NUCLEON CHEMISTRY

CLASSES FOR IIT-JEE

DPP

PHYSICAL CHEMISTRY

Target IIT-JEE 2016

Class -XII **TOPIC : SOLUTION & COLLIGATIVE PROPERTIES** **DPP-01 to 10**

DPP No - 01

1. The volume of water that must be added to a mixture of 250 ml of 0.6 M HCl and 750 ml of 0.2 M HCl to obtain 0.25 M solution of HCl is :
(A) 750 ml (B) 100 ml (C) 200 mℓ (D) 300 mℓ

2. What approximate volume of 0.40 M $Ba(OH)_2$ must be added to 50.0 mL of 0.30 M NaOH to get a solution in which the molarity of the OH^- ions is 0.50 M?
(A) 33 mL (B) 66 mL (C) 133 mL (D) 100 mL

3. 500 ml of 0.1 M KCl , 200 ml of 0.01 M $NaNO_3$ and 500 ml of 0.1 M $AgNO_3$ was mixed. The molarity of K^+, Ag^+, Cl^-, Na^+, NO_3^- in the solution would be
(A) $[K^+] = 0.0416$ $[Ag^+] = 0.04$ $[Na^+] = 0.002$ $[C\ell^-] = 0.04$ $[NO_3^-] = 0.042$
(B) $[K^+] = 0.0416$ $[Na^+] = 0.00166$ $[NO_3^-] = 0.0433$
(C) $[K^+] = 0.04$ $[Ag^+] = 0.05$ $[Na^+] = 0.0025$ $[C\ell^-] = 0.05$ $[NO_3^-] = 0.0525$
(D) $[K^+] = 0.05$ $[Na^+] = 0.0025$ $[NO_3^-] = 0.0525$

4. Mole fraction of A in H_2O is 0.2. The molality of A in H_2O is :
(A) 13.9 (B) 15.5 (C) 14.5 (D) 16.8

5. What is the molarity of H_2SO_4 solution that has a density of 1.84 g/cc and contains 98% by mass of H_2SO_4? (Given atomic mass of S = 32)
(A) 4.18 M (B) 8.14 M (C) 18.4 M (D) 18 M

6. The molality of a sulphuric acid solution is 0.2. Calculate the total weight of the solution having 1000 gm of solvent.
(A) 1000 g (B) 1098.6 g (C) 980.4 g (D) 1019.6g

7. Mole fraction of $C_3H_5(OH)_3$ in a solution of 36 g of water and 46 g of glycerine is :
(A) 0.46 (B) 0.36 (C) 0.20 (D) 0.40

DPP No - 02

1. A solution containing 4 gm of a non-volatile organic solute per 100 ml was found to have an osmotic pressure equal to 500 cm of mercury at 27ºC. The molecular weight of solute is -
(A) 14.97 (B) 29.44 (C) 149.7 (D) 137.2

2. A solution containing 8.6 gm urea in one litre was found to be isotonic with a 5% (wt/vol) solution of an organic volatile solute. The molecular weight of solute is -
(A) 348.9 (B) 34.89 (C) 861.2 (D) 86.12

3. The osmotic pressure of a solution containing 100 ml of 3.4% solution (w/v) of urea (m. wt. 60) and 50 ml of 1.6% solution (w/v) of cane-sugar (m. wt 342) at 27ºC is -
(A) 10.56 atm (B) 8.98 atm (C) 17.06 atm (D) 9.70 atm

4. Two solutions each in 100 mL having 4 g glucose and 10 g sucrose respectively. How much urea should be added to one of them in order to make them isotonic ?

(A) 0.4218 g urea in glucose solution
(B) 0.77 g urea in glucose solution
(C) 0.72 g urea in sucrose solution
(D) 0.421 g urea in sucrose solution

5. 5 g of a polymer of molecular weight 50kg mol^{-1} is dissolved in 1 dm^3 solution. If the density of this solution is 0.96 kg dm^{-3} at 300 K, the height of solution that will represent its osmotic pressure is -

(A) 28.13 mm
(B) 20.85 mm
(C) 26.52 mm
(D) 24.94 mm

6. 100 mL aqueous solution of glucose with osmotic pressure 1.2 atm at 25ºC is mixed with 300 mL aqueous solution of urea at 2.4 atm at 25ºC. Osmotic pressure of the mixture is -

(A) 1.37 atm
(B) 2.59 atm
(C) 1.85 atm
(D) 2.13 atm

7. 10 g of solute A and 20 g of solute B are present in 500 mL of solution. The solution has the same osmotic pressure as 6.67 g of A and 30 g of B present in same volume of solution at same temperature. The ratio of molar masses of solute A and B will be -

(A) 0.25
(B) 0.66
(C) 0.33
(D) 0.75

8. At 10ºC, the osmotic pressure of urea solution is 500 mm. The solution is diluted and the temperature is raised to 25ºC, when the osmotic pressure is found to be 105.3 mm. Find out the extent of dilution

(A) 5
(B) 2.5
(C) 1.25
(D) 6.5

9. The relation ship between osmotic pressure at 273 K, when 10 gm glucose (P_1), 10 gm urea (P_2) and 10 gm sucrose (P_3) are dissolved in 250 ml of water is

(A) $P_1 > P_2 > P_3$
(B) $P_3 > P_1 > P_2$
(C) $P_2 > P_1 > P_3$
(D) $P_2 > P_3 > P_1$

10. What osmotic pressure would the 1.25 molal sucrose solution exhibit at 25ºC ? The density of this solution is 1.34 g/mL.

(A) 28.70 atm
(B) 30.22 atm
(C) 21.72 atm
(D) 24.55 atm

11. At certain temperature, the osmotic pressure of an aqueous solution of urea was found to be 405 mm. How many times the solution should be diluted in order to exhibit the osmotic pressure of 81 mm at the same temperature ?

(A) 2 times
(B) 4 times
(C) 8 times
(D) 5 times

12. If ‘A’ contains 2% NaCl and is separated by a semipermeable membrane from ‘B’ which contains 10% NaCl, which event will occur ?

(A) NaCl will flow from ‘A’ to ‘B’
(B) NaCl will flow from ‘B’ to ‘A’
(C) Water will flow from ‘A’ to ‘B’
(D) Water will flow from ‘B’ to ‘A’

13. Osmotic pressure of blood is 7.40 atm at 27°C. Number of mol of glucose to be used per L for an intravenous injection that is to have the same osmotic pressure as blood is :

(A) 0.3
(B) 0.2
(C) 0.1
(D) 0.4

14. A solution of glucose ($C_6H_{12}O_6$) is isotonic with 4 g of urea ($NH_2–CO–NH_2$) per liter of solution. The concentration of glucose is :

(A) 4 g/ℓ
(B) 8 g/ℓ
(C) 12 g/ℓ
(D) 14 g/ℓ

15. A solution of a substance containing 1.05 g per 100 mL. was found to be isotonic with 3% glucose solution. The molecular mass of the substance is :

(A) 31.5
(B) 6.3
(C) 630
(D) 63

16. Osmotic pressure of 30% solution of glucose is 1.20 atm and that of 3.42% solution of cane sugar is 2.5 atm. The osmotic pressure of the mixture containing equal volumes of the two solutions will be

(A) 2.5 atm
(B) 3.7 atm
(C) 1.85 atm
(D) 1.3 atm.

DPP No - 03

1. An electrolyte A gives 3 ions and B is a non-electrolyte. If 0.1 M solution of B produces an osmotic pressure P, then 0.05 M solution of A will produce an osmotic pressure, assuming that the electrolyte is completely ionised.
(A) 1.5 P (B) P (C) 0.5 P (D) 0.75 P

2. Which is the correct relation between osmotic pressure of 0.1 M NaCl solution and 0.1 M Na_2SO_4 solution?
(A) the osmotic pressure of Na_2SO_4 is less than NaCl solution
(B) the osmotic pressure of Na_2SO_4 is more than NaCl solution
(C) both have same osmotic pressures
(D) none of the above

3. 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

4. The van't Hoff factor of a 0.005 M aqueous solution of KCl is 1.95. The degree of ionisation of KCl is-
(A) 0.95 (B) 0.97 (C) 0.94 (D) 0.96

5. Two solution of KNO_3 and CH_3COOH are prepared separately molarity of both in 0.1 M and osmotic pressure are P_1 & P_2. The correct relationship between the osmotic pressure is -
(A) $P_2 > P_1$ (B) $P_1 > P_2$ (C) $P_1 = P_2$ (D) $\frac{P_1}{P_1+P_2} + \frac{P_2}{P_1+P_2}$

6. A 5.8% wt/vol. NaCl solution will exert an osmotic pressure closest to which one of the following -
(A) 5.8% (wt/vol) sucrose solution (B) 5.8% (wt/vol) glucose solution
(C) 2 molal sucrose solution (D) 1 molal glucose solution

7. Sea water is found to contain NaCl & $MgCl_2$. If NaCl is 80% ionised and $MgCl_2$ is 50% ionised then van't Hoff factor is -
(A) 1.3 (B) 5.0 (C) 3.3 (D) 3.8

8.* In which case van't Hoff factor are equal ?
(A) KCl, 50% ionised (B) K_2SO_4, 40% ionised
(C) $FeCl_3$, 30% ionised (D) $SnCl_4$, 20% ionised

9. The osmotic pressure of equimolar solutions of $BaCl_2$, NaCl and glucose will be in the order
(A) glucose > NaCl > $BaCl_2$ (B) $BaCl_2$ > NaCl > glucose
(C) NaCl > $BaCl_2$ > glucose (D) NaCl > glucose > $BaCl_2$

10.* For the given electrolyte A_xB_y, the degree of dissociation 'α' can be given as
(A) $\alpha = \frac{i-1}{x+y-1}$ (B) $i = (1-\alpha) + x\alpha + y\alpha$ (C) $\alpha = \frac{1-i}{1-x-y}$ (D) None

DPP No - 04

1. The vapour pressure of ether at 20ºC is 442 mm. When 7.2 g of a solute is dissolved in 60 g ether, vapour pressure is lowered by 32 units. If molecular weight of ether is 74 then molecular weight of solute is -
(A) 113.77 (B) 150.35 (C) 116.23 (D) 190.26

2. The vapour pressure of pure benzene at 25ºC is 639.7 mm of Hg and the vapour pressure of a solution of a solute in C_6H_6 at the same temperature is 631.9 mm of Hg. Molality of solution is -
(A) 0.079 mol/kg of solvent (B) 0.256 mol/kg of solvent
(C) 0.158 mol/kg of solvent (D) 0.316 mol/kg of solvent

3. Find out the weight of solute (M. wt. 60) that is required to dissolve in 180 g water to reduce the vapour pressure to 4/5th of pure water -
(A) 130 g (B) 150 g (C) 300 g (D) 75 g

4. The molality of a solution containing a non-volatile solute if the vapour pressure is 2% below the vapour pressure of pure water, will be -
(A) 2.213 (B) 2.518 (C) 1.133 (D) 1.891

5. The weight of a non-volatile solute (m. wt. 40). Which should be dissolved in 114 g octane to reduce its vapour pressure to 80%, is -
(A) 20 gm (B) 10 gm (C) 7.5 gm (D) 5 gm

6. Twenty gram of a solute are added to 100 g of water at 25ºC. The vapour pressure of pure water is 23.76 mm Hg, vapour pressure of solution is 22.41 mm Hg. The mass of this solute that is required in 100 g water to reduce the vapour pressure to one-half of the pure water is -
(A) 333 g (B) 666 g (C) 166 g (D) 256 g

7. 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

8. The vapour pressure of pure liquid solvent A is 0.80 atm. When a non-volatile substance B is added to the solvent, its vapour pressure drops to 0.60 atm ; mole fraction of the component B in the solution is
(A) 0.50 (B) 0.25 (C) 0.75 (D) 0.40

9. Vapour pressure of CCl_4 at 25ºC is 143 mm Hg. If 0.5 gm of non-volatile solute (mol. mass 65) is dissolved in 100 ml CCl_4, then the vapour pressure of the solution at 25ºC is -
[Given : Density of CCl_4 = 1.58 g/cm^3]
(A) 141.93 mm (B) 94.39 mm (C) 199.34 mm (D) 143.99 mm

10. The vapour pressure of a liquid decreases by 10 torr when a non-volatile solute is dissolved. The mole fraction of the solute in solution is 0.1. What would be the mole fraction of the liquid if the decrease in vapour pressure is 20 torr, the same solute being dissolved -
(A) 0.2 (B) 0.9 (C) 0.8 (D) 0.6

11. How many grams of sucrose must be added to 360 g of water to lower the vapour pressure by 1.19 mmHg at a temperature at which pressure of pure water is 25 mm Hg ?
(A) 342 g (B) 360 g (C) 375 g (D) 380 g

12. The vapour pressure of water depends upon :
(A) Surface area of container (B) Volume of container
(C) Temperature (D) All

13. Among the following substances, the lowest vapour pressure is exerted by -
(A) Water (B) Mercury (C) Kerosene (D) Rectified spirit

14. A sample of air is saturated with benzene (vapor pressure = 100 mm Hg at 298 K) at 298K, 750mm Hg pressure. If it is isothermally compressed to one third of its initial volume, the final pressure of the system is

(A) 2250 torr (B) 2150 torr (C) 2050 torr (D) 1950 torr

15. If P_0 and P are the vapour pressures of a solvent and its solution respectively and N_1 and N_2 are the mole fractions of the solvent and non-volatile solute respectively, then correct relation is :

(A) $P = P_0N_2$ (B) $P = P_0N_1$ (C) $P_0 = PN_1$ (D) $P = P_0(N_1/N_2)$

16. The vapour pressure of pure liquid A is 10 torr and at the same temperature when 1 g of B solid is dissolved in 20 g of A, its vapour pressure is reduced to 9.0 torr. If the molecular mass of A is 200 amu, then the molecular mass of B is :

(A) 100 amu (B) 90 amu (C) 75 amu (D) 120 amu

17. The vapour pressure of water at room temperature is lowered by 5% by dissolving a solute in it, then the approximate molality of solution is :

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

18. The vapour pressure of a dilute aqueous solution of glucose is 750 mm of mercury at 373 K. The mole fraction of solute is -

(A) $\frac{1}{10}$ (B) $\frac{1}{7.6}$ (C) $\frac{1}{35}$ (D) $\frac{1}{76}$

DPP No - 05

1. Pressure cooker reduces cooking time because
(A) the heat is more evenly distributed inside the cooker
(B) a large flame is used
(C) boiling point of water is elevated
(D) whole matter is converted into steam

2. At higher altitudes, water boils at temperature < 100ºC because
(A) temperature of higher altitudes is low
(B) atmospheric pressure is low
(C) the proportion of heavy water increases
(D) atmospheric pressure becomes more.

3. Y gm of non-volatile organic substance of molecular mass M is dissolved in 250 gm benzene. Molal elevation constant of benzene is K_b. Elevation in its boiling point is given by :

(A) $\frac{M}{K_bY}$ (B) $\frac{4K_bY}{M}$ (C) $\frac{K_bY}{4M}$ (D) $\frac{K_bY}{M}$

4.* Which has the equal boiling point ?
(A) 0.1 M Na_2SO_4 (B) 0.1 M $C_6H_{12}O_6$ (glucose)
(C) 0.1 M $MgCl_2$ (D) 0.1 M $Al(NO_3)_3$

5. 1 mol each of following solutes are taken in 5 mol water,
A. NaCl B. K_2SO_4 C. Na_3PO_4 D. glucose
Assuming 100% ionisation of the electrolyte, relative decrease in vapour pressure will be in order :
(A) A < B < C < D (B) D < C < B < A (C) D < A < B < C (D) same

6. Consider equimolal aqueous solutions of $NaHSO_4$ and NaCl with ΔT_b and $\Delta T'_b$ as their respective boiling point elevations. The value of $\underset{m\to 0}{\text{Lt}} \frac{\Delta T_b}{\Delta T'_b}$ will be :
(A) 1 (B) 1.5 (C) 3.5 (D) 2 / 3

7. Aluminium phosphate is 100% ionised in 0.01 molal aqueous solution. Hence, $\Delta T_b / K_b$ is :
(A) 0.01 (B) 0.015 (C) 0.0175 (D) 0.02

8. 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)
(A) 375.5 K (B) 374.04 K (C) 377.12 K (D) 373.25 K

9. A solution containing 28 g of phosphorus in 315 g CS_2 (b.p. 46.3ºC) boils at 47.98ºC. If K_b for CS_2 is 2.34 K kg mol^{-1}. The formula of phosphorus is (at. mass of P = 31).
(A) P_6 (B) P_4 (C) P_3 (D) P_2.

10. A solution containing 0.52 g of $C_{10}H_8$ in CCl_4 produced an elevation in boiling point by 0.402ºC. On the other hand a solution of 0.62 g of an unknown solute dissolved in same amount of CCl_4 produced an elevation by 0.65ºC. Molecular weight of solute is :
(A) 85.53 (B) 181.51 (C) 94.38 (D) 160.62

11. 0.65 g naphthalene ($C_{10}H_8$) was dissolved in 100 g methyl acetate. Elevation of b. pt of methyl acetate solution was 0.103ºC. If b. pt. of pure methyl acetate is 57ºC, its molar heat of vaporisation will be -
(A) 8.96 kcal mol^{-1} (B) 7.946 kcal mol^{-1} (C) 6.24 kcal mol^{-1} (D) 15.65 kcal mol^{-1}

12. When 174.5 mg of octa-atomic sulphur is added to 78 g of bromine, the boiling point of bromine is -
[Given K_b for Br_2 is 5.2 K mol^{-1} kg and b. pt. of Br_2 is 332.15 K]
(A) 415.23 K (B) 330 K (C) 220.92 K (D) 332.19 K

13. The molal boiling point constant of water is 0.53ºC. When 2 mole of glucose are dissolved in 4000 gm of water, the solution will boil at :
(A) 100.53ºC (B) 101.06ºC (C) 100.265ºC (D) 99.47ºC

DPP No - 06

1. The boiling point of an aqueous solution of a non-volatile solute is 100.15ºC. What is the freezing point of an aqueous solution obtained by diluting the above solution with an equal volume of water ?
[K_b and K_f for water are 0.512 and 1.86 K molality^{-1}]
(A) -0.544ºC (B) -0.512ºC (C) -0.272ºC (D) -1.86ºC

2. Elevation in b. p of a solution of non-electrolyte in CCl_4 is 0.60. What is depression in f. p. for the same solution? K_f (CCl_4) = 30.00 kg mol^{-1} K ; K_b (CCl_4) = 5.02 kg mol^{-1} K.
(A) 0º (B) 5.39 º (C) 3.59º (D) 2.49º

3. The freezing point of a solution prepared from 1.25 gm of non-electrolyte and 20 gm of water is 271.9 K. If molar depression constant is 1.86 K molality^{-1}. Then molar mass of the solute will be -
(A) 105.68 (B) 106.7 (C) 115.3 (D) 93.9

4. Density of 1 M solution of a non-electrolyte $C_6H_{12}O_6$ is 1.18 g/mL. If K_f (H_2O) is 1.86 K mol^{-1} kg, solution freezes at :
(A) 1.58ºC (B) -1.86ºC (C) -3.16ºC (D) 1.86ºC

5. When a solution containing w g of urea in 1 kg of water is cooled to -.372ºC, 200 g of ice is separated. If K_f for water is 1.86 K kg mol^{-1}, w is -
(A) 4.8 g (B) 12.0 g (C) 9.6 g (D) 6.0 g

6. Glucose is added to 1 litre water to such an extent that $\Delta T_f/K_f$ becomes equal to 1/1000, the weight of glucose added is
(A) 180 gm (B) 18 gm (C) 1.8 gm (D) 0.18 gm

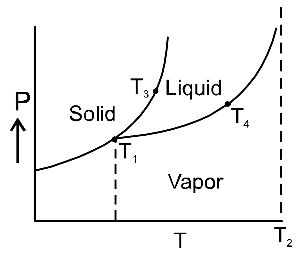
7. 4.00 g of substance A, dissolved in 100 g H_2O depressed the f. pt. of water by 0.1ºC. While 4 g of another substance B, depressed the f. pt. by 0.2 ºC. What is the relation between molecular weights of the two substance -
(A) $M_A = 4M_B$ (B) $M_A = M_B$ (C) $M_A = 0.5M_B$ (D) $M_A = 2M_B$

8. The temperature at which ice will begin to separate from a mixture of 20 mass percent of glycol ($C_2H_6O_2$) in water, is - [K_f(water) = 1.86 K kg mol^{-1}]
(A) 280.5 K (B) 265.5 K (C) 276.5 K (D) 269.5 K

9. Which of the following has been arranged in order of decreasing freezing point?
(A) 0.05 M KNO_3 > 0.04 M $CaCl_2$ > 0.140 M sugar > 0.075 M $CuSO_4$
(B) 0.04 M $BaCl_2$ > 0.140 M sucrose > 0.075 M $CuSO_4$ > 0.05 M KNO_3
(C) 0.075 M $CuSO_4$ > 0.140 M sucrose > 0.04 M $BaCl_2$ > 0.05 M KNO_3
(D) 0.075 M $CuSO_4$ > 0.05 M $NaNO_3$ > 0.140 M sucrose > 0.04 M $BaCl_2$

10. Aqueous solution of barium phosphate which is 100% ionised has $\Delta T_f / K_f$ as 0.05. Hence, given solution is:
(A) 0.01 molal (B) 0.02 molal (C) 0.04 molal (D) 0.05 molal

11. Observe the P-T phase diagram for a given substance A. Then melting point of A(s), boiling point of A(l), critical point of A and triple point of A (at their respective pressures) are respectively :



(A) T_1, T_2, T_3, T_4 (B) T_4, T_3, T_1, T_2 (C) T_3, T_4, T_2, T_1 (D) T_2, T_1, T_3, T_4

DPP No - 07

1. Mixture of volatile components A and B has total vapour pressure (in Torr) p = 254 – 119 x_A where x_A is mole fraction of A in mixture. Hence p_A^0 and p_B^0 are (in Torr)

(A) 254, 119 (B) 119, 254 (C) 135, 254 (D) 119, 373

2. What is the mole ratio of benzene ($P_B{}^0$= 150 torr) and toluene ($P_T{}^0$ = 50 torr) in vapour phase if the given solution has a vapour pressure of 120 torr?

(A) 7 : 1 (B) 7 : 3 (C) 8 : 1 (D) 7 : 8

3. At 323 K, the vapour pressure in millimeters of mercury of a methanol-ethanol solution is represented by the equation p = 120 X_A + 140, where X_A is the mole fraction of methanol. Then the value of $\lim\limits_{x_A \to 1} \frac{p_A}{X_A}$ is

(A) 250 mm (B) 140 mm (C) 260 mm (D) 20 mm

4. Two liquids A and B form ideal solution at 300 K. The vapour pressure of a solution containing one mole of A and four mole of B is 560 mm of Hg. At the same temperature if one mole of B is taken out from the solution, the vapour pressure of solution decreases by 10 mm of Hg. Vapour pressures of A and B in pure state will be:

(A) 330, 550 (B) 200, 300 (C) 400, 600 (D) 800, 1200

5. The vapour pressure of two volatile liquid mixture is $P_T = (5.3 - 2X_B)$ in cm of Hg ; where X_B is mole fraction of B in mixture. What are vapour pressure of pure liquids A and B ?

(A) 3.3 and 2.1 cm of Hg (B) 2.3 and 3.3 cm of Hg
(C) 5.3 and 2.3 cm of Hg (D) 5.3 and 3.3 cm of Hg

6. At 40°C the vapour pressure in torr of methanol and ethanol solution is P = 119 x + 135 where x is the mole 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 torr
(D) mixture is completely immiscible

7. Solution of two volatile liquids A and B obey Raoult's law. At a certain temperature, it is found that when the total vapour pressure above solution is 400 mm of Hg, the mole fraction of A in vapour phase is 0.45 and in liquid phase 0.65 then the vapour pressures of two pure liquids at the same temperature will be -

(A) 138.4 mm, 628.57 mm (B) 276.9 mm, 628.57 mm
(C) 276.9 mm, 314.28 mm (D) 138.4 mm, 314.28 mm

8. The vapour pressure of benzene and toluene at 20°C are 75 mm of Hg and 22 mm of Hg respectively. 23.4 g of benzene and 64.4g of toluene are mixed. If two forms ideal solution, the mole fraction of benzene in vapour phase when vapours are in equilibrium with liquid mixture, is -

(A) 0.59, 0.41 (B) 0.25, 0.75 (C) 0.5, 0.5 (D) 0.35, 0.65

9. The vapour pressure of two liquids are 15000 and 30000 in a unit. When equimolar solution of liquids is made. Then the mole fraction of A and B in vapour phase will be :

(A) $\frac{2}{3}, \frac{1}{3}$ (B) $\frac{1}{3}, \frac{2}{3}$ (C) $\frac{1}{2}, \frac{1}{2}$ (D) $\frac{1}{4}, \frac{3}{4}$

10. At 90°C, the vapour pressure of toluene is 400 mm and that of xylene is 150 mm. The composition of liquid mixture that will boil at 90°C when the pressure of mixture is 0.5 atm, is -

(A) 0.8, 0.2 (B) 0.75 , 0.25 (C) 0.92 , 0.08 (D) 0.66 , 0.34

11. Mole fraction of a liquid A in an ideal mixture with another liquid b is X_A. If X'_A is the mole fraction of component A in the vapour in equilibrium, the total pressure of the liquid mixture is -
(P^o_A = vapour pressure of pure A ; P^o_B = vapour pressure of pure B)

(A) $P^o{}_A \frac{X'_A}{X_A}$ (B) $\frac{P^o{}_A X_A}{X'_A}$ (C) $\frac{P^o{}_B X'_A}{X_A}$ (D) $\frac{P^o{}_B X_A}{X'_A}$

DPP No - 08

1.* Which of the following is correct for an ideal solution ?
(A) Raoult's law is obeyed for entire concentration range and temperatures
(B) $\Delta H_{mix} = 0$ (C) $\Delta V_{mix} = 0$ (D) $\Delta S_{mix} = 0$

2. Which of the following is less than zero for ideal solutions ?
(A) ΔH_{mix} (B) ΔV_{mix} (C) ΔG_{mix} (D) ΔS_{mix}

3. Consider a binary mixture of volatile liquids. If at $X_A = 0.4$ the vapour pressure of solution is 580 torr then the mixture could be ($p_A{}^\circ = 300$ torr, $p_B{}^\circ = 800$ torr) :
(A) $CHCl_3 - CH_3COCH_3$ (B) $C_6H_5Cl - C_6H_5Br$
(C) $C_6H_6 - C_6H_5CH_3$ (D) $nC_6H_{14} - n\,C_7H_{16}$

4.* Which of the following will form non-ideal solution ?
(A) C_2H_5OH and water (B) HNO_3 and water
(C) $CHCl_3$ and CH_3COCH_3 (D) C_6H_6 and $C_6H_5CH_3$

5. Which of the following shows negative deviation from Raoult's law ?
(A) $CHCl_3$ and acetone (B) $CHCl_3$ and C_2H_5OH (C) $C_6H_5CH_3$ and C_6H_6 (D) C_6H_6 and CCl_4

6. A maxima or minima obtained in the temperature composition curve of a mixture of two liquids indicates
(A) an azeotropic mixture
(B) an eutectic formation
(C) that the liquids are immiscible with one another
(D) that the liquids are partially miscible at the maximum or minimum

DPP No - 09

1. What volume of 0.10 M H_2SO_4 must be added to 50 mL of a 0.10 M NaOH solution to make a solution in which the molarity of the H_2SO_4 is 0.050 M ?
(A) 400 mL (B) 50 mL (C) 100 mL (D) 150 mL

2. The van't Hoff factor i for an infinitely dilute solution of $NaHSO_4$ is :
(A) 1/ 2 (B) 1/ 3 (C) 3 (D) 2

3. pH of a 0.1 M monobasic acid is found to be 2. Hence its osmotic pressure at a given temp. T K is-
(A) 0.1 RT (B) 0.11 RT (C) 1.1 RT (D) 0.01 RT

4. Lowering of vapour pressure of 1.00 m solution of a non-volatile solute in a hypothetical solvent of molar mass 40 g at its normal boiling point, is :
(A) 29.23 torr (B) 30.4 torr (C) 35.00 torr (D) 40.00 torr

5. The mole fraction of the solvent in the solution of a non-volatile solute is 0.980. The relative lowering of vapour pressure is -
(A) 0.01 (B) 0.980 (C) 0.02 (D) 0.49

6. The vapour pressure of pure benzene C_6H_6 at 50ºC is 260 Torr. How many moles of nonvolatile solute per mole of benzene are required to prepare a solution of benzene having a vapour pressure of 167.0 Torr at 50ºC ?
(A) 0.305 mol (B) 0.605 mol (C) 0.336 mol (D) 0.663 mol

7. Lowering of vapour pressure due to a solute in 1 molal aqueous solution at 100ºC is :
(A) 13.44 Torr (B) 14.12 Torr (C) 312 Torr (D) 352 Torr

8. A vessel has nitrogen gas and water vapours in equilibrium with liquid water at a total pressure of 1 atm. The partial pressure of water vapours is 0.3 atm. The volume of this vessel is reduced to one third of the original volume, at the same temperature, then total pressure of the system is :(Neglect volume occupied by liquid water)
(A) 3.0 atm (B) 1 atm (C) 3.33 atm (D) 2.4 atm

9. A solute'S' undergoes a reversible trimerization when dissolved in a certain solvent. The boiling point elevation of its 0.1 molal solution was found to be identical to the boiling point elevation in case of a 0.08 molal solution of a solute which neither undergoes association nor dissociation. To what percent had the solute 'S' undergone trimerization ?

(A) 30% (B) 40% (C) 50% (D) 60%

10. Barium ions, CN^- and Co^{2+} form an ionic complex. If that complex is supposed to be 75% ionised in water with vant Hoff factor ' i ' equal to four, then the coordination number of Co^{2+} in the complex can be :

(A) Six (B) Five (C) Four (D) Six and Four both

11. Consider following cases -

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

II : 0.5 M KCl aq. solution at 27°C, which ionises 100%

Which is/are true statements(s) -

(A) both are isotonic (B) I is hypertonic (C) II is hypotonic (D) none is correct

12. $PtCl_4 . 6H_2O$ can exist as a hydrated complex 1 molal aq. solution has depression in freezing point of 3.72°. Assume 100% ionisation and $K_f(H_2O) = 1.86°\ mol^{-1}$ kg, then complex is :

(A) $[Pt(H_2O)_6]Cl_4$ (B) $[Pt(H_2O)_4Cl_2]Cl_2 . 2H_2O$

(C) $[Pt(H_2O)_3Cl_3]Cl . 3H_2O$ (D) $[Pt(H_2O)_2Cl_4] . 4H_2O$

13. When only a little quantity of $HgCl_2(s)$ is added to excess KI(aq) to obtain a clear solution, which of the following is true for this solution? (no volume change on mixing)

(A) Its boiling and freezing points remain same (B) Its boiling point is lowered

(C) Its vapour pressure become lower (D) Its boiling point is raised

14. How many moles of sucrose should be dissolved in 500 gms of water so as to get a solution which has a difference of 104°C between boiling point and freezing point. ($K_f = 1.86$ K Kg mol^{-1}, $K_b = 0.52$ K Kg mol^{-1})

(A) 1.68 (B) 3.36 (C) 8.40 (D) 0.840

15. 1g of arsenic dissolved in 86 g of benzene brings down the freezing point to 5.31 °C from 5.50 °C. If K_f of benzene is 4.9 $\frac{^\circ C}{m}$, the atomicity of the molecule is : (As – 75)

(A) 8 (B) 2 (C) 3 (D) 4

16. An ideal mixture of liquids A and B with 2 moles of A and 2 moles of B has a total vapour pressure of 1 atm at a certain temperature. Another mixture with 1 mole of A and 3 moles of B has a vapour pressure greater than 1 atm. But if 4 moles of C are added to the second mixture, the vapour pressure comes down to 1 atm. Vapour pressure of C, $P_c^0 = 0.8$ atm. Calculate the vapour pressures of pure A and pure B.

(A) $P_A^0 = 1.4$ atm, $P_B^0 = 0.7$ atm (B) $P_A^0 = 1.2$ atm, $P_B^0 = 0.6$ atm

(C) $P_A^0 = 1.4$ atm, $P_B^0 = 0.6$ atm (D) $P_A^0 = 0.6$ atm, $P_B^0 = 1.4$ atm

17. The vapor pressures of benzene, toluene and a xylene are 75 Torr, 22 Torr and 10 Torr at 20ºC. Which of the following is **not** a possible value of the vapor pressure of an equimolar binary/ternary solution of these at 20ºC? Assume all form ideal solution with each other.

(A) $48\frac{1}{2}$ (B) 16 (C) $35\frac{2}{3}$ (D) $53\frac{1}{2}$

18. The vapour pressure of the solution of two liquids A(pº = 80 mm) and B(pº = 120 mm) is found to be 100 mm when $x_A = 0.4$. The result shows that

(A) solution exhibits ideal behaviour

(B) solution shows positive deviations

(C) solution shows negative deviations

(D) solution will show positive deviations for lower concentration and negative deviations for higher concentrations.

19. How many mmoles of sucrose should be dissolved in 500 gms of water so as to get a solution which has a difference of 103.57°C between boiling point and freezing point.
(K_f = 1.86 K Kg mol^{-1}, K_b = 0.52 K Kg mol^{-1})
(A) 500 mmoles (B) 900 mmoles (C) 750 mmoles (D) 650 mmoles

20. The vapour pressure of pure liquid solvent A is 0.80 atm. When a non-volatile substance B is added to the solvent, its vapour pressure drops to 0.60 atm. Mole fraction of the component B in the solution is :
(A) 0.50 (B) 0.25 (C) 0.75 (D) 0.40

21. The vapour pressure of a solution of a non-volatile solute 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 the solute, what is the ratio of weight of solvent to solute.
(A) 0.15 (B) 5.7 (C) 0.2 (D) none of these

22. Relative decrease in vapour pressure of an aqueous solution containing 2 moles $[Cu(NH_3)_3Cl]Cl$ in 3 moles H_2O is 0.50. On reaction with $AgNO_3$, this solution will form(assuming no change in degree of ionisation of substance on adding $AgNO_3$)
(A) 1 mol AgCl (B) 0.25 mol AgCl (C) 0.5 mol AgCl (D) 0.40 mol AgCl

23. Moles of K_2SO_4 to be dissolved in 12 mol water to lower its vapour pressure by 10 mmHg at a temperature at which vapour pressure of pure water is 50 mm is :
(A) 3 mol (B) 2 mol (C) 1 mol (D) 0.5 mol

24. At a constant temperature, ΔS will be maximum for which of the following processes :
(A) Vaporisation of a pure solvent
(B) Vaporisation of solvent from a solution containing nonvolatile and nonelectrolytic solute in it
(C) Vaporisation of solvent from a solution containing nonvolatile but electrolytic solute in it
(D) Entropy change will be same in all the above cases

25. A solution of a non-volatile solute in water has a boiling point of 375. 3 K. The vapour pressure of water above this solution at 338 K is :
[Given p_0 (water) = 0.2467 atm at 338 K and K_b for water = 0.52 K kg mol^{-1}]
(A) 0.18 atm (B) 0.23 atm (C) 0.34 atm (D) 0.42 atm

26. Elevation in boiling point of an aqueous urea solution is 0.52°. (K_b = 0.52K kg mol^{-1}). Hence mole fraction of urea in this solution is :
(A) 0.982 (B) 0.0567 (C) 0.943 (D) 0.018

27. Relative decrease in V. P. of an aqueous glucose dilute solution is found to be 0.018. Hence, elevation in boiling point is : (it is given 1 molal aq. urea solution boils at 100.54°C at 1 atm. pressure)
(A) 0.018° (B) 0.18° (C) 0.54° (D) 0.03°

28. An aqueous solution containing 5% by weight of urea and 10% by weight of glucose. Freezing point of solution is [K_f for H_2O is 1.86 K mol^{-1} kg]
(A) 3.04° C (B) –3.04° C (C) –5.96° C (D) 5.96° C

29. The amount of ice that will separate out from a solution containing 25 g of ethylene glycol in 100 g of water and is cooled to –10°C, will be : [Given : K_f for H_2O = 1.86 K mol^{-1} kg]
(A) 50.0 g (B) 25.0 g (C) 12.5 gm (D) 30.0 gm

30. It has been found that minimum temperature recorded in a hill station is –10°C. The amount of glycerine to be added to 40 dm^3 water used in car radiator, so that it does not freeze, is - [ΔH_{fusion} = 6.01 kJ mol^{-1}]
(A) 39.78 kg (B) 22.45 kg (C) 19.89 kg (D) 42.66 kg

31. In winter, the normal temperature in Kullu valley was found to be –11°C. Is a 28% (by mass) aqueous solution of ethylene glycol suitable for a car radiator ? K_f for water = 1.86 K kg mol^{-1}.
(A) Yes (B) No (C) can't predict (D) None of these

32. A 0.2 molal aqueous solution of a weak acid (HX) is 20 per cent ionised. The freezing point of this solution is (Given $k_f = 1.86°$ C kg mol^{-1} for water) :

(A) –0.45°C (B) – 0.90°C (C) –0.31 °C (D) – 0.53°C.

33. A complex of iron and cyanide ions is 100% ionised at 1m (molal). If its elevation in b.p. is 2.08. Then the complex is ($K_b = 0.52°$ mol^{-1} kg) :

(A) $K_3[Fe(CN)_6]$ (B) $Fe(CN)_2$ (C) $K_4[Fe(CN)_6]$ (D) $Fe(CN)_4$

34. The fraction of phenol dimerised in benzene if 20 g of phenol in 1 kg benzene exhibits a freezing point depression of 0.69 K. (K_f benzene = 5.12 $\frac{K-kg}{mol}$), (MW phenol = 94)

(A) 0.74 (B) 0.37 (C) 0.46 (D) 0.64

35. For a solution of 0.849 g of mercurous chloride in 50 g of $HgCl_2(\ell)$ the freezing point depression is 1.24°C. K_f for $HgCl_2$ is 34.3. What is the state of mercurous chloride in $HgCl_2$? (Hg – 200, Cl – 35.5)

(A) as Hg_2Cl_2 molecules (B) as HgCl molecules

(C) as Hg^+ and Cl^- ions (D) as Hg_2^{2+} and Cl^- ions

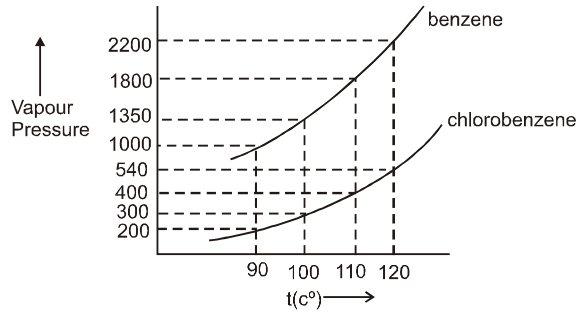
36. A solution of x moles of sucrose in 100 grams of water freezes at –0.2⁰C. As ice separates the freezing point goes down to 0.25⁰C. How many grams of ice would have separated?

(A) 18 grams (B) 20 grams (C) 25 grams (D) 23 grams

37. Consider two liquids A & B having pure vapour pressures P_A° & P_B° forming an ideal solution. The plot of $\frac{1}{X_A}$ v/s $\frac{1}{Y_A}$ (where X_A and Y_A are the mole fraction of liquid A in liquid and vapour phase respectively) is linear with slope and Y intercepts respectively :

(A) $\frac{P_A^\circ}{P_B^\circ}$ and $\frac{(P_A^\circ - P_B^\circ)}{P_B^\circ}$ (B) $\frac{P_A^\circ}{P_B^\circ}$ and $\frac{(P_B^\circ - P_A^\circ)}{P_B^\circ}$ (C) $\frac{P_B^\circ}{P_A^\circ}$ and $\frac{(P_A^\circ - P_B^\circ)}{P_B^\circ}$ (D) $\frac{P_B^\circ}{P_A^\circ}$ and $\frac{(P_B^\circ - P_A^\circ)}{P_B^\circ}$

38. Assuming the formation of an ideal solution, determine the boiling point of a mixture containing 1560 g benzene (molar mass = 78) and 1125 g chlorobenzene (molar mass = 112.5) using the following against an external pressure of 1000 Torr.



(A) 90°C

(B) 100°C

(C) 110°

(D) 120°C

39. Liquids A and B form an ideal solution and the former has stronger intermolecular forces. If X_A and X'_A are the mole fractions of A in the solution and vapour in equilibrium, then :

(A) $\frac{X'_A}{X_A} = 1$ (B) $\frac{X'_A}{X_A} > 1$ (C) $\frac{X'_A}{X_A} < 1$ (D) $X'_A + X_A = 1$

40. At a certain temperature pure liquid A and liquid B have vapour pressures 10 torr and 37 torr respectively. For a certain ideal solution of A and B, the vapour in equilibrium with the liquid has the components A and B in the partial pressure ratio $P_A : P_B = 1 : 7$. What is the mole fraction of A in the solution ?

(A) 0.346 (B) 0.654 (C) 0.5 (D) none of these

41. Two liquids A and B forms an ideal solution at temperature T. When the total vapour pressure above the solution is 400 torr, the mole fraction of A in the vapour phase is 0.40 and in the liquid phase 0.75. The vapour pressure of pure A and B respectively are :

(A) 165.54 torr , 772.00 torr (B) 240.24 torr , 840.00 torr
(C) 213.33 torr, 960.00 torr (D) 312.15 torr , 865.00 torr

42. An aqueous solution containing 28% by mass of a liquid A (mol. mass = 140) has a vapour pressure of 160 mm at 37°C. The vapour pressure of water at 37°C is 150 mm, then the pressure of pure liquid A, is -

(A) 180.22 mm (B) 300.32 mm (C) 360.15 mm (D) 276.55 mm

43. If vapour pressures of pure liquids 'A' & 'B' are 300 and 800 torr respectively at 25°C. When these two liquids are mixed at this temperature to form a solution in which mole percentage of 'B' is 92, then the total vapour pressure is observed to be 0.95 atm. Which of the following is true for this solution.

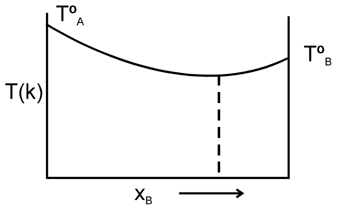
(A) $\Delta V_{mix} > 0$ (B) $\Delta H_{mix} < 0$ (C) $\Delta V_{mix} = 0$ (D) $\Delta H_{mix} = 0$

44. A liquid is kept in a closed vessel. If a glass plate (negligible mass) with a small hole is kept on top of the liquid surface, then the vapour pressure of the liquid in the vessel is :

(A) More than what would be if the glass plate were removed
(B) Same as what would be if the glass plate were removed
(C) Less than what would be if the glass plate were removed
(D) Cannot be predicted

Multiplce Choice Type

45. The diagram given below represents boiling point composition diagram of solution of component A and B, which is/are incorrect among the following ?



(A) The solution shows negative deviation (B) A-B-interactions are stronger than A-A and B-B
(C) The solution is ideal solution (D) The solution shows positive deviation.

46. For chloroform and acetone or for a solution of chloroform and acetone if p_s (observed (actual)) is compared with p_s (Theoretical (Raoult)) then which of the following is /are true ?

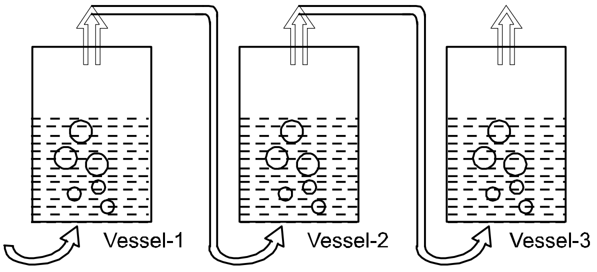
(A) $p_s(\text{actual}) < p_s(\text{raoult})$ (B) $\underset{X_{\text{chloroform}} \longrightarrow 0}{\text{Limit}} (p^o_{\text{acetone}} - p_{s\ \text{actual}}) = 0$

(C) $\underset{X_{\text{acetone}} \longrightarrow 0}{\text{Limit}} (p^o_{\text{chloroform}} - p_s(\text{actual})) = 0$ (D) $p^o_{\text{acetone}} > p^o_{\text{chloroform}}$ near room temperature

47. In which of the following pairs of solutions will the values of the vant 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 $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$
(C) 0.20 M NaCl and 0.10 M $BaCl_2$
(D) 0.05 M $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ and 0.02 M $KCl \cdot MgCl_2 \cdot 6H_2O$

48. Dry air is slowly passed through three solutions of different concentrations, c_1, c_2 and c_3 ; each containing (non volatile) NaCl as solute and water as solvent, as shown in the Fig. If the vessel 2 gains weight and the vessel 3 loses weight, then :



(A) $c_1 > c_2$ (B) $c_1 < c_2$ (C) $c_1 < c_3$ (D) $c_2 > c_3$

DPP No - 10

1. Calculate the molality and molarity of a solution made by mixing equal volumes of 30% by weight of H_2SO_4 (density = 1.20 g/mL) and 70% by weight of H_2SO_4 (density = 1.60 g/mL).

2. At 2ºC the osmotic pressure of a urea solution is found to be 500 mm of Hg. The solution is diluted and the temperature is raised to 27ºC, when the osmotic pressure is found to be 109.09 mm of Hg. Determine the extent of dilution.

3. The vapour pressure of water at 80º C is 355 torr. A 100 ml vessel contained water–saturated oxygen at 80º C, the total gas pressure being 760 torr. The contents of the vessel were pumped into a 50.0 ml, vessel at the same temperature. What were the partial pressures of oxygen and of water vapour, what was the total pressure in the final equilibrated state ? Neglect the volume of any water which might condense.

4. Twenty grams of a solute are added to 100 g of water at 25ºC. The vapour pressure of pure water is 23.76 mmHg; the vapour pressure of the solution is 22.41 Torr.
(a) Calculate the molar mass of the solute.
(b) What mass of this solute is required in 100 g of water to reduce the vapor pressure to one-half the value for pure water ?

5. 2 g of a non-volatile hydrocarbon solute dissolved in 100 g of a hypothetical organic solvent (molar mass=50) was found to lower the vapour pressure from 75.00 to 74.50 mm of Hg at 20ºC. Given that the hydrocarbon contains 96% of C, what is the molecular formula of the hydrocarbon ?

6. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution containing 7 g salt per 100 g of water at 100ºC is 70%. If the vapour pressure of water at 100ºC is 760 mm of Hg, calculate the vapour pressure of the solution.

7. Dry air was passed through bulbs containing a solution of 40 grams of nonelectrolytic solute in 360 grams of water, then through bulbs containing pure water at the same temperature and finally through a tube in which pumice moistened with strong H_2SO_4 was kept. The water bulbs lost 0.0870 grams and the sulphuric acid tube gained 2.175 grams. Calculate the molecular weight of solute.

8. A solution containing 1.5 g of ethyl benzoate in 65 g of benzene has density of 0.8 g/cc and vapor pressure of 747 mm Hg at 80ºC. Vapor pressure of pure benzene is 756 mm Hg. What is the osmotic pressure of the solution in Torr ? Note that the solute may have some extent of association in the solvent.

9. **(a)** A solution containing 0.5 g of nephthalene in 50 g CCl_4 yield a boiling point elevation of 0.4 K, while a solution of 0.6 g of an unknown solute in the same mass of the solvent gives a boiling point elevation of 0.65 K. Find the molar mass of the unknown solute.

(b) The boiling point of a solution of 0.1 g of a substance in 16 g of ether was found to be 0.100ºC higher that of pure ether. What is the molecular mass of the substance. K_b(ether) = 2.16 K kg mol^{-1}

10. The boiling point of a solution of 5 g of sulphur in 100 g of carbon disulphide is 0.474ºC above that of pure solvent. Determine the molecular formula of sulphur in this solvent. The boiling point of pure carbon disulphide is 47ºC and its heat of vaporisation is 84 calories per gram.

11. Calculate the freezing point of a solution of a non-volatile solute in a unknown solvent of molar mass 30 g/mole having mole fraction of solvent equal to 0.8. Given that latent heat of fusion of solid solvent = 2.7 kcal mol^{-1}, freezing point of solvent = 27°C and R = 2cal mol^{-1} k^{-1}.

12. 1 g of a monobasic acid dissolved in 200 g of water lowers the freezing point by 0.186ºC. On the other hand when 1 g of the same acid is dissolved in water so as to make the solution 200 mL, this solution requires 125 mL of 0.1 N NaOH for complete neutralization. Calculate % dissociation of acid ? (K_f = 1.86 $\frac{K-kg}{mol}$)

13. 0.001 molal solution of a ionic complex with molecular formula $Pt(NH_3)_4Cl_4$ lowers the freezing point of water by 0.0054 °C. Assume the above compound to be 100% ionised and k_f for water = 1.86 k kg mol^{-1}.

(i) Write IUPAC name of the above compound.
Now 0.001 moles of above complex is taken separately and enough $AgNO_3$(aq) is added to it for complete precipitation of free Cl^- as AgCl. The precipitate is filtered and dried. It requires at least five times the volume of NH_3(aq.) needed stoichiometrically for its dissolution.

(ii) Calculate the volume of 1.0 M NH_3(aq.) required for this purpose.

(iii) Write IUPAC name of the second complex formed.

Assume molality to be equal to molarity when ever needed.

14. The amount of benzene that will separate out (in grams) if a solution containing 7.32 g of triphenylmethane in 1000 g of benzene is cooled to a temperature which is 0.2°C below the freezing point of benzene?
(K_f = 5.12 K-Kg/mol)

15. Two liquids A and B form an ideal solution. At 300 K, the vapour pressure of a solution containing 1 mole of A and 3 moles of B is 550 mm of Hg. At the same temperature, if one mole of B is added to this solution, the vapour pressure of the solution increases by 10 mm of Hg. Determine the vapour pressure of A and B in their pure states.

16. Two liquids, A and B, form an ideal solution. At the specified temperature, the vapour pressure of pure A is 200 mmHg while that of pure B is 75 mmHg. If the vapour over the mixture consists of 50 mol percent A, what is the mole percent A in the liquid ?

17. At 80ºC, the vapour pressure of pure benzene is 753 mm Hg and of pure toluene 290 mm Hg. Calculate the composition of a liquid in mole per cent which at 80ºC is in equilibrium with the vapour containing 30 mole per cent of benzene.

18. At a constant temperature liquid 'A' has vapour pressure of 170 mm Hg and liquid 'B' has vapour pressure of 280 mm Hg. A solution of the two at the same temperature in which mole fraction of A is 0.7 has a total vapour pressure of 376 mm. Identify whether the solution process is Endothermic or Exothermic ?

19. Boiling point of a mixture of water and nitrobenzene is 99°C, the vapour pressure of water is 733 mm of Hg and the atmospheric pressure is 760 mm of Hg. The molecular weight of nitrobenzene is 123. Find the ratio of weights of the components of the distillate.

20. A mixture of an organic liquid A and water distilled under one atmospheric pressure at 99.2ºC. How many grams of steam will be condensed to obtain 1.0 g of liquid A in the distillate ? (Vapour pressure of water at 99.2ºC is 739 mm Hg. Molecular weight of A = 123)

21. The partial pressure of ethane over a solution containing 6.56×10^{-3} g of ethane is 1 bar. If the solution contains 5.00×10^{-2} g of ethane, then what shall be the partial pressure of the gas ?

22. A membrane permeable only to water separates a 0.01 M solution of sucrose from another 0.001 M sucrose solution. On which solution must pressure be applied to bring the system into equilibrium ? Find this pressure if the T = 298 K.

23. A solution contains 68.4 gms of cane sugar ($C_{12}H_{22}O_{11}$) in 1000 gms of water. Calculate the following for this solution (a) Vapour pressure; (b) Osmotic pressure at 20ºC ; (c) Freezing point ; (d) Boiling point. [density of the solution = 1.024 gm cm^{-3}; vapour pressure of water = 17.54 mm; latent heat of fusion = 80 cal gm^{-1} latent heat of vaporization = 540 cal gm^{-1}]

24. A solution containing 24g of a non - electrolyte per kg of water starts to freeze at – 0.75º C. The molar mass of the solute is 60g mol^{-1}. Calculate the molal depression constant for water. If the solution is cooled to –1ºC, how much of ice would separate ?

25. If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 litre of water. Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 kbar.

26. An aqueous solution containing 288 gm of a non-volatile compound having the stoichiometric composition $C_xH_{2x}O_x$ in 90 gm water boils at 101.24°C at 1.00 atmospheric pressure. What is the molecular formula?

$K_b(H_2O) = 0.512$ K mol^{-1} kg
$T_b(H_2O) = 100°C$

27. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution containing 7 gm of the salt per 100 gm of water at 100°C is 70%. If the vapour pressure of water at 100°C is 760 mm. Calculate the vapour pressure of the solution.

28. The addition of 3 gm of substance to 100 gm CCl_4(M = 154 gm mol^{-1}) raises the boiling point of CCl_4 by 0.60°C of K_b (CCl_4) is 5.03 kg mol^{-1} K. Calculate
(a) the freezing point depression
(b) the relative lowering of vapour pressure
(c) the osmotic pressure at 298 K
(d) the molar mass of the substance
Given $K_f(CCl_4)$ = 31.8 kg mol^{-1}K and ρ (density) of solution = 1.64 gm/cm^3

29. A complex is represented as $CoCl_3 \cdot x\, NH_3$. It's 0.1 molal solution in aq. solution shows $\Delta T_f = 0.558°C$. K_f for H_2O is 1.86 K mol^{-1} kg . Assuming 100% ionisation of complex and coordination no. of Co is six, calculate formula of complex.

30. Calculate the boiling point of a solution containing 0.61g of benzoic acid in 50g of carbon disulphide assuming 84% dimerization of the acid. The boiling point and K_b of CS_2 are 46.2°C and 2.3 K kg mol^{-1}, respectively.

31. At 25ºC, 1 mol of A having a vapor pressure of 100 torr and 1 mol of B having a vapor pressure of 300 torr were mixed. The vapor at equilibrium is removed, condensed and the condensate is heated back to 25ºC. The vapors now formed are again removed, recondensed and analyzed. What is the mole fraction of A in this condensate?

32. A very dilute saturated solution of a sparingly soluble salt A_3B_4 has a vapour pressure of 20 mm of Hg at temperature T, while pure water exerts a pressure of 20.0126 mm Hg at the same temperature. Calculate the solubility product constant of A_3B_4 at the same temperature.

33. The specific conductivity of a 0.5 M aq. solution of monobasic acid HA at 27°C is 0.006 Scm^{-1}. It's molar conductivity at infinite dilution is 200 S cm^2 mol^{-1}.
Calculate osmotic pressure (in atm) of 0.5 M HA (aq) solution at 27°C.

Given $R = 0.08\ \dfrac{\text{atm L}}{\text{mol K}}$.

34. A 250 mL water solution containing 48.0 g of sucrose, $C_{12}H_{22}O_{11}$, at 300 K is separated from pure water by means of a semipermeable membrane. What pressure must be applied above the solution in order to just prevent osmosis?

35. 0.85 % aqueous solution of $NaNO_3$ is apparently 90% dissociated at 27°C. Calculate its osmotic pressure. (R= 0.082 *l* atm K^{-1} mol^{-1})

36. An aqueous solution containing 288 gm of a non-volatile compound having the stoichiometric composition $C_xH_{2x}O_x$ in 90 gm water boils at 101.24°C at 1.00 atmospheric pressure. What is the molecular formula?

$K_b(H_2O) = 0.512$ K mol^{-1} kg
$T_b(H_2O) = 100$°C

37. The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution containing 7 gm of the salt per 100 gm of water at 100°C is 70%. If the vapour pressure of water at 100°C is 760 mm. Calculate the vapour pressure of the solution.

38. The latent heat of fusion of ice is 80 calories per gram at 0^0C. What is the freezing point of a solution of KCl in water containing 7.45 grams of solute in 500 grams of water, assuming that the salt is dissociated to the extent of 95%?

39. The molar volume of liquid benzene (density = 0.877 g ml^{-1}) increases by a factor of 2750 as it vaporizes at 20°C and that of liquid toluene (density = 0.867gml^{-1}) increases by a factor of 7720 at 20°C.
Solution of benzene & toluene has a vapour pressure of 46.0 torr. Find the mole fraction of benzene in the vapour above the solution.

40. At 25^OC, 1 mol of A having a vapor pressure of 100torr and 1 mol of B having a vapor pressure of 300 torr were mixed. The vapor at equilibrium is removed, condensed and the condensate is heated back to 25ºC. The vapors now formed are again removed, recondensed and analyzed. What is the mole fraction of A in this condensate?

41. When the mixture of two immicible liquids (water and nitrobenzene) boils at 372 K and the vapour pressure at this temperature are 97.7 kPa (H_2O) and 3.6 kPa ($C_6H_5NO_2$). Calculate the weight % of nitrobenzene in the vapour.

42. An ideal solution was prepared by dissolving some amount of cane sugar (non–volatile) in 0.9 moles of water. The solution was then cooled just below its freezing temperature (271 K), where some ice get separated out. The remaining aqueous solution registered a vapour pressure of 700 torr at 373 K. Calculate the mass of ice separated out, if the molar heat of fusion of water is 6 kJ.

ANSWERS

DPP No - 01

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

DPP No - 02

1.	(C)	**2.**	(A)	**3.**	(D)	**4.**	(A)	**5.**	(C)	**6.**	(D)	**7.**	(C)
8.	(A)	**9.**	(C)	**10.**	(A)	**11.**	(B)	**12.**	(C)	**13.**	(A)	**14.**	(C)
15.	(D)	**16.**	(C)										

DPP No - 03

1.	(A)	**2.**	(B)	**3.**	(D)	**4.**	(A)	**5.**	(B)	**6.**	(C)	**7.**	(C)
8.*	(BD)	**9.**	(B)	**10.***	(ABC)								

DPP No - 04

1.	(A)	**2.**	(C)	**3.**	(B)	**4.**	(C)	**5.**	(B)	**6.**	(A)	**7.**	(A)
8.	(B)	**9.**	(A)	**10.**	(C)	**11.**	(A)	**12.**	(C)	**13.**	(B)	**14.**	(C)
15.	(B)	**16.**	(B)	**17.**	(D)	**18.**	(D)						

DPP No - 05

1.	(C)	**2.**	(B)	**3.**	(B)	**4.***	(AC)	**5.**	(C)	**6.**	(B)	**7.**	(D)
8.	(B)	**9.**	(B)	**10.**	(C)	**11.**	(B)	**12.**	(D)	**13.**	(C)		

DPP No - 06

1.	(A)	**2.**	(C)	**3.**	(A)	**4.**	(B)	**5.**	(C)	**6.**	(D)
7.	(D)	**8.**	(B)	**9.**	(A)	**10.**	(A)	**11.**	(C)		

DPP No - 07

1.	(C)	**2.**	(A)	**3.**	(C)	**4.**	(C)	**5.**	(D)	**6.**	(B)	**7.**	(B)
8.	(A)	**9.**	(B)	**10.**	(C)	**11.**	(B)						

DPP No - 08

1.*	(ABC)	**2.**	(C)	**3.**	(A)	**4.***	(ABC)	**5.**	(A)	**6.**	(A)

DPP No - 09

1.	(C)	**2.**	(C)	**3.**	(B)	**4.**	(A)	**5.**	(C)	**6.**	(B)	**7.**	(A)
8.	(D)	**9.**	(A)	**10.**	(B)	**11.**	(A)	**12.**	(C)	**13.**	(B)	**14.**	(D)
15.	(D)	**16.**	(D)	**17.**	(D)	**18.**	(C)	**19.**	(C)	**20.**	(B)	**21.**	(B)
22.	(C)	**23.**	(C)	**24.**	(A)	**25.**	(B)	**26.**	(D)	**27.**	(C)	**28.**	(B)
29.	(B)	**30.**	(C)	**31.**	(A)	**32.**	(A)	**33.**	(A)	**34.**	(A)	**35.**	(A)
36.	(B)	**37.**	(B)	**38.**	(B)	**39.**	(C)	**40.**	(A)	**41.**	(C)	**42.**	(C)
43.	(B)	**44.**	(B)	**45.**	(ABC)	**46.**	(ABCD)	**47.**	(BD)	**48.**	(BD)		

DPP No - 10

1. Molality = 11.44 m, Molarity = 7.55 M

2. Volume must have been made 5 times

3. P_{O_2} = 810 mm Hg, P_{H_2O} = 355 mm Hg, P_{total} = 1165 mm Hg

4. (a) 60 g/mol (b) 333.6 g **5.** $C_{12}H_6$ **6.** 749.9 mm of Hg

7. M = 48 **8.** 2660.3 Torr **9.** (a) M = 94.52 (b) m = 135

10. S_8 **11.** 10.33ºC **12.** 60

13. (i) Tetraamminedichloroplatinum (IV) chloride

(ii) Volume of NH_3(aq) needed = 20 mL

(iii) Diamminesilver (I) chloride

14. 232

15. p_A^0 = 400 mm of Hg, P_B^0 = 600 mm of Hg

16. 27.3 mole %

17. 14.16 mole percent benzene

18. Endothermic **19.** 3.973 **20.** 5.15 g **21.** 7.62 bar **22.** 0.24 atm

23. (a) 17.48 mm (b) 4.611 atm (c) – 0.372ºC (d) 100.103ºC

24. 1.875, 250 gm **25.** 0.716 m mol **26.** $C_{44}H_{88}O_{44}$

27. 746.24 mm/Hg **28.** (a) 3.79ºC (b) 0.018 (c) 4.65 atm (d) 251.5

29. $[Co(NH_3)_5Cl]Cl_2$ **30.** 46.33ºC **31.** $x_a'' = 0.1$ **32.** 5.4×10^{-13}

33. 12.72 **34.** 13.8 atm **35.** 4.64 atm **36.** $C_{44}H_{88}O_{44}$

37. 746.24 mm/Hg **38.** $T_f = -0.73$ºC **39.** 0.73 **41.** 20.11 %

42. 12.54