

CHAPTER - 12 SOLUTIONS

PART I - (JEEMAIN LEVEL)

SECTION - I

1. 3 Molarity, normality and volume percent are temperature dependent
2. 1
$$\frac{(100 \times 0.3) + (150 \times 0.1 \times 2)}{100 + 150} = 0.24 \text{ mol L}^{-1}$$
3. 4 As temperature increases, K_H increases
4. 2
$$P_{\text{Total}} = P_A^0 \chi_A + P_B^0 \chi_B = (7 \times 10^3 \times 0.4) + (12 \times 10^3 \times 0.6) = 10^4 \text{ Pa}$$
5. 3 For ideal binary solution, $\Delta_{\text{mix}} H = 0$, $\Delta_{\text{mix}} G = -ve$, $\Delta S_{\text{mix}} = +ve$
6. 1 Phenol-aniline mixture shows negative deviation from Raoult's law. Thus $\Delta_{\text{mix}} H < 0$ and $\Delta_{\text{mix}} V < 0$
7. 1 HNO_3 - water mixture shows negative deviation whereas ethanol-water mixture shows positive deviation from the Raoult's law
8. 2
$$\Delta T_b = K_b \times 1 = 2$$

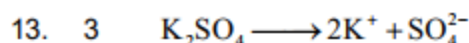
$$\Delta T_f = K_f \times 2 = 2$$

$$\Rightarrow K_b = 2K_f$$
9. 4 $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ is a non-dissociating solute. Its vapour pressure will be the highest
10. 3

<u>Solute</u>	<u>i</u>
Urea	1
CaCl_2	3
MgSO_4	2
Glucose	1

Solutions (i), (ii) and (iv) have the same value of ' $i \times C$ '. Thus, they are isotonic
11. 3 3, 4 and 5 are solid solutions
12. 17
$$\frac{P_1^0 - P_1}{P_1^0} = X_2 \Rightarrow P_1 = P_1^0 - P_1^0 X_2 = P_1^0 (1 - X_2)$$

$$\text{Thus, } P_1 = 17.535 \left(1 - \frac{1}{181} \right) = 17.44 \text{ mm Hg}$$



14. 19 For NaCl, $i = 1 + \alpha = 1.9$

$$\pi = iCRT = \underbrace{i \times 0.01 \times R \times T}_{\text{Osmotic pressure of urea solution}} = 1.9 \times \pi_{\text{urea}}$$

15. 1 For benzoic acid dimerisation, $i = 1 - \frac{\alpha}{2}$

$$\Delta T_b = \left(1 - \frac{\alpha}{2}\right) K_b m$$

$$1.25 = \left(1 - \frac{\alpha}{2}\right) \times 2.5 \times \left[\frac{12.2/122 \text{ mol}}{0.1 \text{ kg}}\right]$$

Thus, $\alpha = 1$

ART - II (JEE ADVANCED LEVEL)

SECTION - III (One correct answer)

16. A $P = P_A^\circ X_A + P_B^\circ X_B$

$$550 = P_A^\circ \left(\frac{1}{4}\right) + P_B^\circ \left(\frac{3}{4}\right)$$

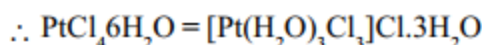
$$560 = P_A^\circ \left(\frac{1}{5}\right) + P_B^\circ \left(\frac{4}{5}\right)$$

On solving, $P_A^\circ = 400 \text{ mmHg}$ and $P_B^\circ = 600 \text{ mmHg}$

17. B $\Delta_{\text{vap}} H = \frac{R \times M_1 \times T_b^2}{1000 \times K_b} = \frac{(8.314)(92)(383)^2}{1000 \times 3.32} = 33.795 \text{ kJmol}^{-1}$

18. B For a given solution, ΔT_f is larger than ΔT_b

19. C $\Delta T_f = i K_f m \Rightarrow i = \frac{3.72}{1.86 \times 1} = 2$



20. B Vapour pressure of solution = $P_b^\circ X_b + P_c^\circ X_c$

$$\text{Given, } X_b = \frac{1560/78}{(1560/78) + (125/125)} = \frac{20}{30} = \frac{2}{3}$$

$$\text{and } X_c = \frac{1}{3}$$

$$\text{At } 100^\circ\text{C}, P_{\text{total}} = 1350 \times \frac{2}{3} + 200 \times \frac{1}{3} = 1000 \text{ torr}$$

∴ Boiling point of solution will be 100°C

21. A $\Delta T_f = i k_f m \Rightarrow i = \frac{2.56}{512 \times 1} = \frac{1}{2} \Rightarrow \text{dimerisation}$

$$\Delta T_f = i k_b m \Rightarrow i = \frac{2.53}{2.53 \times 1} = 1 \Rightarrow \text{no dimerisation}$$

SECTION - IV (More than one correct answer)

22. A, B Only solvent is volatile thus, $P_s = P_B^\circ X_B$

Number of solvent molecules escaping from liquid phase decreases due to decrease in surface occupancy. Thus, vapour pressure of solution will be less than that of pure solvent

23. C, D Acetone is more volatile than carbon disulphide. The given mixture can form minimum boiling azeotrope. Thus, complete separation by fractional distillation is not possible

Vapour pressure increases therefore boiling point decreases on adding small amount of CS_2 into excess of acetone.

24. B, C, D

Solution	van't Hoff factor (assuming 100% association/dissociation)
P	1
Q	2
R	4
S	0.5

∴ order of π is, $S < P < Q < R$

SECTION - V (Numerical Type - Upto two decimal place)

25. 1550.00

$$\Delta T_f = k_f m \Rightarrow m = \frac{93}{1.86} = 5$$

i.e., 5 mol ethylene glycol must be added to 1 kg water

∴ 25 mol ethylene glycol needs to be added to 5 kg water

$$\text{Mass of ethylene glycol} = 25 \times 62 = 1550 \text{ g}$$

26. 7.00 $\Delta T_f = k_f m \Rightarrow m = \frac{10}{1.86}$ (Molality at -10°C)

$$\text{Therefore, } \frac{(81/62) \text{ mol}}{x \text{ kg}} = \frac{10}{1.86} \Rightarrow x = 0.243 \text{ kg (or) } 243 \text{ g}$$

∴ Amount of ice separated = $250 - 243 = 7 \text{ g}$

27. 5.00 $\text{For NaCl } \Delta T_b = i k_b m$

$$\frac{f_{0x} \times}{2} = 2 \times k_b \times m_x$$

$$\frac{f_{0y} \times}{1} = 2 \times k_b \times m_y$$

$$\therefore \frac{k_{bx}}{k_{by}} = 2 \quad \text{--- (1)}$$

$\text{For sucrose } m_x = m_y$

$$\Delta T_{bx} = 3 \Delta T_{by}$$

$$i_x k_{bx} m = 3 i_y k_{by} m$$

$$\frac{k_{bx}}{k_{by}} = 3 \frac{i_y}{i_x}$$

$$2 = 3 \frac{i_y}{i_x}$$

$$\frac{i_y}{i_x} = \frac{2}{3}$$

$$\text{Also } \alpha_x = \frac{1 - i_x}{1 - \frac{1}{2}}$$

$$= 2(1 - i_x)$$

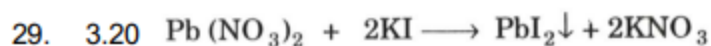
$$\alpha_y = 2(1 - i_y)$$

$$\text{or } 0.7 = 2(1 - i_y)$$

Sub the values of i_x and i_y

$$\alpha_x = 0.05$$

28. 2.70 Before opening $C = K_H \cdot P = 3 \times 10^{-2} \times 5 = 1.5 \times 10^{-1}$
 After opening $C = K_H \cdot P = 3 \times 10^{-2} \times 0.0004 = 1.2 \times 10^{-5}$



$$\begin{array}{cccc} 0.1 \times V & 0.1 \times 2V & - & - \\ - & - & - & 0.2V \\ & & & i = 2 \end{array}$$

$$\pi = 2 \times \frac{0.2V}{3V} \times 0.08 \times 300 = 3.2 \text{ atm}$$

SECTION - VI (Matrix Matching)

30. A Osmosis occurs from hypotonic to hypertonic side.