SOLUTION –II PUC

1. 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

2. 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

3. 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

4. Which of the following aqueous solutions should have the highest boiling point?
   a) 1.0 M NaOH b) 1.0 M Na_2SO_4 c) 1.0 M $NH_4 NO_3$ d) 1.0 M KNO_3

5. In comparison to a 0.01 M solution or glucose, the depression in freezing point of a 0.001 M $MgCl_2$ solution is
   a) the same
   b) about twice
   c) about three times
   d) about six times

6. 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

7. 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

8. 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

9. K_H values for $Ar_{(g)}$, $CO_{2(g)}$, $HCHO_{(g)}$ and $CH_{4(g)}$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility.
   a) HCHO < CH_4 < CO_2 < Ar
   b) HCHO < CO_2 < CH_4 < Ar
   c) Ar < CO_2 < CH_4 < HCHO
   d) Ar < CH_4 < CO_2 < 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 100^0 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^{-1})
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 $mol^{-1}$is
a) 0.512 K kg mol^{-1} b) 1.86 K kg mol^{-1}
c) 5.12 K kg mol^{-1} d) 3.56 K kg mol^{-1}

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 1.5×10^{-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 25^0 C is given by $p_{AB} = 33x + 94$, whereas that of an ideal solution of A and C at 25^0 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 an d4 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 -0.74^0 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 CS_2 (b.p. = 46.3^0 C) boils at 47.9^0 C ($K_{b(CS_2)}$ = 2.34). What will be molecular formula of phosphorus? (Assuming complete association.)
a) P_4 b) P_B c) P_2 d) none

26. An aqueous solution of a solute which neither associates nor dissociates has a freezing point depression of X^0C. An equimolal solution of a second salt has a freezing point depression of $3X^0$C. Assuming 100% dissociation of slat, the second solution could be a salt of formula
a) AB_3 b) AB_2 c) A_3B d) A_2B_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 25^0 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 $Ca(NO_3)_2$ 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 -0.74^0 C, k_f = 1.86 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 X_3Y_2 is 25% ionized. The boiling point of the solution is (K_b for H_2O = 0.52 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 $Ca(NO_3)_2$ in dilute aqueous solution containing 7 g of the salt per 100 g of water at 100^0 C is 70%. If the vapor pressure of water at 100^0 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) $CHCl_3$ and CH_3COCH_3 b) $CHCl_3 + C_6H_6$
c) CH_3CH_2OH and CH_3COCH_3 d) $CH_3COCH_3 + C_6H_5NH_2$

42. At certain hill-station, pure water boils at 99.725^0 C.If K_b for water is 0.513^0C kg mol^{-1}, the boiling point of 0.69 m solution of urea will be

a) 100.079^0 C b) 103^0 C c) 100.359^0 C d) unpredictable

43. An aqueous solution freezes at – 0.186^0 C (K_f = 1.86, K_b = 0.512). What is the elevation in boiling point?

a) 0.186 b) 0.512 c) 0.86 d) 0.0512

44. What is the freezing point of a solution containing 8.1 g HBr in 100 g water assuming the acid to be 90% ionized (K_f for water = 1.86 K kg mol^{-1})

a) 0.85^0 C b) – 3.53^0 C c) 0^0 C d) – 0.35^0 C

45. Phenol dimerises in benzene having van't Hoff factor 0.54. What is the degree of association?

a) 0.46 b) 0.27 c) 0.54 d) 0.92

46. A 3 molal solution of sodium chloride has a density of 1.21 g mL^{-1}. The molarity of this solution is

a) 4.15 b) 1.143 c) 2.95 d) 3.15

47. 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 mm Hg. At the same temperature if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mm Hg) 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

48. A solution of A and B with 0.2 mole fraction of A is found to have total vapour pressure of 125 mm. Pure A and B have vapour pressures 100 mm and 150 mm respectively. Will it show

a) +ve deviation b) –ve deviation

c) no deviation d) any thing can happen

49. An aqueous solution containing 1 g of urea boils at 100.25^0C. The aqueous solution containing 3 g of glucose in the same volume will boil at

a) 100.75^0 C b) 100.5^0 C c) 100^0C d) 100.25^0 C

50. 1 mole of heptane (V.P = 82 mm of Hg) was mixed with 4 mole of octane (V.P. = 31 mm of Hg). The vapour pressure of resulting ideal solution is

a) 46.2 mm of Hg b) 40.0 mm of Hg

c) 41.2 mm of Hg d) 38.4 mm of Hg

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 favpoured 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 Na_2SO_4 solution, i = 3 hence, it has highest boiling point.

5.Ans: (c)

$\Delta T_f = iK_f\, m$

For glucose, i = 1

Fro $MgCl_2$, i = 3

Thus, the depression in freezing point (ΔT_f) of a 0.01 M $MgCl_2$ 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_2	<	CH_4	< HCHO
K_H value:	40.39		1.67		0.413	1.83×10^{-5}

10. Ans: (b)

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

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

Let the weight of cane sugar be x

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

11. Ans:(c)

Relative lowing of vapor pressure = $x_{solute} \times i$

$x_{Glucose} \times i_1 = x_{urea} \times i_2$

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

12. Ans:(a)

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

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

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

Therefore, $x_{solute} = \frac{18}{1018}$

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

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

13. Ans:(a)

$$0.0125 = x_{solute} = \frac{n_{solute}}{n_{solute}+n_{solvent}}$$

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

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

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

14. Ans:(c)

$y_A \times p_{Total} = x_{A(\ell)} \times P_A^0$

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

$$A_2B_3 \rightleftharpoons 2A^{3+} + 3B^{2-}$$

At t = 0	1	0	0
At t = t	1 - α	2α	3α

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 $\Delta T_b = iK_bm$

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

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

$T_b = 374.76\ K \simeq 374.8\ K$

16. Ans:(a)

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

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

$= 0.512$ 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): $i_1C_1 = i_2C_2$ (3×10^{-3}) $= 2 \times 1.5 \times 10^{-3}$). Therefore, solution is isotonic.

18. Ans:(a)

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

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

The dissociation reaction is

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

At t = 0	1	0	0
At t = t	1 - α	α	α

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

19. Ans:(c)

The reaction is

	nA	$\rightleftharpoons$	A
At t = 0	1		0
At t = t	1 – x		$\frac{x}{n}$

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

20. Ans: (d)

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

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

21. Ans:(a)

$P_A^0 = 33 + 94 = 127$ mm of Hg

$p_B^0 = 94$ mm of Hg and $p_C^0 = 46$ mm of Hg

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

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

$= 80$ mm of Hg

22. Ans: (b)

We known $\frac{p_A^0 - p_A}{p_A^0}$ = x_{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

$\Delta T_t = iK_fM$

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

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

Therefore, B is in associated state.

24. Ans:(d)

The ionization of electrolyte is

	AB	⇌	A^+	+	B^-
At t = 0	$\frac{20}{100}$		0		0
At t = t	$0.5(1 - \alpha)$		0.5α		0.5α

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

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

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

$\alpha = 0.0053 \approx 0$

25. Ans:(a)

Elevation in boiling point is given by

$\Delta T_b = iK_bm$ or $T_b - T_b^0 = iK_bm$ (1)

	xP	⇌	P_x
At t = 0	1		0
At t = t	0		$\frac{1}{x}$

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)

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

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

AB_2	⇌	A^{2+}	+	$2B^-$

At t = 0	1	0	0
At t = t	0	1	2

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

27. Ans:(a)

The reaction is $\underset{(ppt.)}{HgI_2}\downarrow + 2I^- \rightarrow \underset{Soluble}{[HgI_4]^{2-}}$

$[HgI_4]^{2-}$ is consumed, therefore molality decreases and ΔT_f decreases or T_f increases.

28. Ans:(a)

Osmotic pressure can be calculated as Π = 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

	KCl	$\rightleftharpoons$	K^+	+	Cl^-
At t = 0	0.005		0		0
At t = t	$0.005(1-\alpha)$		0.005α		0.005α

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

	2A	$\rightleftharpoons$	A_2
At t = 0	1		0
At t = t	0		$\frac{1}{2}$

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

	3A	$\rightleftharpoons$	A_3
At t = 0	1		0
At t = t	0		$\frac{1}{3}$

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

31. Ans:(d)

The ionization reaction is

	$Ca(NO_3)_2$	$\rightleftharpoons$	Ca^{2+}	+	$2NO_3^-$
At t = 0	1		0		0
At t = t	$1-\alpha$		α		2α

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

32. Ans: (b)

The reaction is

	4A	$\rightleftharpoons$	A_4
At t = 0	1		0
At t = t	0		$\frac{1}{4}$

van't Hoff factor i = 0.25

33. Ans:(b)

The reaction involved is

$$AgNO_3 \rightleftharpoons Ag^+ + NO_3^-$$

Initial moles	1	0	0
Moles at equilibrium	1 - α	α	α

Total number of moles at equilibrium

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

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

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

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, $\Pi_{Glucose} = \Pi_{Blood}$

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

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

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

The expression for mass by volume percentage of solute is

$$= \frac{Mass\ of\ solute}{Volume\ of\ solution(mL)} \times 100$$

$$= \frac{54.1}{1000} \times 100 = 5.41\%$$

35. Ans: (d)

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

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

van't Hoff factor is calculated as

$$i = \frac{\Delta T_f}{K_f \times m} = \frac{\Delta T_f \times w_{H_2O}}{K_f \times n_{electrolyte} \times 1000}$$

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

$$\underset{(1-\alpha)}{X_3Y_2} \rightleftharpoons \underset{3\alpha}{3X^{2+}} + \underset{2\alpha}{2X^{3-}}$$

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 $\Delta T_b = iK_bm$

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

Boiling point elevation is given by

$\Delta T_b = T_b - T_b^0$

$1.04 = T_b - 373 \Rightarrow T_b = 373 + 1.04 = 374.04$ K

37. Ans: (c)

For NaCl, i = 2.

Depression of freezing point can be expressed as

$\Delta T_f = iK_f m$

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

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

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

38. Ans: (b)

From Raoult's law,

$p^0_{solvent} - p^0_{solution} = x_{solute}\, p^0_{solvent}$

$10 = 0.2 \times p^0_{solvent}$ (1)

Similarly $20 = x \times p^0_{solvent}$ (2)

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

$x_{solute} = 0.4$

Therefore, mole fraction of solvent

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

39. Ans: (a)

The dissociation of $Ca(NO_3)_2$ is

$Ca(NO_3)_2 \rightarrow Ca^{2+} + 2NO_3^-$

Initial conc.	1	0	0
Final conc.	1 - α	α	2α

Total number of moles (N) = 1 - α + α + 2α

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

Number of moles of solvent (H_2O) = $\frac{100}{18} = 5.55$

From Raoult's law, we have $\frac{(p^0_{solvent} - p_{solution})}{p^0_{solvent}} = \frac{n_{H_2O}}{N + n_{H_2O}}$

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

40. Ans: (c)

$p_{Total} = p^0_{methanol}\, x_{methanol} + p^0_{ethanol}\, x_{ethanol}$

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

$= 29.5 + 28$

$= 57.5$

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

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

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)

$\Delta T_b = K_b \times m$

$= 0.513 \times 0.69$

$\approx 0.353^o$

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

$= 100.078$

43. **Ans:**(d)

If the depression in freezing point is 0.186^o, the elevation in boiling point is 0.0512^o

$1.86 \rightarrow 0.186^o$

$0.512 \rightarrow ?$

44. **Ans:** (b)

If α is 0.9, $i = 1 + \alpha = 1.9$

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

$= 1.9 \times 1.86 \times m$

molality $= \frac{8.1 \times 10}{81} = 1$ m $\quad \begin{pmatrix} 8.1 - - - - - 100 \\ ? - - - - - - 1000 \end{pmatrix}$

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

$= 3.534$

$\therefore T_2 = T_1 - \Delta T_f$

$= 0 - 3.534 = -3.534^oC$

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)

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

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

1175.5 – 175.5

1210 - ?

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

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

47. **Ans:** (c)

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

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

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

$x + 3y = 2200$ ----- (3)

$x + 3y = 2800$ ----- (4)

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

$x = 400$

48.**Ans:** (b)

0.2 A + 0.8 B = 125 mm

Pure A = 100 mm and pure B = 150 mm

$\therefore$ 0.2 x 100 + 0.8 x 150 = 140 mm

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

49. **Ans:** (d)

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

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

50. **Ans:** (c)

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

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