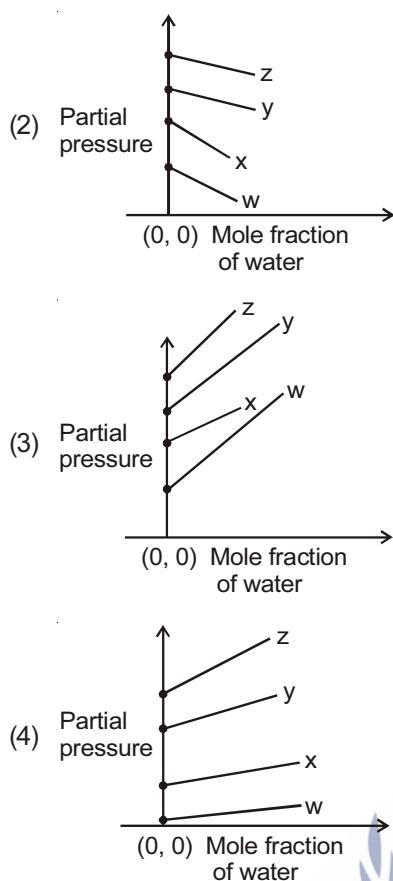


Solutions

1. 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? [AIEEE-2009]
- (1) The solution is non-ideal, showing +ve deviation from Raoult's Law
(2) The solution is non-ideal, showing -ve deviation from Raoult's Law
(3) n-heptane shows +ve deviation while ethanol shows -ve deviation from Raoult's Law
(4) The solution formed is an ideal solution
2. 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 [AIEEE-2009]
- (1) 300 and 400 (2) 400 and 600
(3) 500 and 600 (4) 200 and 300
3. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mol of sodium sulphate is dissolved in 1 kg of water, is ($K_f = 1.86 \text{ K kg mol}^{-1}$) [AIEEE-2010]
- (1) 0.0186 K (2) 0.0372 K
(3) 0.0558 K (4) 0.0744 K
4. On mixing, heptane and octane from 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 25.0 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}) [AIEEE-2010]
- (1) 144.5 kPa (2) 72.0 kPa
(3) 36.1 kPa (4) 96.2 kPa
5. 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 [AIEEE-2011]
- (1) 34.2 (2) 136.2
(3) 171.2 (4) 68.4
6. K_f for water is $1.86 \text{ K kg mol}^{-1}$. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to -2.8°C ? [AIEEE-2012]
- (1) 93 g (2) 39 g
(3) 27 g (4) 72 g
7. Consider separate solutions of 0.500 M $C_2H_5OH(aq)$, 0.100 M $Mg_3(PO_4)_2(aq)$, 0.250 M $KBr(aq)$ and 0.125 M $Na_3PO_4(aq)$ at 25°C . Which statement is true about these solutions, assuming all salts to be strong electrolytes? [JEE (Main)-2014]
- (1) They all have the same osmotic pressure.
(2) 0.100 M $Mg_3(PO_4)_2(aq)$ has the highest osmotic pressure.
(3) 0.125 M $Na_3PO_4(aq)$ has the highest osmotic pressure.
(4) 0.500 M $C_2H_5OH(aq)$ has the highest osmotic pressure.
8. The vapour pressure of acetone at 20°C is 185 torr. When 1.2 g of a non-volatile substance was dissolved in 100 g of acetone at 20°C , its vapour pressure was 183 torr. The molar mass (g mol^{-1}) of the substance is [JEE (Main)-2015]
- (1) 32 (2) 64
(3) 128 (4) 488
9. 18 g glucose ($C_6H_{12}O_6$) is added to 178.2 g water. The vapor pressure of water (in torr) for this aqueous solution is [JEE (Main)-2016]
- (1) 76.0 (2) 752.4
(3) 759.0 (4) 7.6

10. The freezing point of benzene decreases by 0.45°C when 0.2 g of acetic acid is added to 20 g of benzene. If acetic acid associates to form a dimer in benzene, percentage association of acetic acid in benzene will be (K_f for benzene = $5.12 \text{ K kg mol}^{-1}$) [JEE (Main)-2017]
- (1) 74.6% (2) 94.6%
 (3) 64.6% (4) 80.4%
11. Which one of the following statements regarding Henry's law is not correct? [JEE (Main)-2019]
- (1) Different gases have different K_H (Henry's law constant) values at the same temperature
 (2) The value of K_H increases with increase of temperature and K_H is function of the nature of the gas
 (3) The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution
 (4) Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids.
12. Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapor pressures of pure A and pure B are $7 \times 10^3 \text{ Pa}$ and $12 \times 10^3 \text{ Pa}$, respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is [JEE (Main)-2019]
- (1) $x_A = 0.76; x_B = 0.24$ (2) $x_A = 0.37; x_B = 0.63$
 (3) $x_A = 0.28; x_B = 0.72$ (4) $x_A = 0.4; x_B = 0.6$
13. Elevation in the boiling point for 1 molal solution of glucose is 2 K. The depression in the freezing point for 2 molal solution of glucose in the same solvent is 2 K. The relation between K_b and K_f is [JEE (Main)-2019]
- (1) $K_b = 0.5 K_f$ (2) $K_b = 2 K_f$
 (3) $K_b = 1.5 K_f$ (4) $K_b = K_f$
14. The freezing point of a diluted milk sample is found to be -0.2°C , while it should have been -0.5°C for pure milk. How much water has been added to pure milk to make the diluted sample? [JEE (Main)-2019]
- (1) 3 cups of water and 2 cups of pure milk
 (2) 1 cup of water and 2 cups of pure milk
 (3) 2 cups of water to 3 cups of pure milk
 (4) 1 cup of water to 3 cups of pure milk
15. K_2HgI_4 is 40% ionised in aqueous solution. The value of its van't Hoff factor (i) is [JEE (Main)-2019]
- (1) 1.6 (2) 2.0
 (3) 2.2 (4) 1.8
16. Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is [JEE (Main)-2019]
- (1) $2A$ (2) $3A$
 (3) A (4) $4A$
- (Since density of solutions are not given therefore assuming molality to be equal to molarity and given % as % W/V)
17. Molecules of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) dimerise in benzene. 'w' g of the acid dissolved in 30 g of benzene shows a depression in freezing point equal to 2 K. If the percentage association of the acid to form dimer in the solution is 80, then w is (Given that $K_f = 5 \text{ K kg mol}^{-1}$, Molar mass of benzoic acid = 122 g mol^{-1}) [JEE (Main)-2019]
- (1) 1.5 g (2) 2.4 g
 (3) 1.8 g (4) 1.0 g
18. The vapour pressures of pure liquids A and B are 400 and 600 mmHg, respectively at 298 K. On mixing the two liquids, the sum of their initial volumes is equal to the volume of the final mixture. The mole fraction of liquid B is 0.5 in the mixture. The vapour pressure of the final solution, the mole fractions of components A and B in vapour phase, respectively are [JEE (Main)-2019]
- (1) 500 mmHg, 0.4, 0.6 (2) 500 mmHg, 0.5, 0.5
 (3) 450 mmHg, 0.4, 0.6 (4) 450 mmHg, 0.5, 0.5
19. For the solution of the gases w, x, y and z in water at 298 K, the Henry's law constants (K_H) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is : [JEE (Main)-2019]
- (1) Partial pressure
-



20. Liquid 'M' and liquid 'N' form an ideal solution. The vapour pressures of pure liquids 'M' and 'N' are 450 and 700 mmHg, respectively, at the same temperature. Then correct statement is

$(x_M = \text{Mole fraction of 'M' in solution;})$

$x_N = \text{Mole fraction of 'N' in solution;}$

$y_M = \text{Mole fraction of 'M' in vapour phase;}$

$y_N = \text{Mole fraction of 'N' in vapour phase})$

[JEE (Main)-2019]

(1) $\frac{x_M}{x_N} = \frac{y_M}{y_N}$

(2) $\frac{x_M}{x_N} > \frac{y_M}{y_N}$

(3) $\frac{x_M}{x_N} < \frac{y_M}{y_N}$

(4) $(x_M - y_M) < (x_N - y_N)$

21. The osmotic pressure of a dilute solution of an ionic compound XY in water is four times that of a solution of 0.01 M BaCl₂ in water. Assuming complete dissociation of the given ionic compounds in water, the concentration of XY (in mol L⁻¹) in solution is

[JEE (Main)-2019]

(1) 16×10^{-4}

(2) 4×10^{-4}

(3) 6×10^{-2}

(4) 4×10^{-2}

22. Molal depression constant for a solvent is 4.0 K kg mol⁻¹. The depression in the freezing point of the solvent for 0.03 mol kg⁻¹ solution of K₂SO₄ is

(Assume complete dissociation of the electrolyte)

[JEE (Main)-2019]

(1) 0.36 K (2) 0.18 K

(3) 0.12 K (4) 0.24 K

23. At room temperature, a dilute solution of urea is prepared by dissolving 0.60 g of urea in 360 g of water. If the vapour pressure of pure water at this temperature is 35 mmHg, lowering of vapour pressure will be : (molar mass of urea = 60 g mol⁻¹)

[JEE (Main)-2019]

(1) 0.031 mmHg (2) 0.017 mmHg

(3) 0.028 mmHg (4) 0.027 mmHg

24. 1 g of a non-volatile non-electrolyte solute is dissolved in 100 g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1 : 5. The ratio of the elevation in their boiling

points, $\frac{\Delta T_b(A)}{\Delta T_b(B)}$, is :

[JEE (Main)-2019]

(1) 1 : 5 (2) 10 : 1

(3) 5 : 1 (4) 1 : 0.2

25. A solution is prepared by dissolving 0.6 g of urea (molar mass = 60 g mol⁻¹) and 1.8 g of glucose (molar mass = 180 g mol⁻¹) in 100 mL of water at 27°C. The osmotic pressure of the solution is

(R = 0.08206 L atm K⁻¹ mol⁻¹) [JEE (Main)-2019]

(1) 1.64 atm (2) 2.46 atm

(3) 8.2 atm (4) 4.92 atm

26. A solution containing 62 g ethylene glycol in 250 g water is cooled to -10°C. If K_f for water is 1.86 K kg mol⁻¹, the amount of water (in g) separated as ice is

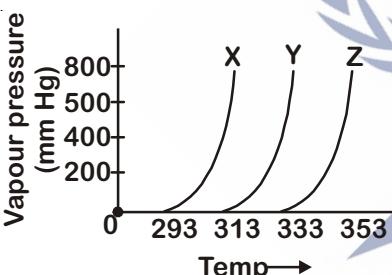
[JEE (Main)-2019]

(1) 64 (2) 32

(3) 16 (4) 48

27. At 35°C, the vapour pressure of CS₂ is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS₂ in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is

[JEE (Main)-2020]

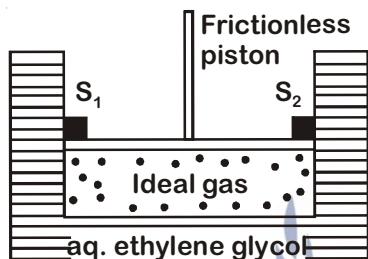
- (1) Raoult's law is not obeyed by this system
 (2) A mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL
 (3) Heat must be absorbed in order to produce the solution at 35°C
 (4) CS_2 and acetone are less attracted to each other than to themselves
28. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non volatile solute are together sealed in a container. Over time [JEE (Main)-2020]
 (1) The volume of the solution and the solvent does not change
 (2) The volume of the solution increases and the volume of the solvent decreases
 (3) The volume of the solution does not change and the volume of the solvent decreases
 (4) The volume of the solution decreases and the volume of the solvent increases.
29. A graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below
- 
- The following inferences are made
 (A) X has higher intermolecular interactions compared to Y.
 (B) X has lower intermolecular interactions compared to Y
 (C) Z has lower intermolecular interactions compared to Y.
- The correct inferences is/are [JEE (Main)-2020]
 (1) (B)
 (2) (C)
 (3) (A) and (C)
 (4) (A)
30. An open beaker of water in equilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules [JEE (Main)-2020]
 (1) Leaves the solution increases
 (2) Leaves the vapour increases
 (3) Leaves the vapour decreases
 (4) Leaves the solution decreases
31. The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following processes can explain this? [JEE (Main)-2020]
 (1) Osmosis
 (2) Reverse osmosis
 (3) Diffusion
 (4) Dialysis
32. Henry's constant (in kbar) for four gases α , β , γ and δ in water at 298 K is given below
- | | | | | |
|-------|----------|---------|--------------------|----------|
| K_H | α | β | γ | δ |
| | 50 | 2 | 2×10^{-5} | 0.5 |
- (density of water = 10^3 kg m^{-3} at 298 K)
- This table implies that [JEE (Main)-2020]
 (1) The pressure of a 55.5 molal solution of γ is 1 bar
 (2) Solubility of γ at 308 K is lower than at 298 K
 (3) α has the highest solubility in water at a given pressure
 (4) The pressure of a 55.5 molal solution of δ is 250 bar
33. A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of these solutes are in the order [Given, molar mass of A = 100 g mol^{-1} ; B = 200 g mol^{-1} ; C = $10,000 \text{ g mol}^{-1}$] [JEE (Main)-2020]
 (1) A > C > B
 (2) C > B > A
 (3) A > B > C
 (4) B > C > A

34. How much amount of NaCl should be added to 600 g of water ($\rho = 1.00 \text{ g/mL}$) to decrease the freezing point of water to -0.2°C ? _____.

(The freezing point depression constant for water = 2 K kg mol^{-1}) **[JEE (Main)-2020]**

35. A cylinder containing an ideal gas (0.1 mol of 1.0 dm^3) is in thermal equilibrium with a large volume of 0.5 molal aqueous solution of ethylene glycol at its freezing point. If the stoppers S_1 and S_2 (as shown in the figure) are suddenly withdrawn, the volume of the gas in litres after equilibrium is achieved will be _____.

(Given, K_f (water) = $2.0 \text{ K kg mol}^{-1}$, $R = 0.08 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$)



[JEE (Main)-2020]

36. If 250 cm^3 of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is _____ $\times 10^{-2}$ (to the nearest integer). **[JEE (Main)-2020]**

37. At 300 K, the vapour pressure of a solution containing 1 mole of n-hexane and 3 moles of n-heptane is 550 mm of Hg. At the same temperature, if one more mole of n-heptane is added to this solution, the vapour pressure of the solution increases by 10 mm of Hg. What is the vapour pressure in mm Hg of n-heptane in its pure state _____? **[JEE (Main)-2020]**

38. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is $x \times 10^{-3}$ atm. x is _____. (nearest integer) **[JEE (Main)-2020]**

39. The elevation of boiling point of 0.10 m aqueous $\text{CrCl}_3 \cdot x\text{NH}_3$ solution is two times that of 0.05 m aqueous CaCl_2 solution. The value of x is _____. [Assume 100% ionisation of the complex and CaCl_2 , coordination number of Cr as 6, and that all NH_3 molecules are present inside the coordination sphere] **[JEE (Main)-2020]**