Solution-2

1. The following are some statements about vapour pressure

I. Vapour pressure of a solution increases with increase in temperature.

II. Liquids with high vapour pressure even at ordinary temperatures are volatile liquids.

III. The temperature at which vapour pressure of solution is equal to atmospheric pressure is called Boiling point.

IV. When a non-volatile solute is dissolved in a volatile solvent, its vapour pressure decreases.

Correct statement/statements are

1) All are correct 2) II, III and IV 3) I and II 4) II and IV

2) As temperature increases, vapour pressure of a liquid

1) Increases linearly 2) Decreases linearly

3) Increases exponentially 4) Decreases exponentially

3) Rate of evaporation depends up on

a) Nature of liquid b) Surface area of the liquid

c) Temperature d) Flow of air current over the surface

The correct answer is

1) a, b only 2) b, c only 3) a, b, and c only 4) a, b, c and d

4) At a given temperature

a) Vapour pressure of a solution containing nonvolatile solute is proportional to mole fraction of solvent.

b) Lowering of vapour pressure of solution containing nonvolatile solute is proportional to mole fraction of solute.

c) Relative lowering of vapour pressure is equal to mole fraction of solute.

The correct combination is

1) a only 2) a, b only 3) a, b and c only 4) b, c only

Assertion & reason type questions

Note: 1) Both (A) and (R) are true and (R) is the correct explanation of (A).

2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

3) (A) is true but (R) is false.

4) Both (A) and (R) is false.

5) (A): Increase in temperature increases vapour pressure of a liquid.
(R): Average kinetic energy liquid molecules increases by increasing the temperature.

6) (A): Rate of evaporation increases with an increase in the surface area of the vessel.
(R): Evaporation is a surface phenomenon.

7) (A): Vapour pressure of 0.5M sugar solution is more than 0.5M KCl solution.
(R): Lowering of vapour pressure is directly proportional to the number of particles present in the solution.

8) (A): For two solutions, 0.1m aqueous solution of glucose and 0.2 m aqueous solution of urea the lowering of vapour pressure is same.
(R): Vapour pressure is always increased when non – volatile solute is added to water.

9) (A): Sea water boils at higher temperature than distilled water.
(R): Addition of non volatile solute to a solvent lowers the vapour pressure

10) (A): A pressure cooker reduces cooking time.
(R): The boiling point of water inside the cooker is elevated.

11) (A): Raoult's law is not applicable for concentrated solutions.
(R): Raoult's law is applicable only for solutes which undergo association or disassociation.

12) (A): At high altitudes the boiling point of water is low.

(R): At high altitudes atmospheric pressure is low.

13) Isotonic solutions have same

1) Boiling Point 2) Vapour Pressure 3) Osmotic Pressure 4) All of these.

14) Which of the following is a Colligative Property?

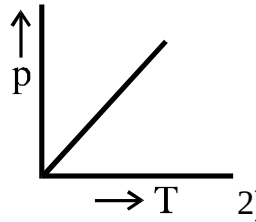
1) Boiling Point 2) Vapour Pressure 3) Freezing Point 4) Osmotic Pressure

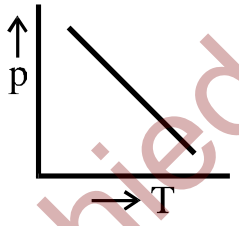
15) A solution that obeys Raoult's law at all concentrations and temperatures is called

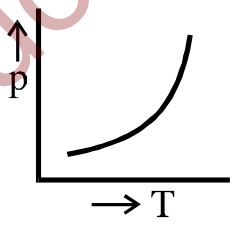
1) Ideal solution 2) Non-ideal solution

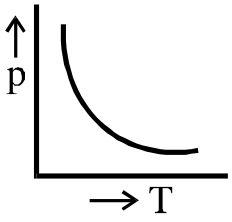
3) Normal solution 4) Saturated solution

16) The graph obtained by taking vapour pressure (P) of a liquid on y-axis and temperature (T) on x-axis will be

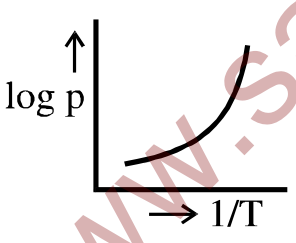
1) 

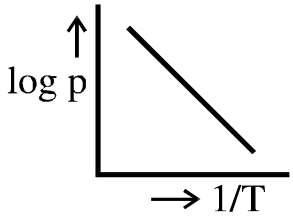
2) 

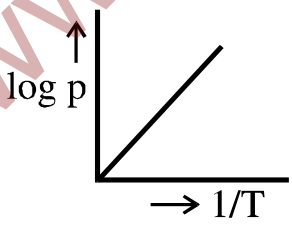
3) 

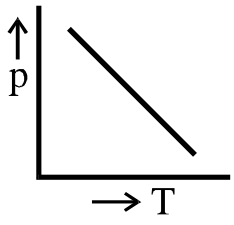
4) 

17) Which graph of the following represents the graph between log p (on Y - axis) and 1/T (on X - axis)?

1) 

2) 

3) 

4) 

18) Two Aqueous solution S_1 and S_2 are separated by a semi permeable membrane. If Solution S_1 has higher vapour pressure than solution S_2 then Water will be flowing

1) From S_1 to S_2

2) From S_2 to S_1

3) In both the directions

4) In either direction depending upon the nature of the solute

19) Camphor is used as solvent to determine the molecular mass of non volatile solute by Rast method because for Camphor

1) Molal depression constant is high 2) Melting point is low

3) Dielectric constant is high 4) All the above

20) The molecular weight of $CaCl_2$ determined by osmotic pressure method will be

1) Same as theoretical value 2) Higher than theoretical value

3) Lower than theoretical value 4) Either higher or lower than theoretical value

21)

List - 1	**List - 2**
A) Lowering of vapour pressure	1) P^0-P^s/ P^0
B) Relative lowering of vapour pressure	2) $P^0-P^s/ P^0= n_{solute}/n_{solvent}+ n_{solute}$
C) Raoult's law	3) $Po – P^s$
D) Ideal solution	4) Obeying Raoults law

The correct match is

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

22) X is a non- volatile solute and Y is a volatile solvent. The following vapour pressures are observed by dissolving X in Y

X/mol lit^{-1} Y/mm of Hg

0.10 P_1

0.25 P_2

0.01 P_3

The correct of vapour pressure is

1) $P_1 < P_2 < P_3$ 2) $P_3 < P_2 < P_1$ 3) $P_3 < P_1 < P_2$ 4) $P_2 < P_1 < P_3$

Hint: VP of a liquid decreases with increase in quantity of non-volatile solute.

23) Which of the following solutions will have the lowest vapour pressure?

1) 0.1M Glucose 2) 0.1M NaCl

3) 0.1 M $BaCl_2$ 4) 0.1 M $Al_2(SO_4)_3$

24) Which has greater lowering of vapour pressure?

1) 0.1m Urea 2) 0.1m Glucose 3) 0.1m Sucrose 4) equal in all cases

25) The vapour pressure is highest for

1) Pure water 2) 0.1m aqueous urea

3) 0.2m aqueous urea 4) 0.3m aqueous urea

26). Relative lowering of vapour pressure is maximum for

1) 0.1m urea 2) 0.1m NaCl 3) 0.1m $MgCl_2$ 4) 0.1m $Al_2(SO_4)_3$

27) Boiling point is least for

1) 0.1m urea 2) 0.2m urea 3) 0.1m NaCl 4) 0.2m $MgCl_2$

28) Which among the following will show maximum osmotic pressure?

1) 1M NaCl 2) 1M $MgCl_2$ 3) 1M $(NH_4)_3PO_4$ 4) 1M Na_2SO_4

29) K_b and K_f for water are respectively 0.52 and 1.80 kg mol^{-1} respectively. If the freezing point of an aqueous glycolic solution is 3.72^0C, the boiling point of the solution is

1) 1.04^0C 2) 98.96 ^{0}C

3) 101.04^0C 4)100.52 ^{0C}

Solution: Depression of freezing point = $\Delta T_f = 3.72^0C$

$\Delta T_f = K_f \times m$;

$m = \Delta T_f / K_f = 3.72/ 1.86 = 2 \text{ mol kg}^{-1}$.

Elevation of boiling point $=\Delta T_b = K_b X\ m = 0.52 \times 2 = 1.04^0C$

Boiling point of the solution = $100 + 1.04 = 101.04^0C$.

30) 50 ml of an aqueous solution of polymer contains 3.15 g of polymer. If osmotic pressure of the solution at 27^0C is 2.57×10^{-3} bar, the molar mass of polymer is nearly

1) 61gm/mol 2) 305gm/mol 3) 366gm/mol 4) 610gm/mol

Solution: Osmotic pressure $= 2.57 \times 10^{-3}$ bar;

Weight of solute = w = 3.15g

Solution constant = S = 0.083 L bar K^{-1} mol^{-1}

Volume of solution = V = 50 mL = 0.05 L: T = 300K

Molar mass $= \frac{wST}{\pi V} = \frac{3.15 \times 0.083 \times 300}{2.57 \times 10^{-3} \times 0.05} = 610 g\ mol^{-1}$

31) K_b for diethyl ether is 2.16 K kg mol^{-1}. The boiling point of ether is increased by 0.17 K. when 0.4g of solute is dissolved in 40 g of ether. The molar mass of solute is

1) 127 gm/mol 2) 254 gm/mol 3) 635gm/mol 4) 63.5gm/mol

Solution: Weight of solute =w = 0.4g;

Weight of solvent = W = 40 g

$K_b = 2.16$ K kg mol^{-1};$T_b = 0.17K$

Molar mass of solute $= \frac{w \times K_b \times 1000}{W \Delta T_b} = \frac{0.4 \times 2.16 \times 1000}{0.17 \times 40} = 127$gm/mol

32) The relationship between osmotic pressure at 273K when 30g glucose (P_1), 30g urea (P_2), and 30g sucrose (P_3) are dissolved in 500 ml of water is

1) $P_1 > P_2 > P_3$ 2) $P_3 > P_1 > P_2$ 3) $P_2 > P_1 > P_3$ 4) $P_2 > P_3 > P_1$

Solution: Osmotic pressure is proportional to number of moles of solute at a given temperature.

33) A solution is obtained by dissolving 0.2 moles of urea in a litre of water. Another solution is obtained by dissolving 0.4 moles of glucose in a litre of water at the same temperature. The lowering of vapour pressure in the first solution is.

1) Same as that of the second solution 2) Half to that of the second solution

3) Double to that of the second solution 4) None

Solution: lowering of vapour pressure is directly proportional to mole fraction or moles of solute

34) At a certain temperature, the vapour pressure of water is 80 mm. At the same temperature the vapour pressure of a solution containing a non-volatile solute is 72 mm. The Mole fraction of solute in the solution is

1. 9 2. 0.9 3. 10 4. 0.1

Solution: $X_{solute} = P_0 - P^s / P_0 = 80-72/80 = 0.1$

35) 3 gms of urea is added to 36 gms of boiling water. The lowering in vapour pressure of solution is

1. 19 mm 2. 38 mm 3. 760 mm 4. 76 mm

Solution: At boiling point $P^0 = 760mm$

$P_0 - P^s / P_0 = wXM/mXW = 3X18/60X36 = 1/40$

$P_0 - P^s = P_0 X0.1 = 760X1/40 = 19$ mm

36) When 5 grams of a solute is added to 90gm of water, its vapour pressure decreased from 30mm to 27mm. The mole fraction of the solvent in the solution is

1) 0.2 2) 0.8 3) 0.1 4) 0.9

Solution: $X_{solute} = P_0 - P^s / P_0 = 30-27/30 = 0.1$

$X_{solvent}$ =1 -0.1= 0.9

37) Which of the following solutions have more lowering in vapour pressure at a certain temperature?

1) 90 grams of glucose in 900 grams of water

2) 34.2 grams of sucrose in 900 grams of water

3) 45 grams of urea in 900 grams of water

4) 36 grams of Fructose in 900 grams of water

Solution: lowering of vapour pressure is directly proportional to mole fraction or moles of solute

38) If the elevation in boiling point of a solution of 10gm of solute (mol. wt=100) in 100 gm of water is T_b, the ebullioscopic constant of water is

1) 10/ T_b 2) 10T_b 3) T_b 4) T_b /10

Solution: $\Delta T_b = K_b.m = K_b\left[\frac{w}{M}\times\frac{1000}{W}\right]$,

T_b, = K_b X (10/100) X (1000/100) = K_b

39) If α is the degree of dissociation of $CaCl_2$, the Vant Hoff factor (i) used for calculating the molecular mass is

1) 1+α 2) 1–α 3) 1+2α 4) 1–2α

Solution: $CaCl_2 \rightarrow Ca^{+2} + 2\ Cl^-$ i.e. no of ions, n=3

α =i-1/n-1 =i-1/3-1 =i-1/2, 2α =i-1, i=1+2α

40) Solution A contains 9.5g/L $MgCl_2$ and solution B contains 5.85g/L of NaCl. At room temperature, the osmotic pressure of

1) Solution A is greater than B 2) both have same osmotic pressure

3) Solution B is greater than A 4) Can't be compared

Hint: Van't Hoff factor (i) of $MgCl_2$ > NaCl

41) Which of the following salt will have same value of Van't Hoff's factor [i] as that of $K_3[Fe(CN)_6]$

1) $Al_2(SO_4)_3$ 2) $AlCl_3$ 3) NaCl 4) Na_2SO_4

Hint: Both $K_3[Fe(CN)_6]$ & $AlCl_3$ contain same no. of ions i.e. 4

42) Human Blood is isotonic with

1) 0.16 M NaCl 2) Conc.NaCl 3) 0.16% NaCl 4) 0.16 N NaCl

43)

Set - I	Set - II
1) Ostwald-Walker	A) Osmotic pressure
2) Cottrell's method	B) Depression of F.P
3) Rast's camphor method	C) Elevation of B.P
4) Berkeley and Hartley's method	D) Lowering of vapour pressure

Correct match is

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

44) The boiling point of 0.1molal $K_4[Fe(CN)_6]$ solution will be (Given K_b for water = 0.52 K kg mol^{-1})

1) 100.52^0C 2) $100.10\ 4^0C$ 3) 100.26^0C 4) 102.6^0C

Solution: $K_4[Fe(CN)_6]$ gives 5 ions(i)

$\Delta T_b = i\ k_b\ m = 5X\ 0.52\ X0.1=0.26$, $T_b=100+0.26=100.26^0C$

45) Molal elevation constant and molal depression constant of water respectively (in Kg K m^{-1}) are

1) 0.52, 1.86 2) 1.86, 0.52 3) 1.52, 0.86 4) 0.86, 1.52

46) In a 0.2 molal aqueous solution of a weak acid HX the degree of ionization is 0.3. Taking k_f for water as 1.85, the freezing point of the solution will be nearest to

1) -0.360^0C 2) -0.260^0C 3) $+0.480^0C$ 4) -0.480^0C

Solution: HX gives 2 ions, n=2 and α= 0.3

α=i-1/n-1 =i-1/2-1 =i-1 i.e. i=1+0.3=1.3

$\Delta T_f = i\ k_f\ m$=1.3 X1.85 X0.2= 0.481 $\therefore T_f$=0-0.481= -0.481^0C

47) Which of the following aqueous solution will have highest depression in freezing point?

1) 0.1 M urea 2) 0.1 M $AgNO_3$ 3) 0.1 M $AlCl_3$ 4)0.1 M Na_3PO_4

Hint: More the solute particles, greater is the depression in freezing point

48) The depression in freezing point for 1 M urea, 1 M NaCl and 1M $BaCl_2$ are in the ratio

1) 1 : 2 : 3 2) 3 : 2 : 2 3) 1 : 1 : 2 4) 2 : 3 : 2

Hint: as concentration is same, ΔT_f values are in the ratio of their vant Hoff constants.

49) Two solutions of glucose have osmotic pressure 1.5 and 2.5 atm .2litres of 1st solution is mixed with 3 litres of 2nd solution. The osmotic pressure of resultant solution will be

1) 10.5 atm 2) 1.05 atm 3) 2.1 atm 4) 21 atm

Hint: $\pi = \frac{\pi_1 V_1 + \pi_2 V_2}{V_1 + V_2}$

50) The van't Hoff factor for 0.1M Barium nitrate is 2.74. The percentage of dissociation of Barium nitrate is

1) 91.3% 2) 87% 3) 100% 4) 74%

Solution: $Ba(NO_3)_2 \rightarrow Ba^{+2} + 2NO_3^{-}$ $\therefore$ *Number of ions produced* $= 3 = n$

$\alpha = \frac{i-1}{n-1}$=2, 74-1/3-1 =1.74/2 =0.87 $\therefore$ percentage of dissociation= 0.87 X100=87%

Key

1)1 2) 3 3) 4 4) 3 5) 1 6) 1 7) 1 8) 4 9) 1 10) 1

11)3 12)1 13)3 14)4 15)1 16) 3 17) 2 18)1 19)3 20)1

21)3 22)4 23) 4 24) 4 25) 1 26) 4 27) 1 28)3 29)3 30)4

31)1 32)3 33) 2 34) 4 35)1 36) 4 37) 3 38) 3 39)3 40)1

41)2 42) 1 43) 1 44) 3 45) 2 46) 4 47) 4 48) 1 49)3 50) 2