0.60 atm. Mole fraction of solute is [UP SEE]
(a) 0.25  (b) 0.75  
(c) 0.50  (d) 0.33

96. A solution of 4.5 g of a pure non-electrolyte in 100 g of water was found to freeze at 0.465°C. The molecular weight of the solute is closest to \( k_f = 1.86 \) [Kerala CEE]
(a) 135.0  (b) 172.0  
(c) 90.0  (d) 86.2  
(e) 180.0

97. Which of the following solution has highest boiling point? [AMU]
(a) 0.1 M urea  (b) 0.1 M sucrose  
(c) 0.1 M NaNO\(_3\)  (d) 0.1 M Al(NO\(_3\))\(_3\)

98. Which of the following statement is true? [OJEE]
(a) The relative lowering of vapour pressure of a solution is equal to the mole fraction of the solute present in the solution.  
(b) Passage of solute molecules towards solution side through semipermeable membrane is osmosis.  
(c) The boiling point of a solution is always lower than the solvent.  
(d) The boiling point of a liquid is the temperature at which its vapour pressure becomes equal to 260 mm.
99. Elevation in boiling point was 0.52°C when 6 g of a compound was dissolved in 100 g of water. Molecular weight of A is (A, weight of water is 5.2°C per 100 g water).

(a) 120  (b) 60  (c) 600  (d) 180

100. If 0.15 g of a solute, dissolved in 15 g of solvent, is boiled at a temperature higher by 0.216°C than that of the pure solvent. The molecular weight of the substance (molal elevation constant for the solvent is 2.16°C) is

(a) 100  (b) 10.1  (c) 10  (d) 1.001

101. 20 g of binary electrolyte (mol. wt. = 100) are dissolved in 500 g of water. The depression in freezing point of the solution is 0.74°C

(k_f = 1.86 K m⁻¹) The degree of ionisation of the electrolyte is

(a) 0%  (b) 100%  (c) 75%  (d) 50%

102. The order of osmotic pressure of isomolar solution of BaCl₂, NaCl and sucrose is

(a) BaCl₂ > NaCl > sucrose
(b) NaCl > BaCl₂ > sucrose
(c) sucrose > NaCl > BaCl₂
(d) BaCl₂ > sucrose > NaCl

103. The vapour pressure of pure liquid is 1.2 atm. When a non-volatile substance B is mixed in A, then its vapour pressure becomes 0.6 atm. The mole fraction of B in the solution is

(a) 0.15  (b) 0.25  (c) 0.50  (d) 0.75

104. The freezing point of equimolal aqueous solution will be highest for

(a) C₆H₅NH₄Cl  (b) La(NO₃)₃  (c) C₆H₂O₆  (d) Ca(NO₃)₂

**Topic 4**

**Abnormal Molar Masses**

**2011**

1. The degree of dissociation (α) of a weak electrolyte, \( A,B \), is related to van’t Hoff factor \( i \) by the expression \[ \alpha = \frac{i - 1}{x + y - 1} \]

(a) \( i = \frac{x + y}{x + y - 1} \)  (b) \( i = \frac{x + y + 1}{x + y - 1} \)

(c) \( i = \frac{x + y - 1}{i - 1} \)  (d) \( i = \frac{x + y}{i - 1} \)

**2010**

2. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water \( (\Delta T_f)_k \) when 0.01 mole of sodium sulphate is dissolved in 1 kg of water, is \( (k_f = 1.86 K kg mol^{-1}) \)

(a) 0.0372 K  (b) 0.0558 K

(c) 0.0744 K  (d) 0.0186 K

**2009**

3. If the various terms in the below given expressions have usual meanings, the van’t Hoff factor \( i \) cannot be calculated by which one of the expressions? \[ \text{(a) } \pi V = \sqrt{nRT} \]

(b) \( \Delta T_f = ik_f \cdot m \)  (c) \( \Delta T_f = ik_p \cdot m \)

(d) \[ \frac{P_{\text{solute}} - P_{\text{solution}}}{P_{\text{solute}}} = \frac{n}{N + n} \]

4. van’t Hoff factor of aq. K₂SO₄ at infinite dilution has value equal to

(a) 1  (b) 2  (c) 3  (d) between 2 and 3

**2008**

5. van’t Hoff factor of Ca(NO₃)₂ is

(a) one  (b) two  (c) three  (d) four

6. Osmotic pressure observed when benzoic acid is dissolved in benzene is less than that expected from theoretical considerations. This is because

(a) benzoic acid is an organic solute  (b) benzoic acid has higher molar mass than benzene

(c) benzoic acid gets associated in benzene  (d) benzoic acid gets dissociated in benzene

7. van’t Hoff factor more than unity indicates that the solute in solution has

(a) dissociated  (b) associated

(c) Both (a) and (b)  (d) cannot say anything

8. Abnormal colligative properties are observed only when the dissolved non-volatile solute in a given dilute solution

(a) is a non-electrolyte
2007

9. When 20 g of naphthoic acid \( (C_7H_6O_2) \) is dissolved in 50 g of benzene \( (k_f = 1.72 \text{ K kg mol}^{-1}) \), a freezing point depression of 2 K is observed. The van’t Hoff factor \( (i) \) is \( \text{HIT JEE} \)
   (a) 0.5  
   (b) 1  
   (c) 2  
   (d) 3

10. Phenol dimerises in benzene having van’t Hoff factor 0.54. What is the degree of association? \( \text{OJEE} \)
   (a) 1.92  
   (b) 0.98  
   (c) 1.08  
   (d) 0.92

2006

11. Observe the following abbreviations
   \( \pi_{\text{obs}} \) = observed colligative property
   \( \pi_{\text{cal}} \) = theoretical colligative property assuming normal behaviour of solute.
   van’t Hoff factor \( (i) \) is given by \( \text{J&K CET} \)
   (a) \( i = \pi_{\text{obs}} \times \pi_{\text{cal}} \)  
   (b) \( i = \pi_{\text{obs}} + \pi_{\text{cal}} \)  
   (c) \( i = \pi_{\text{obs}} - \pi_{\text{cal}} \)  
   (d) \( i = \frac{\pi_{\text{obs}}}{\pi_{\text{cal}}} \)

2005

12. The elevation in boiling point of a solution of 13.44 g of CuCl\(_2\) in 1 kg of water using the following information will be (molecular weight of CuCl\(_2\) = 134.4 and \( k_f = 0.52 \text{ K mol}^{-1} \)) \( \text{HIT JEE} \)
   (a) 61  
   (b) 244  
   (c) 366  
   (d) 122

13. If \( \alpha \) is the degree of dissociation of Na\(_2\)SO\(_4\), the van’t Hoff factor \( (i) \) used for calculating the molecular mass is \( \text{AIEEE} \)
   (a) \( 1 - 2\alpha \)  
   (b) \( 1 + 2\alpha \)  
   (c) \( 1 - \alpha \)  
   (d) \( 1 + \alpha \)

14. The van’t Hoff factor of BaCl\(_2\) at 0.01 M concentration is 1.98. The percentage of dissociation of BaCl\(_2\) at this concentration is \( \text{Kerala CEE} \)
   (a) 49  
   (b) 69  
   (c) 89  
   (d) 98  
   (e) 100

2004

15. 0.004 M Na\(_2\)SO\(_4\) is isotonic with 0.01 M glucose. Degree of dissociation of Na\(_2\)SO\(_4\) is \( \text{HIT JEE} \)
   (a) 75\%  
   (b) 50\%  
   (c) 25\%  
   (d) 85\%

2003

16. Benzoic acid dissolved in benzene shows a molecular weight of \( \text{Manipal} \)
   (a) 61  
   (b) 244  
   (c) 366  
   (d) 122

17. The van’t Hoff factor for 0.1 M Ba(NO\(_3\))\(_2\) solution is 2.74. The degree of dissociation is \( \text{J&K CET} \)
   (a) 91.3\%  
   (b) 87\%  
   (c) 100\%  
   (d) 74\%

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2011

1. One gram of silver gets distributed between 10 cm\(^3\) of molten zinc and 100 cm\(^3\) of molten lead at 800\(^\circ\)C. The percentage of silver still left in the lead layer in approximately \( \text{KCET} \)
   (a) 2  
   (b) 5  
   (c) 3  
   (d) 1

2006

2. Distribution law was given by \( \text{WB JEE} \)
   (a) Henry  
   (b) van’t Hoff  
   (c) Nernst’s  
   (d) Ostwald

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**Topic 5**

**Distribution Law**
# Answers

## Topic 1: Types of Solutions and Methods of Expressing Concentration

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## Topic 2: Vapour Pressure of Liquid Solutions (Raoult’s Law) Ideal and Non-ideal Solutions

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## Topic 3: Colligative Properties and Determination of Molar Mass

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## Topic 4: Abnormal Molar Masses

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