Objective Questions

LEVEL – I

Choose the correct alternate. Only ONE is correct.

Q 1. Which one of the following salts would have the same value of the van't Hoff factor as that of $K_3[Fe(CN_6)]$?.
(A) $Al_2(SO_4)_3$ (B) NaCl (C) Na_2SO_4 (D) $Al(NO_3)_3$

Q 2. The vapour pressure of benzene at a certain temperature is 640 mm of Hg. A non -volatile and non-electrolytic solid, weighing 2.175g, is added to 39.08g of benzene. The vapour pressure of thesolution is 600mm of Hg. What is the molecular mass of the solid substance ?.
(A) 49.50 (B) 59.6 (C) 65 (D) 79.8

Q 3. A 5 % solution of cane sugar (mol. mass = 342) is isotonic with 1 % solution of a substance X . The molecular mass of X is :
(A) 34.2 (B) 171.2 (C) 68.4 (D) 136.8

Q 4. The degree of dissociation 'α' of a weak electrolyte is:

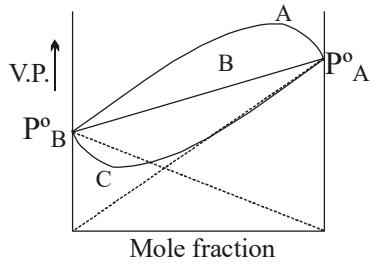
(A) $\frac{i-1}{n+1}$ (B) $\frac{i-1}{n-1}$ (C) $\frac{n-1}{i-1}$ (D) $\frac{n+1}{i-1}$

Q 5. The molal boiling point constant for water is 0.513 K kg mol^{-1} . When 0.1 mole of sugar is dissolved in 200 g of water , the solution boils under a pressure of 1 atm at :
(A) 100.513 ºC (B) 100.0513 ºC (C) 100.256 ºC (D) 101.025 ºC

Q 6. The correct expression relating molality (m) , molarity (M) , density (D) and molar mass (M_2) of solute is :

(A) $m = \frac{M}{d + M M_2}$ (B) $m = \frac{M}{d - M M_2}$ (C) $m = \frac{d + M M_2}{M}$ (D) $m = \frac{d - M M_2}{M}$

Q 7. Match the following graph



A (i) (+) deviation B (ii) ideal C (iii) (-) deviation
(A) A (i) , B (ii) , C (iii) (B) A (iii) , B (ii) , C (i)
(C) A (ii) , B (iii) , C (i) (D) none of these

Q 8. Human blood gives rise to an osmotic pressure of approximately 7.65 atm at body temperature, 37^0C. Hence , molarity of an glucose solution to be, to have the same osmotic pressure as blood is :
(A) 0.30 M (B) 0.20M (C) 0.10 M (D) 0.50 M

Q 9. At a given temperature, total vapour pressure in Torr of a mixture of volatile components A and B is given by $p = 120 - 75\ X_B$ hence, vapour pressure of pure A and B respectively (in Torr) are:
(A) 120, 75 (B) 120, 195 (C) 120, 45 (D) 75, 45

Q 10. Total vapour pressure of mixture of 1 mole volatile component A (p^o_A = 100 mg Hg) and 3 moles of volatile component B (p^o_B= 60 mm Hg) is 75 mm . For such case:
(A) there is positive deviation from Raoult's law
(B) boiling point has been lowered
(C) force of attraction between A and B is smaller than that between A and A or between B and B
(D) all the above statements are correct

Q 11. Vapour pressure of pure water is 40 mm . If a non-volatile solute is added to it , vapour pressure falls by 4 mm . Hence, molality of solution is :
(A) 6.173 molal (B) 3.0864 molal (C) 1.543 molal (D) 0.772 molal

Q 12. 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. Mole fraction of A in the solution, if it obeys Raoult's law, is :
(A) 0.8 (B) 0.5 (C) 0.2 (D) 0.4

Q 13. The total concentration of dissolved particles inside red blood cells is approximately 0.30 M and the membrane surrounding the cells is semipermeable. What would be the osmotic pressure (in atmosphere) inside the cells become if the cells were removed from the blood plasma and placed in pure water at 298 K?
(A) 7.34 atm (B) 1.78 atm (C) 2.34 atm (D) 0.74 atm

Q 14. Which one of the following pairs of solutions will be expected to be isotonic under the same temperature ?
(A) 0.1 M urea and 0.1 M NaCl (B) 0.1 M urea and 0.2 M $MgCl_2$
(C) 0.1 M NaCl and 0.1 M Na_2SO_4 (D) 0.1 M $Ca(NO_3)_2$ and 0.1 M Na_2SO_4

LEVEL – II

Choose the correct alternate. Only ONE is correct.

Q 1. Equimolal solutions of A and B show depression in freezing point in the ratio of 2 : 1. A remains in normal state in solution. B will be in ... state in solution.
(A) normal (B) associated (C) hydrolysed (D) dissociated

Q 2. The values of observed and calculated molecular mass of $Ca(NO_3)_2$ are 65.4 and 164 respectively. The degree of ionisation of the salt will be :
(A) 0.25 (B) 0.50 (C) 0.60 (D) 0.75

Q 3. Assuming the salts to be unionised in solution, which of the following has highest osmotic pressure?
(A) 1 % CsCl (B) 1 % RbCl (C) 1 % KCl (D) 1 % NaCl

Q 4. The vapour pressure of a solvent decreased by 10 mm of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2 What should be the mole fraction of the solvent, if the decrease in the vapour pressure is to be 20 mm of mercury?
(A) 0.8 (B) 0.6 (C) 0.4 (D) 0.2

Q 5. An aqueous solution of sucrose, $C_{12}H_{22}O_{11}$ containing 34.2 g/L has an osmotic pressure of 2.38 atmospheres at 17 ºC . For an aqueous solution of glucose $C_6H_{12}O_6$, to be isotonic with this solution, it would have :

(A) 34.2 g/L (B) 17.1 g/L (C) 18.0 g/L (D) 36.0 g/L of glucose

Q 6. The expression relating to mole fraction of solute (x_2) and molarity (M) of the solution is : (where ρ is the density of solution & M_1 & M_2 are the molar masses of solvent and solute respectively)

(A) $x_2 = \dfrac{M M_1}{M(M_1 - M_2) + \rho}$ (B) $x_2 = \dfrac{M M_1}{M(M_1 - M_2) - \rho}$

(C) $x_2 = \dfrac{M(M_1 - M_2) + \rho}{M M_1}$ (D) $x_2 = \dfrac{M(M_1 - M_2) - \rho}{M M_1}$

Q 7. Elevation in b.p.of a molar glucose solution ($d = 1.2\ gmL^{-1}$) is:

(A) 0.98 K_b (B) K_b (C) 1.20 K_b (D) 1.02 K_b

Q 8. Elevation in b.p.of an aqueous urea solution is 0.52^0C (K_b = 0.52 K mol $^{-1}$ kg). Hence, mole fraction of urea in this solution is :

(A) 0.982 (B) 0.0567 (C) 0.943 (D) 0.018

Q 9. An aqueous solution of a solute AB has b.p of 101.08^0C (AB is 100% ionised in boiling point of the solution) and freezes at -1.80^0C. Hence, AB ($K_b / K_f = 0.3$)

(A) is 100% ionised at the f.p. of the solution

(B) behaves as non-electrolyte at the f.p. of the solution

(C) forms dimer (D) none of these

Q 10. In the following equilibrium $N_2O_4(g) \rightleftharpoons 2NO_2.NO_2$ is 50 % of the total volume. Hence, degree of dissociation (x) and van`t Hoff factor (i) respectively are:

(A) 0.5,1.5 (B) 0.25,1.25 (C) 0.33,1.33 (D) 0.66,1.66

Q 11. Depression of freezing point of 0.01 mole aq. CH_3COOH solution is 0.02046°C. 1 molal urea solution freezes at – 1.86°C. Assuming molality equal to molarity, pH of CH_3COOH solution is :

(A) 2 (B) 3 (C) 3.2 (D) 4.2

Q 12. Mole fraction of A vapour above the solution in mixture of A and B (X_A = 0.4) will be [$P_A^0 = 100$ mm $P_B^0 = 200$ mm]

(A) 0.4 (B) 0.8 (C) 0.25 (D) none of these

Q 13. If relative decrease in V.P. is 0.4 for a solution containing 1 mole NaCl in 3 moles H_2O, NaCl is ... % ionized:

(A) 60% (B) 50% (C) 100% (D) 40%

Q 14. 12.2 g of benzoic acid (m.w.= 122) in 100 g benzene has depression in freezing point 2.6K; K_f = 5.2 K kg/mol. If there is 100% polymerization, number of molecules of benzoic acid in associated state is :

(A) 1 (B) 2 (C) 3 (D) 4

LEVEL – III

Q.1 For an ideal binary liquid solution with $P_A^\circ > P_B^\circ$, which relation between X_A (mole fraction of A in liquid phase) and Y_A(mole fraction of A in vapour phase) is correct?

(A) $Y_A < Y_B$ (B) $X_A > X_B$ (C) $\frac{Y_A}{Y_B} > \frac{X_A}{X_B}$ (D) $\frac{Y_A}{Y_B} < \frac{X_A}{X_B}$

Q.2 Mole fraction of A vapours above the solution in mixture of A and B ($X_A = 0.4$) will be

[Given : P_A° = 100 mm Hg and P_B° = 200 mm Hg]

(A) 0.4 (B) 0.8 (C) 0.25 (D) none of these

Q.3 The exact mathematical expression of Raoult's law is

(A) $\frac{P^0 - P_s}{P^0} = \frac{n}{N}$ (B) $\frac{P^0 - P_s}{P^0} = \frac{N}{n}$ (C) $\frac{P^0 - P_s}{P_s} = \frac{n}{N}$ (D) $\frac{P^0 - P_s}{P^0} = n \times N$

Q.4 A mixture contains 1 mole of volatile liquid A (P_A° =100 mm Hg) and 3 moles of volatille liquid B (P_B° = 80 mm Hg). If solution behaves ideally, the total vapour pressure of the distillate is

(A) 85 mm Hg (B) 85.88 mm Hg (C) 90 mm Hg (D) 92 mm Hg

Q.5 Which of the following aqueous solution will show maximum vapour pressure at 300 K?

(A) 1 M NaCl (B) 1 M $CaCl_2$ (C) 1 M $AlCl_3$ (D) 1 M $C_{12}H_{22}O_{11}$

Q.6 The Van't Hoff factor for a dilute aqueous solution of glucose is

(A) zero (B) 1.0 (C) 1.5 (D) 2.0

Q.7 The correct relationship between the boiling points of very dilute solution oif $AlCl_3$ (T_1K) and $CaCl_2$ (T_2K) having the same molar concentration is

(A) $T_1 = T_2$ (B) $T_1 > T_2$ (C) $T_2 > T_1$ (D) $T_2 \le T_1$

Q.8 A 0.001 molal solution of a complex [MA_8] in water has the freezing point of –0.0054°C. Assuming 100% ionization of the complex salt and K_f for H_2O = 1.86 km^{-1}, write the correct representation for the complex

(A) [MA_8] (B) [MA_7]A (C) [MA_6]A_2 (D) [MA_5]A_3

Q.9 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

Q.10 At a given temperature, total vapour pressure in Torr of a mixture of volatile components A and B is given by

$$P_{Total} = 120 - 75\ X_B$$

hence, vapour pressure of pure A and B respectively (in Torr) are

(A) 120, 75 (B) 120, 195 (C) 120, 45 (D) 75, 45

Q.11 Assuming each salt to be 90 % dissociated, which of the following will have highest boiling point?

(A) Decimolar $Al_2(SO_4)_3$

(B) Decimolar $BaCl_2$

(C) Decimolar Na_2SO_4

(D) A solution obtained by mixing equal volumes of (B) and (C)

Q.12 The vapour pressure of a solvent decreased by 10 mm of 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 vapour pressure is 20 mm of Hg

(A) 0.2 (B) 0.4 (C) 0.6 (D) 0.8

Q.13 Elevation of boiling point of 1 molar aqueous glucose solution (density = 1.2 g/ml) is

(A) K_b (B) 1.20 K_b (C) 1.02 K_b (D) 0.98 K_b

Q.14 What will be the molecular weight of $CaCl_2$ determined in its aq. solution experimentally from depression of freezing point?

(A) 111 (B) < 111 (C) > 111 (D) data insufficient

Q.15 1.0 molal aqueous solution of an electrolyte A_2B_3 is 60% ionised. 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

Q.16 Which of the following plots represents an ideal binary mixture?

(A) Plot of P_{total} v/s $1/X_B$ is linear (X_B = mole fraction of 'B' in liquid phase).

(B) Plot of P_{total} v/s Y_A is linear (Y_B = mole fraction of 'A' in vapour phase)

(C) Plot of $\frac{1}{P_{total}}$ v/s Y_A is linear

(D) Plot of $\frac{1}{P_{total}}$ v/s Y_B is non linear

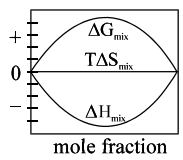
Q.17 Pressure over ideal binary liquid mixture containing 10 moles each of liquid A and B is gradually decreased isothermally. If P_A^o =200 mm Hg and P_B^o =100 mm Hg, find the pressure at which half of the liquid is converted into vapour.

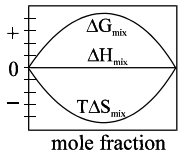
(A) 150 mm Hg (B) 166.5 mm Hg (C) 133 mm Hg (D) 141.4 mm Hg

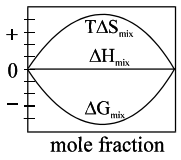
Q.18 The lowering of vapour pressure in a saturated aq. solution of salt AB is found to be 0.108 torr. If vapour pressure of pure solvent at the same temperature is 300 torr. Find the solubility product of salt AB

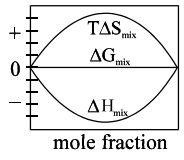
(A) 10^{-8} (B) 10^{-6} (C) 10^{-4} (D) 10^{-5}

Q.19 Which of the following represents correctly the changes in thermodynamic properties during the formation of 1 mol of an ideal binary solution.

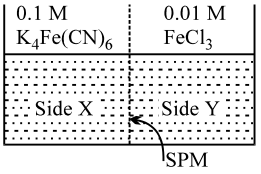
(A) 

(B) 

(C) 

(D) 

Q.20 $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ in aqueous solution gives blue colour. These are separated by a semipermeable membrane AB as shown. Due to osmosis there is



(A) blue colour formation in side X.

(B) blue colour formation in side Y.

(C) blue colour formation in both of the sides X and Y.

(D) no blue colour formation.

LEVEL – IV

Choose the correct alternate(s). ONE or MORE than one may be correct

Q.1 When a non-volatile solute is added to a pure solvent, the
(A) vapour pressure of the solution becomes lower than that of the pure solvent
(B) rate of evaporation of the pure solvent is reduced
(C) solute does not affect the rate of condensation
(D) rate of evaporation of the solution is equal to the rate of condensation of the solution at a lower vapour pressure than that in the case of the pure solvent.

Q.2 According to Raoult's law the relative decrease in the solvent vapour pressure over the solution is equal to
(A) the mole fraction of the solvent (B) the mole fraction of the solute
(C) the number of moles of the solute
(D) i times the mole fraction of the solute which undergoes dissociation or association in the solvent [i = van't Hoff factor]

Q.3 Which of the following combinations are correct for a binary solution, in which the solute as well as the solvent are liquid?

(A)	C_6H_6 and $C_6H_5CH_3$;	$\Delta H_{soln} > 0$;	$\Delta V_{sol} = 0$
(B)	CH_3COCH_3 and $CHCl_3$;	$\Delta H_{soln} < 0$;	$\Delta V_{sol} < 0$
(C)	H_2O and HCl;	$\Delta H_{soln} > 0$;	$\Delta V_{sol} < 0$
(D)	H_2O and C_2H_5OH;	$\Delta H_{soln} > 0$;	$\Delta V_{sol} > 0$

Q.4 Which of the following statements are correct for a binary solution which shows negative deviation from Raoult's law?
(A) The negative deviation from linearity diminishes and tends to zero as the concentration of the solution component approaches unity.
(B) When solutions from, their volumes are smaller than the sum of the volumes of their components
(C) Heat is released during the formation of the solution.
(D) Heat is absorbed during the formation of the solution.

Q.5 A binary liquid (AB) shows positive deviation from Raoult's law wen
(A) $p_A > p_A^0 X_A^{liq} > p_B^0 X_B^{liq}$ (B) intermolecular forces: A–A, B–B > A–B
(C) $\Delta V_{mix} > 0$ (D) $\Delta H_{mix} > 0$

Q.6 The azeotropic solutions of two miscible liquids
(A) can be separated by simple distillation
(B) may show positive or negative deviation from Raoult's law
(C) are supersaturated solutions
(D) behave like a single component and boil at a constant temperature

Q.7 In which of the following pairs of solutions will the values of the van't Hoff factor be the same?
(A) 0.05 M $K_4[Fe(CN)_6]$ and 0.10 M $FeSO_4$
(B) 0.10 M $K_4[Fe(CN)_6]$ and 0.05 M $FeSO_4(NH_4)_2SO_4.6H_2O$
(C) 0.20 M NaCl and 0.10 M $BaCl_2$
(D) 0.05 M $FeSO_4(NH_4)_2SO_4.6H_2O$ and 0.02 M KCl. $MgCl_2.6H_2O$

Q.8 1 mol benzene ($P^0_{benzene}$ = 42 mm) and 2 mol toluene ($P^0_{toluene}$ = 36 mm) will have:
(A) total vapour pressure 38 mm
(B) mol fraction of vapours of benzene above liquid mixture is 7/19
(C) positive deviation from Raoult's law
(D) negative deviation from Raoult's law.

Q.9 At 40 ºC, the vapour pressure in torr. of methanol and ethanol solutions is , $P = 199x + 135$ where x is the mol fraction of methanol . Hence :
(A) vapour pressure of pure methanol is 119 torr.
(B) vapour pressure of pure ethanol is 135 torr.
(C) vapour pressure of equimolar mixture of each is 127 mm
(D) mixture is completely immiscible.

Q.10 Consider following cases:

I : 2 M CH_3COOH solution in benzene at 27ºC where there is dimer formation to the extent of 100%

II : 0.5 M KCL aq. solution at 27ºC, which ionises 100%; which is/are true statement(s)
(A) both are isotonic (B) I is hypertonic
(C) II is hypertonic (D) none is correct

Q.11 Consider following solutions:
I : 1 M aq. glucose II : 1 M aq. sodium chloride
III : 1 M benzoic acid in benzene IV : 1 M ammonium phosphate
Select correct statement (s)
(A) all are isotonic solutions (B) III is hypotonic of I, II, IV
(C) I, II, IV are hypertonic of III (D) IV is hypertonic of I, II, III

Q.12 If P_A is the vapour pressure of a pure liquid A and the mol fraction of A in the mixture of two liquids A and B is x, the partial vapour pressure of A is:

(A) $(1-x)P_A$ (B) xP_A (C) $\frac{x}{(1-x)}P_A$ (D) $\frac{(1-x)}{X}P_A$

Q.13 When mercuric iodide is added to the aqueous solution of potassium iodide, the
(A) Freezing point is increase (B) freezing point is lowered
(C) freezing point does not change (D) boiling point does not change

Q.14 Which is/are correct statement(s)?
(A) when mixture is less volatile, there is positive deviation from Raoult's law.
(B) when mixture is more volatile, there is negative deviation from Raoult's law.
(C) when mixture is less volatile, there is negative deviation from Raoult's law.
(D)when mixture is less volatile, there is positive deviation from Raoult's law.

Q.15 At 35ºC, the vapour pressure of CS_2 is 512 mm Hg, and of acetone is 344 mm Hg. A solution of CS_2 and acetone in, which the mol fraction of CS_2 is 0.25, has a total vapour pressure of 600 mm Hg. Which of the following statement is/are correct?
(A) a mixture of 100 mL of acetone and 100 mL of CS_2 has a volume of 200 mL
(B) when acetone and CS_2 are mixed at 35º, heat must be absorbed in order to produce a solution at 35ºC
(C) when acetone and CS_2 are mixed at 35ºC heat is released
(D) there is negative deviation from Raoult's law

LEVEL – V

Match the followng columns

Q.1

	Column I **Symbols of concentration terms**		**Column II** **formula**
(a)	% w/w	(i)	$\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^6$
(b)	ppm	(ii)	$\frac{\text{Number of moles of solute}}{\text{Volume (of solution in Litre)}}$
(c)	m (molality)	(iii)	$\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^2$
(d)	N (normality)	(iv)	$\frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$
(e)	M (molarity)	(v)	$\frac{\text{Number of moles of solute}}{\text{Weight (of solvent in kg)}}$

Q.2

	Column I **Examples of solution**		**Column II** **Types of solution**
(a)	Acetone + Aniline	(i)	Positive deviation from ideal behaviour
(b)	Water + Methanol	(ii)	Negative deviation from ideal behaviour
(c)	Benzene + Toluene	(iii)	Ideal solution
(d)	n-Hexane + N-heptane		
(e)	Water + HCl		

Q.3

	Column I **Condition for various solutions**		**Column II** **Type of solutions**
(a)	$P_A + P_B < P_A^o x_A + P_B^o x_B$	(i)	Positive deviation from ideal behaviour
(b)	A–B attractive forces should be weaker than B–B attractive forces.	(ii)	Negative deviation from ideal behaviour
(c)	$\Delta V_{mix} > 0$ & Endothermic dissolution	(iii)	Ideal solution
(d)	$\Delta H_{mix} < 0$ & volume decreased during dissolution		
(e)	Raoult's law is obeyed at every range of temperatre		

Q.4

	Column I **Example of electrolyte**		**Column II** **Value of Van't Hoff factor.**
(a)	$K_3[Fe(CN)_3]$	(i)	2
(b)	Benzoic acid in benzene	(ii)	1
(c)	NaCl	(iii)	$1 + \alpha$
(d)	CH_3COOH	(iv)	$1 - \left(1 - \frac{1}{n}\right) \alpha$
(e)	Urea	(v)	$1 + 3\alpha$

Q.5

Column I **Colligative properties.**		**Column II** **Their formula**	
(a)	π	(i)	P_0x_B
(b)	P_0-P_s	(ii)	$\frac{nRT}{V}$
(c)	ΔT_f	(iii)	$K_b.m$
(d)	ΔT_b	(iv)	$\frac{1000K_fW_A}{m_AW_B}$

Q.6

Column I **Properties**		**Column II** **Formula**	
(a)	Molal depression constant (K_f)	(i)	$\frac{1000\times K_f\times W}{W\times\Delta T_f}$
(b)	degree of dissociation	(ii)	$\frac{i-1}{\frac{1}{n}-1}$
(c)	degree of association	(iii)	$\frac{M_{solute}(normal)}{M_{solute}(observed)}$
(d)	Van't Hoff factor	(iv)	$\frac{i-1}{n-1}$
(e)	M_{solute} (observed)	(v)	$\frac{R\,T_f^{\,2}}{1000\times L_f}$

Subjetive Questions

LEVEL – I

Q.1 At 50 ºC the vapour pressure of pure water and ethyl alcohol are 92.5 and 219.9 mm of Hg respectively. If 6 g of non-volatile solute of m. wt. 120 is dissolved in 150 g of each of these solvent, what will be the ratio of relative vapour pressure lowering in two solvents ?

Q.2 Benzene and toluene form two ideal solution A and B at 313 K. Solution "A" contains 4 mole of toluene and one mole of C_6H_6. Solution B contains equal masses of toluene and Benzene . Calculate total pressure in each case . The vapour pressure of C_6H_6 and toluene are 160 and 60 mm respectively at 313 K.

Q.3 A solution of 1-propanol and 2-propanol having $\frac{3}{4}$ by weight of 2-propanol has an equilibrium vapour pressure of 88.8 mm Hg . Another solution having $\frac{1}{3}$ by weight of 2-propanol has an equilibrium vapour pressure of 68.3 mm Hg. Calculate vapour pressure of pure alcohols at 40 ºC assuming ideal solution mixtures prepared at 40ºC.

Q.4 A liquid mixture containing 26 g C_6H_6 and 46 g C_7H_8 at 50 ºC has a vapour pressure of 163.75 mm of Hg. When another 52 g of C_6H_6 are added , vapour pressure of mixture is increased to 211.57 mm of Hg. Calculate the vapour pressure of pure components . Also find the values of A and B if vapour pressure of mixture is represented by $P = A + B\,X_T$, X_T is mole fraction of toluene.

Q.5 The boiling point of a solution of 0.1050 g of a substance in 15.84 g of ether was found to be 0.1 ºC higher than that of pure ether . What is molecular weight of solute ?
Molal elevation constant of ether = 21.6 K mol^{-1} 100 g .

Q.6 Calculate the molecular weight of a substance , 1.3 g of which is dissolved in 169 g of H_2O gave a solution boiling at 100.025 ºC. K_b for H_2O is .52 K kg mol^{-1}.

Q.7 Calculate the density of glycol solution whose 2.976 litre on addition to 5 litre of water produce an antifreeze which protects automobile radiator down to - 20 ºC . Also calculate the temperature at which the solution will boil . K_f and K_b for water are 1.86 and 0.51 K mol^{-1} kg respectively.

Q.8 Two solvents A and B have K_f values 1.86 and 2.72 K mol^{-1} kg respectively . A given amount of substance when dissolved in 500 g of A , it completely dimerizes and when same amount of substance is dissolved in 500 g of B , the solute undergoes trimerization . What will be the ratio of observed lowering of freezing points in two cases .

Q.9 2.8 g of cadmium iodide (CdI_2) in 20 g of water boiled at 0.20 K higher temperature than the boiling point of pure water . Calculate the molar mass of CdI_2 and comment on result . K_b for H_2O = 0.52 K molality $^{-1}$.

Q.10 What approximate proportion by volume of water (d = 1 g mL^{-1}) and ethylene glycol (d = 1.2 g mL^{-1}) must be mixed to ensure protection of an automobile radiator to cooling – 10 ºC.

LEVEL – II

Q.1 Vapour pressure of C_6H_6 and C_7H_8 mixture at 50 ºC are given by P = 179 X_B + 92 , where X_B is mole fraction of C_6H_6 . Calculate (in mm) :

(a) Vapour pressure of pure liquids

(b) Vapour pressure of liquid mixture obtained by mixing 936 g C_6H_6 and 736 g toluene .

(c) If the vapours are removed and condensed into liquid and again brought to the temperature of 50 ºC, what would be mole fraction of C_6H_6 in vapour state ?

Q.2 2 g of benzoic acid dissolved in 25 g of C_6H_6 shows a depression in freezing point equal to 1.62 K. Molal depression constant of C_6H_6 is 4.9 K mol^{-1} kg . What is the percentage association of acid, if it forms double molecule in solution .

Q.3 1.1 g $CoCl_3$. 6 NH_3 (molecular weight = 267.5) was dissolved in 100 g of water . The freezing point of solution was - 0.306 ºC . How many mol of solute particles exist in solution for each mole of solute introduced if 100 % ionisation of complex is noticed . [K_f for H_2O = 1.86 K mol^{-1} kg]

Q.4 A metal M of molar mass 96 g mol^{-1} reacts with fluorine to form a salt that can be represented as MF_x . In order to determine ' x ' , a 9.18 g of the sample of the salt is dissolved in 100 g of water and its boiling point was determined to be 374.38 K . What is the chemical formula of the salt ?
[Given K_b (water) = 0.52 K kg mol^{-1}] Assume complete dissociation of salt.

Q.5 An aqueous solution of cane sugar (molecular weight = 342) has an osmotic pressure 1.5 atm at 18 ºC . What will be its osmotic pressure at 40 ºC ? If 100 g of this solution is cooled to - 3 ºC , will it freeze out . If so , what weight of ice will be separated out ?
[K_f = 1.86 K mol^{-1} kg] Assume molality and molarity same.

ANSWERS

OBJECTIVE

LEVEL I

1. D **2.** C **3.** C **4.** B **5.** C **6.** B **7.** A

8. A **9.** C **10.** D **11.** A **12.** A **13.** A **14.** D

LEVEL II

2. D **3.** D **4.** B **5.** C **6.** A **7.** A **8.** D

9. B **10.** C **11.** B **12.** C **13.** A **14.** B

LEVEL III

Q.1	C	Q.2	C	Q.3	C	Q.4	B	Q.5	D	Q.6	B	Q.7	B
Q.8	C	Q.9	B	Q.10	C	Q.11	A	Q.12	C	Q.13	D	Q.14	B
Q.15	D	Q.16	C	Q.17	D	Q.18	C	Q.19	C	Q.20	D		

LEVEL IV

1. ABCD **2.** BD **3.** BD **4.** ABC **5.** ABC **6.** BD **7.** BD

8. AB **9.** B **10.** A **11.** BCD **12.** B **13.** B **14.** CD

15. BD

LEVEL V

Q.1 (a)-(iii), (b)-(i), (c) -(v), (d) -(ii), e-(iv)

Q.2 (a), (e) - (ii), (b)-(i), (c), (d)-(iii)

Q.3 (a), (d) - (ii), (b),(c)-(i), (e)-(iii)

Q.4 (a)-(v), (b)-(iv), (c) -(i), (d)-(iii), (e)-(ii)

Q.5 (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Q.6 (a)-(v), (b)-(iv), (c)-(ii), (d)-(iii), (e)-(i)

SUBJETIVE

LEVEL I

1. 0.3949 **2.** $P^{\circ}_{A} = 80$ mm, $P^{\circ}_{B} = 114.117$ mm

3. 2 - propanol = 101.10 mm; 1 - propanol = 51.9 mm

4. $P_B^{\circ} = 271.35$, $P_T^{\circ} = 92.02$ mm , A = 271.35 , B = – 179.33

5. 143.18 **6.** 160 **7.** 1.12 g mL^{-1} , 105.48 ºC

8. 1 : 1 :: A : B **9.** 364.0 ; CdI_2 is not dissociated **10.** 36 : 10

LEVEL II

1. **(a)** 271 mm , 92 mm **(b)** 199.4 mm **(c)** 0.072

2. 99.2 % **3.** i = 4 ; $[Co(NH_3)_6]Cl_3 \longrightarrow Co(NH_3)_6^{3+} + 3\,Cl^{-}$

4. x = 4, MF_4 **5.** 1.613 atm , Yes , 93.89 g