

## SOLUTION –II PUC

- On dissolving sugar in water at room temperature solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid?  
a) Sugar crystals in cold water                      b) Sugar crystals in hot water  
c) Powdered sugar in cold water                      d) Powdered sugar in hot water
- A beaker contains a solution of substance 'A'. Precipitation of substance 'A' takes place when small amount of 'A' is added to the solution. The solution is .....  
a) saturated                      b) supersaturated                      c) unsaturated                      d) concentrated
- Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?  
a) Methanol and acetone                      b) Chloroform and acetone  
c) Nitric acid and water                      d) Phenol and aniline
- Which of the following aqueous solutions should have the highest boiling point?  
a) 1.0 M NaOH                      b) 1.0 M Na<sub>2</sub>SO<sub>4</sub>                      c) 1.0 M NH<sub>4</sub> NO<sub>3</sub>                      d) 1.0 M KNO<sub>3</sub>
- In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.001 M MgCl<sub>2</sub> solution is  
a) the same                      b) about twice  
c) about three times                      d) about six times
- At a given temperature, osmotic pressure of a concentrated solution of a substance .....  
a) is higher than the at a dilute solution  
b) is lower than that of a dilute solution  
c) is same as that of a dilute solution  
d) cannot be compared with osmotic pressure of dilute solution
- The value of Henry's constant  $K_H$  is .....  
a) greater for gases with higher solubility                      b) greater for gases with lower solubility  
c) constant for all gases                      d) not related to the solubility of gases
- If two liquids A and B form minimum boiling azeotrope at some specific composition then .....  
a) A – B interactions are stronger than those between A – A or B – B  
b) Vapour pressure of solution increases because more number of molecules of liquids A and B can escape from the solution  
c) vapour pressure of solution decreases because less number of molecules of only one of the liquids escape from the solution  
d) A – B interactions are weaker than those between A – A or B – B
- $K_H$  values for Ar<sub>(g)</sub>, CO<sub>2(g)</sub>, HCHO<sub>(g)</sub> and CH<sub>4(g)</sub> are 40.39, 1.67,  $1.83 \times 10^{-5}$  and 0.413 respectively. Arrange these gases in the order of their increasing solubility.  
a) HCHO < CH<sub>4</sub> < CO<sub>2</sub> < Ar                      b) HCHO < CO<sub>2</sub> < CH<sub>4</sub> < Ar  
c) Ar < CO<sub>2</sub> < CH<sub>4</sub> < HCHO                      d) Ar < CH<sub>4</sub> < CO<sub>2</sub> < HCHO

10. How many grams of cane sugar are present in 534.2 g of its aqueous solution having molality 0.2?  
 a) 3.42                                      b) 34.2                                      c) 18                                      d) 1.8
11. What weight of glucose dissolved in 100 g of water will produce the same lowering of vapour pressure as one gram of urea dissolved in 50 g of water, at the same temperature?  
 a) 3 g                                      b) 5 g                                      c) 6 g                                      d) 4 g
12. Lowering of vapor pressure due to a solute in 1 molal aqueous solution at 100° C is  
 a) 13.43 torr                                      b) 14.12 torr                                      c) 312 torr                                      d) 352 torr
13. The relative lowering of the vapor pressure of an aqueous solution containing a non-volatile solute is 0.0125. The molality of the solution is  
 a) 0.70                                      b) 0.50                                      c) 0.80                                      d) 0.40
14. Mole fraction of A vapours above the solution in mixture of A and B ( $x_A = 0.4$ ) will be (Given:  $p_A^0 = 100$  mm Hg and  $p_B^0 = 200$  mm Hg)  
 a) 0.4                                      b) 0.8                                      c) 0.25                                      d) 2.5
15. 1.0 molal aqueous solution of an electrolyte  $A_2B_3$  is 60% ionized. The boiling point of the solution at 1 atm is ( $K_{b(H_2O)} = 0.52$  K kg mol<sup>-1</sup>)  
 a) 274.76 K                                      b) 377 K                                      c) 376.4 K                                      d) 374.76 K
16. The ebullioscopic constant for water if its enthalpy of vaporization is 40.685 kJ mol<sup>-1</sup> is  
 a) 0.512 K kg mol<sup>-1</sup>                                      b) 1.86 K kg mol<sup>-1</sup>  
 c) 5.12 K kg mol<sup>-1</sup>                                      d) 3.56 K kg mol<sup>-1</sup>
17. In which of the following cases osmosis takes place, if the solutions are separated by a semi permeable membrane  
 a) 0.1 M NaCl and 0.2 M glucose.                                      b) 0.1 M sucrose and 0.1 M fructose  
 c) 0.05 M  $K_4[Fe(CN)_6]$  and 0.1 M  $CaCl_2$                                       d)  $10^{-3}$  M  $CaCl_2$  and  $1.5 \times 10^{-3}$  M NaCl
18. If the observed and normal osmotic pressures of 1% NaCl solution are 5.7 and 3.0 atm, the degree of dissociation of NaCl is  
 a) 0.9                                      b) 1.0                                      c) 0.57                                      d) 0.3
19. If in a solvent, n simple molecules of solute combine to form an associated molecule, x is the degree of association, the van't Hoff factor i is equal to  
 a)  $\frac{1}{1 - nx}$                                       b)  $\frac{1 - x + nx}{1}$   
 c)  $\frac{1 - x + x/n}{1}$                                       d)  $\frac{x/n - 1 + x}{1}$
20. A sample of 20 g of a compound (Mol. Wt. = 120) which is a non-electrolyte is dissolved in 10.0 g of ethanol ( $C_2H_5OH$ ). If the vapor pressure of pure ethanol at the temperature is 0.250 atm. What is the vapor pressure of the solution?  
 a) 0.250 atm                                      b) 0.83 atm                                      c) 0.125 atm                                      d) 0.141 atm

21. The vapor pressure in mm of Hg of an ideal solution of A and B at 25° C is given by  $p_{AB} = 33x + 94$ , whereas that of an ideal solution of A and C at 25° C is given by  $p_{AC} = 81x + 46$ ;  $x$  being mole fraction of A in the solution. The vapour pressure of solution containing 2 mol A, 3 mol B and 4 mol of C will be  
 a) 80                                      b) 90                                      c) 100                                      d) 70
22. The vapour pressure of a solution of a non-volatile electrolyte B in a solvent A is 95% of the vapour pressure of the solvent at the same temperature. If the molecular weight of the solvent is 0.3 times the molecular weight of solute, the weight ratio of the solvent and solute are  
 a) 0.15                                      b) 5.7                                      c) 0.2                                      d) 4.0
23. Equimolal solutions of A and B show depression in freezing point in the ratio 2:1. If A remains in its normal state in solution, then B will be in which state  
 a) normal                                      b) dissociated                                      c) associated                                      d) hydrolysis
24. 20 g of a binary electrolyte AB (Mol. Wt. = 100) are dissolved in 500 g of water ( $K_f = 1.86$ ). The freezing point of the solution is  $-0.74^\circ\text{C}$ . The degree of ionization of the electrolyte is  
 a) 50%                                      b) 75%                                      c) 10%                                      d) 0%
25. A solution containing 28 g phosphorous in 315 g  $\text{CS}_2$  (b.p. =  $46.3^\circ\text{C}$ ) boils at  $47.9^\circ\text{C}$  ( $K_{b(\text{CS}_2)} = 2.34$ ). What will be molecular formula of phosphorus? (Assuming complete association.)  
 a)  $\text{P}_4$                                       b)  $\text{P}_8$                                       c)  $\text{P}_2$                                       d) none
26. An aqueous solution of a solute which neither associates nor dissociates has a freezing point depression of  $X^\circ\text{C}$ . An equimolal solution of a second salt has a freezing point depression of  $3X^\circ\text{C}$ . Assuming 100% dissociation of salt, the second solution could be a salt of formula  
 a)  $\text{AB}_3$                                       b)  $\text{AB}_2$                                       c)  $\text{A}_3\text{B}$                                       d)  $\text{A}_2\text{B}_3$
27. When mercuric iodide is added to the aqueous solution of potassium iodide, the  
 a) freezing point is raised                                      b) freezing point is lowered  
 c) freezing point does not change                                      d) cannot predict
28. The weight of urea dissolved in 100 mL solution which produce an osmotic pressure of 20.4 atm at 25° C, will be  
 a) 5 g                                      b) 4 g                                      c) 3 g                                      d) 6 g
29. If the van't Hoff factor of a 0.005 M aqueous solution of KCl is 1.95, then the degree of dissociation of KCl is  
 a) 0.95                                      b) 0.97c                                      c) 0.94                                      d) 0.96
30. If solute undergoes dimerization and trimerization, the minimum values of the van't Hoff factors are  
 a) 0.50 and 1.50                                      b) 1.50 and 1.33                                      c) 0.50 and 0.33                                      d) 0.25 and 0.67

31. The values of observed and calculated molecular mass of  $\text{Ca}(\text{NO}_3)_2$  are 65.4 and 164 respectively. What is the degree of ionization of the salt?  
 a) 0.25                                      b) 0.30                                      c) 0.60                                      d) 0.75
32. A compound X undergoes tetramerization in a given organic solvent. The van't Hoff factor is  
 a) 4.0    b) 0.25                                      c) 0.125                                      d) 2.0
33. The values of observed and calculated formula mass of silver nitrate are 92.64 and 170 respectively. The degree of dissociation of silver nitrate is  
 a) 60%    b) 83.5%                                      c) 46.7%                                      d) 60.23%
34. Osmotic pressure of blood is 7.65 atm at 310 K. An aqueous solution of glucose that will be isotonic with blood is ..... (w/V).  
 a) 5.41%    b) 3.54%                                      c) 4.53%                                      d) 53.4%
35. 20 g of a binary electrolyte (Mol. Wt. = 100) is dissolved in 500 g of water. The freezing point of the solution is  $-0.74^\circ\text{C}$ ,  $k_f = 1.86\text{ K m}^{-1}$ . The degree of ionization of the electrolyte is  
 a) 50%    b) 75%    c) 100%    d) 0
36. 1.0 molal aqueous solution of an electrolyte  $\text{X}_3\text{Y}_2$  is 25% ionized. The boiling point of the solution is ( $K_b$  for  $\text{H}_2\text{O} = 0.52\text{ K kg mol}^{-1}$ )  
 a) 375.5 K    b) 374.04 K    c) 377.12 K    d) 373.25 K
37. NaCl is added to 1 L water to such an extent that  $\Delta t_f/K_f$  becomes equal to 1/500. The weight of NaCl added is  
 a) 5.85 g    b) 0.585 g    c) 0.0585 g    d) 58.5 g
38. The vapour pressure of a solvent decreased by 10 mm Hg when a non-volatile solute was added to the solvent. The mole fraction of solute in solution is 0.2, what would be mole fraction of the solvent if decrease in vapor pressure is 20 mm of Hg.  
 a) 0.8    b) 0.6    c) 0.4    d) 0.2
39. The degree of dissociation of  $\text{Ca}(\text{NO}_3)_2$  in dilute aqueous solution containing 7 g of the salt per 100 g of water at  $100^\circ\text{C}$  is 70%. If the vapor pressure of water at  $100^\circ\text{C}$  is 760 mm Hg. The vapour pressure of the solution is  
 a) 746.3 mm Hg    b) 1492.6 mm Hg  
 c) 373.2 mm Hg    d) 74.63 mm Hg
40. The vapour pressures of ethanol and methanol are 42.0 mm Hg and 88.5 mm Hg respectively. An ideal solution is formed at the same temperature by mixing 46.0 g of ethanol with 16.0 of methanol. The mole fraction of methanol in the vapour is  
 a) 9.467    b) 0.502    c) 0.513    d) 0.556
41. Which of the following azeotropic solutions has the boiling point less than boiling points of the constituents A and B?  
 a)  $\text{CHCl}_3$  and  $\text{CH}_3\text{COCH}_3$     b)  $\text{CHCl}_3 + \text{C}_6\text{H}_6$   
 c)  $\text{CH}_3\text{CH}_2\text{OH}$  and  $\text{CH}_3\text{COCH}_3$     d)  $\text{CH}_3\text{COCH}_3 + \text{C}_6\text{H}_5\text{NH}_2$



**Solution:****1. Ans: (d)**

Powdered sugar has large surface area and thus, dissolves faster in hot water. As solution feels cool to touch, dissolution is endothermic so, dissolution will be favoured at high temperature.

**2. Ans: (b)**

A saturated solution cannot dissolve any more solute at that temperature. If precipitation occurs, it is supersaturated.

**3. Ans: (a)**

Mixture of methanol and acetone shows positive deviation from Raoult's law. In pure methanol, molecules are hydrogen bonded. On adding acetone, its molecules get in between the host molecules and break some of the hydrogen bonds between them.

**4. Ans: (b)**

$$\Delta T_b = iK_b m$$

$$T_b - T_b^0 = iK_b m$$

Thus, boiling point of solution ( $T_b$ ) depends on value of van't Hoff factor ( $i$ ).

For 1.0 M  $\text{Na}_2\text{SO}_4$  solution,  $i = 3$  hence, it has highest boiling point.

**5. Ans: (c)**

$$\Delta T_f = iK_f m$$

For glucose,  $i = 1$

For  $\text{MgCl}_2$ ,  $i = 3$

Thus, the depression in freezing point ( $\Delta T_f$ ) of a 0.01 M  $\text{MgCl}_2$  solution is about three times of that of 0.01 M glucose solution.

**6. Ans: (a)**

$$\pi = CRT$$

Greater the concentration of solution, more will be its osmotic pressure. Thus, osmotic pressure of a concentrated solution of a substance is higher than that at a dilute solution.

**7. Ans: (b)**

$$p = K_H X$$

Higher the value of  $K_H$  at a given pressure, the lower is the solubility of the gas in the liquid.

**8. Ans: (d)**

The solutions which show a large positive deviation from Raoult's law (i.e., A – B interactions are weaker than those between A – A or B – B) form minimum boiling azeotrope at a specific composition.

**9. Ans: (c)**

Higher the value of  $K_H$ , the lower is the solubility of gas in the liquid.

Thus, the order of increasing solubility is

Ar	<	CO <sub>2</sub>	<	CH <sub>4</sub>	<	HCHO
K <sub>H</sub> value:		40.39		1.67		0.413      1.83 × 10 <sup>-5</sup>

**10. Ans: (b)**

$$\text{Molality (m)} = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$$

$$0.2 = \frac{\text{Moles of cane sugar}}{\text{Wt. of solvent (kg)}}$$

Let the weight of cane sugar be x

$$0.2 = \frac{(x/342)}{(534.2 - x)/1000} \Rightarrow x = 34.2 \text{ g}$$

**11. Ans:(c)**

Relative lowering of vapor pressure =  $X_{\text{solute}} \times i$

$$X_{\text{Glucose}} \times i_1 = X_{\text{urea}} \times i_2$$

$$\frac{(x/180) \times 1}{(x/180) + (100/18)} = \frac{(1/60) \times 1}{(1/60 + 50/18)} = x = 6\text{g}$$

**12. Ans:(a)**

$$\text{Molality} = \frac{\text{Moles of solute} \times 1000}{\text{Wt. of solvent}}$$

$$1 = \frac{\text{Moles of solute} \times 1000}{\text{Moles of solvent} \times 18}$$

$$\frac{n_{\text{solute}}}{n_{\text{solvent}}} = \frac{18}{1000}$$

Therefore,  $X_{\text{solute}} = \frac{18}{1018}$

Also,  $\frac{p^0 - p}{p^0} = \frac{18}{1018}$

$$p^0 - p = \frac{18}{1018} \times 760 = 13.43 \text{ torr}$$

**13. Ans:(a)**

$$0.0125 = X_{\text{solute}} = \frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}}$$

$$0.0125 = \frac{(n_{\text{solute}} / n_{\text{solvent}})}{(n_{\text{solute}} / n_{\text{solvent}}) + 1}$$

$$0.0125 = \frac{(n_{\text{solute}} \times 18 \times 1000) / (n_{\text{solvent}} \times 18 \times 1000)}{\left( \frac{n_{\text{solute}} \times 18 \times 1000}{n_{\text{solvent}} \times 18 \times 1000} \right) + 1}$$

$$0.0125 = \frac{(m \times 18 / 1000)}{(m \times 18 / 1000) + 1} \Rightarrow m = 0.7$$

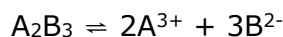
**14. Ans:(c)**

$$y_A \times p_{\text{Total}} = X_A(\ell) \times P_A^0$$

Therefore,  $y_A = \frac{(0.4 \times 100)}{(0.4 \times 100 + 0.6 \times 200)} = 0.25$

**15. Ans:(d)**

The ionization reaction is



At  $t = 0$     1            0            0

At  $t = t$      $1 - \alpha$          $2\alpha$          $3\alpha$

van't Hoff factor can be calculated as  $i = 1 + 4\alpha$

$$i = 1 + 4 \times 0.6 = 3.4$$

Elevation in boiling point is given by  $\Delta T_b = iK_b m$

$$\Delta T_b = 3.4 \times K_b \times m$$

$$T_b - 373 = 3.4 \times 0.52 \times 1 \quad [\text{Since, at 1 atm } T_b^0 = 373 \text{ K}]$$

$$T_b = 374.76 \text{ K} \approx 374.8 \text{ K}$$

**16. Ans:(a)**

$$K_b = \frac{RT_b^2 M}{1000 \times \Delta H}$$

$$= \frac{0.00831 \text{ kJ K}^{-1} \text{ mol}^{-1} \times (373 \text{ K})^2 \times 18 \text{ kg mol}^{-1}}{1000 \times 40.685 \text{ kJ mol}^{-1}}$$

$$= 0.512 \text{ K kg mol}^{-1}$$

**17. Ans:(c)**

For solution to be isotonic  $\Pi_1 = \Pi_2$ . Osmotic pressure is given by  $\Pi = iCRT$ .

Option (1):  $i_1C_1 = i_2C_2$  ( $0.1 \times 2 = 0.2 \times 1$ ). Therefore, solution is isotonic.

Option (2):  $i_1C_1 = i_2C_2$  ( $0.1 \times 1 = 0.1 \times 1$ ). Therefore, solution is isotonic.

Option (3):  $\Pi_1 = iC_1RT = 5 \times 0.05 RT = 0.25 RT$

$$\Pi_2 = iC_2RT = 3 \times 0.1 RT = 0.3 RT$$

$\Pi_1 \neq \Pi_2$ . Therefore, in this case osmosis will take place.

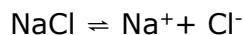
Option (4):  $i_1C_1 = i_2C_2$  ( $3 \times 10^{-3} = 2 \times 1.5 \times 10^{-3}$ ). Therefore, solution is isotonic.

**18. Ans:(a)**

$$i = \frac{\text{Observed colligative property}}{\text{Normal colligative property}}$$

$$i = \frac{5.7}{3} = 1.9$$

The dissociation reaction is



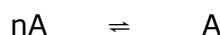
At  $t = 0$     1        0        0

At  $t = t$      $1 - \alpha$      $\alpha$          $\alpha$

van't Hoff factor can be calculated as  $i = 1 + \alpha \Rightarrow \alpha = 0.9$ .

**19. Ans:(c)**

The reaction is



At  $t = 0$     1                    0

At  $t = t$      $1 - x$                  $\frac{x}{n}$

Therefore,  $i = 1 - x + \frac{x}{n}$

**20. Ans: (d)**

$$\frac{p_A^0 - p_A}{p_A^0} = i \times X_{\text{solute}}$$

$$\frac{0.25 - p_A}{0.25} = 1 \times \frac{\left(\frac{20}{120}\right)}{\left(\frac{20}{120}\right) + \left(\frac{10}{46}\right)} \Rightarrow p_A = 0.141 \text{ atm}$$

**21. Ans:(a)**

$$P_A^0 = 33 + 94 = 127 \text{ mm of Hg}$$

$$p_B^0 = 94 \text{ mm of Hg and } p_C^0 = 46 \text{ mm of Hg}$$

$$p_{\text{Total}} = P_A^0 x_A + p_B^0 x_B + p_C^0 x_C$$

$$= 127 \times \frac{2}{9} + 94 \times \frac{3}{9} + 46 \times \frac{4}{9}$$

$$= 80 \text{ mm of Hg}$$



**22. Ans: (b)**

We know  $\frac{p_A^0 - p_A}{p_A^0} = X_{\text{solute}}$

$$\frac{p_A^0 - 0.95p_A}{p_A^0} = \frac{X_B / M_B}{\frac{X_B}{M_B} + \frac{X_A}{M_A}}$$

$$0.05 = \frac{X_B / M_B}{\frac{X_B}{M_B} + \frac{X_A}{0.3M_B}} \Rightarrow \frac{X_A}{X_B} = 5.7$$

**23. Ans:(c)**

Depression in freezing point is given by

$$\Delta T_t = iK_f M$$

$$\frac{(\Delta T_f)_B}{(\Delta T_f)_A} = \frac{i_B}{i_A}$$

$$\frac{1}{2} = \frac{i_B}{1} \Rightarrow i_B = 0.5 \text{ or } i_B < 1$$

Therefore, B is in associated state.

**24. Ans:(d)**

The ionization of electrolyte is



$$\text{At } t = 0 \quad \frac{20}{100} \quad 0 \quad 0$$

$$\text{At } t = t \quad 0.5(1 - \alpha) \quad 0.5\alpha \quad 0.5\alpha$$

$$i = \frac{0.5(1 + \alpha)}{0.5} = 1 + \alpha$$

Depression in freezing point is given by  $\Delta T_f = iK_f m$

$$0.74 = (1 + \alpha) \times 1.86 \times \frac{(20/100)}{(500/1000)}$$

$$\alpha = 0.0053 \approx 0$$

**25. Ans:(a)**

Elevation in boiling point is given by

$$\Delta T_b = iK_b m \text{ or } T_b - T_b^0 = iK_b m \quad (1)$$

$$xP \rightleftharpoons P_x$$

$$\text{At } t = 0 \quad 1 \quad 0$$

$$\text{At } t = t \quad 0 \quad \frac{1}{x}$$

$$\text{van't Hoff factor } i = \frac{1}{x}$$

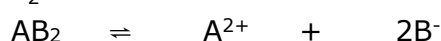
Substituting the values in Eq. (1), we get

$$(47.9 - 46.3) = \frac{1}{x} \times 2.34 \times \frac{(28/31x)}{(315/1000)} \Rightarrow x = 4$$

**26. Ans:(b)**

$$\frac{i_1}{i_2} = \frac{(\Delta T_f)_1}{(\Delta T_f)_2}$$

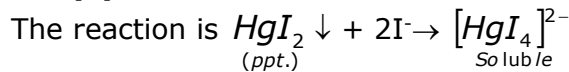
$$\frac{1}{i_2} = \frac{x}{3x} \Rightarrow i_2 = 3$$





For  $AB_2$  salt, van't Hoff factor is 3.

**27. Ans:(a)**



$[\text{HgI}_4]^{2-}$  is consumed, therefore molality decreases and  $\Delta T_f$  decreases or  $T_f$  increases.

**28. Ans:(a)**

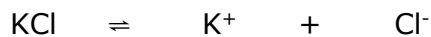
Osmotic pressure can be calculated as  $\Pi = iCRT$

$$20.4 = i \times C \times R \times T$$

$$20.4 = 1 \times \frac{(x/60)}{(100/1000)} \times 0.0821 \times 298 \Rightarrow x = 5 \text{ g}$$

**29. Ans:(a)**

The dissociation reaction is

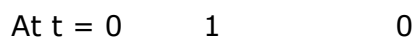
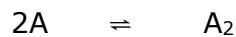


van't Hoff factor can be calculated as  $i = \frac{0.005(1 + \alpha)}{0.005} = 1 + \alpha$

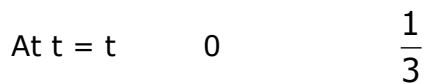
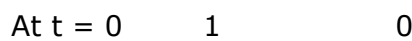
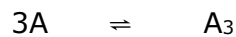
$$1.95 = 1 + \alpha \Rightarrow \alpha = 0.95$$

**30. Ans: (c)**

The reactions are



$$i = \frac{1}{2} \text{ or } 0.5$$



$$i = \frac{1}{3} \text{ or } 0.33$$

**31. Ans:(d)**

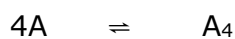
The ionization reaction is



$$i = \frac{(1 + 2\alpha)}{1} = \frac{164}{65.4} \Rightarrow \alpha = 0.75$$

**32. Ans: (b)**

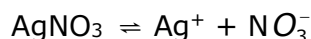
The reaction is



van't Hoff factor  $i = 0.25$

**33. Ans: (b)**

The reaction involved is



Initial moles                    1                    0                    0

Moles at equilibrium 1 -  $\alpha$                      $\alpha$                      $\alpha$

Total number of moles at equilibrium

$$1 - \alpha + \alpha + \alpha = 1 + \alpha = i \quad (1)$$

$$i = \frac{\text{Calculated formula mass}}{\text{Observed formula mass}}$$

$$= \frac{170}{92.64} = 1.835$$

From Eq. (1), we get  $1 + \alpha = 1.835 \Rightarrow \alpha = 0.835$

Therefore, degree dissociation of salt is 83.5%.

**34. Ans: (a)**

$$\Pi V = \frac{W}{M} RT \quad (1)$$

For isotonic solution,  $\Pi_{\text{Glucose}} = \Pi_{\text{Blood}}$

Substituting  $\Pi = 7.65 \text{ atm}$ ,  $T = 310 \text{ K}$ ,  $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$  and  $M = 180 \text{ g mol}^{-1}$  in Eq. (1), we get

$$7.65 \times V = \frac{W}{180} \times 0.0821 \times 310$$

$$\frac{W}{V} = \frac{7.65 \times 180}{0.0821 \times 310} = 54.1 \text{ gL}^{-1}$$

The expression for mass by volume percentage of solute is

$$\begin{aligned} &= \frac{\text{Mass of solute}}{\text{Volume of solution (mL)}} \times 100 \\ &= \frac{54.1}{1000} \times 100 = 5.41\% \end{aligned}$$

**35. Ans: (d)**

The freezing point depression is given by  $\Delta T_f = iK_f m$

We have  $\Delta T_f = 0 - (-0.74) = 0.74$

van't Hoff factor is calculated as

$$i = \frac{\Delta T_f}{K_f \times m} = \frac{\Delta T_f \times w_{\text{H}_2\text{O}}}{K_f \times n_{\text{electrolyte}} \times 1000}$$

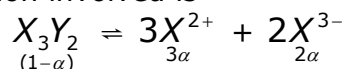
Substituting the values, we get

$$i = \frac{0.74 \times 500}{1.86 \times (20 / 100) \times 1000} = 0.99 \approx 1$$

For binary electrolyte,  $1 + \alpha = i \Rightarrow 1 + \alpha = 1 \Rightarrow \alpha = 0$

**36. Ans: (b)**

The reaction involved is



Total number of moles at equilibrium =  $1 - \alpha + 3\alpha + 2\alpha = 1 + 4\alpha = i$

$$i = 1 + 4 \times 0.25 = 2$$

We know  $\Delta T_b = iK_b m$

$$\Delta T_b = 2 \times 0.52 \times 1 = 1.04$$

Boiling point elevation is given by

$$\Delta T_b = T_b - T_b^0$$

$$1.04 = T_b - 373 \Rightarrow T_b = 373 + 1.04 = 374.04 \text{ K}$$

**37. Ans: (c)**

For NaCl,  $i = 2$ .

Depression of freezing point can be expressed as

$$\Delta T_f = iK_f m$$

$$\frac{\Delta T_f}{K_f} = 2 \times m$$

$$\frac{1}{500} = 2 \times m \Rightarrow m = \frac{1}{1000} \text{ mol kg}^{-1} \text{ water or } \frac{1}{1000} \text{ mol L}^{-1} \text{ water}$$

$$m = \frac{1}{1000} \times 58.5 \text{ g NaCl} = 0.0585 \text{ g NaCl}$$

**38. Ans: (b)**

From Raoult's law,

$$p_{\text{solvent}}^0 - p_{\text{solution}}^0 = x_{\text{solute}} p_{\text{solvent}}^0$$

$$10 = 0.2 \times p_{\text{solvent}}^0 \quad (1)$$

Similarly  $20 = x \times p_{\text{solvent}}^0 \quad (2)$

From Eq. (1) and Eq. (2), we get

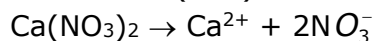
$$x_{\text{solute}} = 0.4$$

Therefore, mole fraction of solvent

$$x_{\text{solvent}} = 1 - x_{\text{solute}} = 1 - 0.4 = 0.6$$

**39. Ans: (a)**

The dissociation of  $\text{Ca}(\text{NO}_3)_2$  is



Initial conc.            1                    0                    0

Final conc.            1 -  $\alpha$                      $\alpha$                      $2\alpha$

Total number of moles (N) = 1 -  $\alpha$  +  $\alpha$  +  $2\alpha$

$$= 1 + 2\alpha = (1 + 2 \times 0.7) \times \frac{7}{164} = 0.1$$

Number of moles of solvent ( $\text{H}_2\text{O}$ ) =  $\frac{100}{18} = 5.55$

From Raoult's law, we have  $\frac{(p_{\text{solvent}}^0 - p_{\text{solution}}^0)}{p_{\text{solvent}}^0} = \frac{n_{\text{H}_2\text{O}}}{N + n_{\text{H}_2\text{O}}}$

$$\frac{760 - p_{\text{solution}}}{760} = \frac{0.1}{0.1 + \frac{100}{18}} \Rightarrow p_{\text{solution}} = 746.3 \text{ mm Hg}$$

**40. Ans: (c)**

$$p_{\text{Total}} = p_{\text{methanol}}^0 x_{\text{methanol}} + p_{\text{ethanol}}^0 x_{\text{ethanol}}$$

$$p_{\text{Total}} = 88.5 \times \left( \frac{16/32}{16/32 + 46/46} \right) + 42 \times \left( \frac{46/46}{16/32 + 46/46} \right)$$

$$= 29.5 + 28$$

$$= 57.5$$

Now,  $p_{\text{methanol}}^0 x_{\text{methanol}} = p_{\text{Total}} y_{\text{methanol}}$

$$29.5 = 57.5 y_{\text{methanol}} \Rightarrow y_{\text{methanol}} = \frac{29.5}{57.5} = 0.513$$

**41. Ans:(c)**

For a binary mixture showing +ve deviation from Raoult's law, the boiling point of azeotropic mixture is less than boiling points of constituents A and B.

42. **Ans:**(a)

$$\Delta T_b = K_b \times m$$

$$= 0.513 \times 0.69$$

$$\approx 0.353^\circ$$

$$\therefore T_2 = T_1 + \Delta T_b = 99.725 + 0.353$$

$$= 100.078$$

43. **Ans:**(d)

If the depression in freezing point is  $0.186^\circ$ , the elevation in boiling point is  $0.0512^\circ$

$$1.86 \rightarrow 0.186^\circ$$

$$0.512 \rightarrow ?$$

44. **Ans:** (b)

If  $\alpha$  is 0.9,  $i = 1 + \alpha = 1.9$

$$\Delta T_f = i \times K_f \times m$$

$$= 1.9 \times 1.86 \times m$$

$$\text{molality} = \frac{8.1 \times 10}{81} = 1 \text{ m} \quad \left( \begin{array}{l} 8.1 \text{-----} 100 \\ ? \text{-----} 1000 \end{array} \right)$$

$$\therefore \Delta T_f = 1.9 \times 1.86 \times 1$$

$$= 3.534$$

$$\therefore T_2 = T_1 - \Delta T_f$$

$$= 0 - 3.534 = -3.534^\circ\text{C}$$

45. **Ans:** (d)

$$\alpha = \frac{i-1}{1/n-1} \Rightarrow \alpha = \frac{0.54-1}{1/2-1} = \frac{-0.46}{-1/2} = 0.92$$

46. **Ans:** (d)

$$\text{Mass of 1 L of NaCl} = 1000 \times 1.21 = 1210 \text{ g}$$

$$\text{Mass of 3 m NaCl solution} = 3 \times 58.5 + 1000 = 1175.5 \text{ g}$$

$$1175.5 - 175.5$$

$$1210 - ?$$

$$\therefore \text{Mass of NaCl in 1210 g NaCl solution} = 180.65 \text{ g}$$

$$\therefore \text{Molarity} = \frac{180.65}{58.5} = 3.08$$

47. **Ans:** (c)

$$\frac{1}{4}x + \frac{3}{4}y = 550 \text{ mm Hg} \quad \text{----- (1)}$$

$$\frac{1}{5}x + \frac{4}{5}y = 560 \text{ mm Hg} \quad \text{----- (2)}$$

Multiply (1) by 4 and (2) by 5

$$x + 3y = 2200 \quad \text{----- (3)}$$

$$x + 3y = 2800 \quad \text{----- (4)}$$

Solving (3) and (4)  $y = 600$ , substituting  $y = 600$  into 3

$$x = 400$$

48. **Ans:** (b)

$$0.2 A + 0.8 B = 125 \text{ mm}$$

Pure A = 100 mm and pure B = 150 mm

$$\therefore 0.2 \times 100 + 0.8 \times 150 = 140 \text{ mm}$$

Observed pressure is less. Therefore it shows -ve deviation.

49. **Ans:** (d)

$$\Delta T_5 = \frac{1000 K_0 W_2}{W_1 M_2} = \frac{1000 \times 0.52 \times 1}{W_1 \times 60}$$

$$\Delta T_{b^1} = \frac{1000 \times 0.52 \times 3}{W \times 180} \quad \therefore \Delta T_b = \Delta T_{b^1}$$

50. **Ans:** (c)

$$x_A \times p_A^0 + x_B \times p_B^0 = P$$

$$\Rightarrow \frac{1}{5} \times 82 + \frac{4}{5} \times 31 = 16.4 + 24.8 = 41.2 \text{ mm of Hg}$$