PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 3

Total Marks : 38

Max. Time : 41 min.

Topic : Solution Colligative Properties

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7 to Q.8	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.9	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) Q. 10	(8 marks, 10 min.)	[8, 10]

1. In which case van't Hoff factor is maximum ?

(A) KCl, 50% ionised

(B) K_2SO_4, 40% ionised

(C) $SnCl_4$, 20% ionised

(D) $FeCl_3$, 30% ionised

2. Solution having osmotic pressure nearer to that of an equimolar solution of $K_4[Fe(CN)_6]$ is:

(A) Na_2SO_4

(B) $BaCl_2$

(C) $Al_2(SO_4)_3$

(D) $C_{12}H_{22}O_{11}$

3. Three solutions are prepared by adding 'w' gm of 'A' into 1kg of water, 'w' gm of 'B' into another 1 kg of water and 'w' gm of 'C' in another 1 kg of water (A, B, C are non electrolytic). Dry air is passed from these solutions in sequence (A $\longrightarrow$ B $\longrightarrow$ C). The loss in weight of solution A was found to be 2 gm while solution B gained 0.5 gm and solution C lost 1 gm. Then the relation between molar masses of A, B and C is :

(A) $M_A : M_B : M_C = 4 : 3 : 5$

(B) $M_A : M_B : M_C = \frac{1}{4} : \frac{1}{3} : \frac{1}{5}$

(C) $M_C > M_A > M_B$

(D) $M_B > M_A > M_C$

4. 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

5. 20g of a binary electrolyte (molecular weight = 100) are dissolved in 500 g of water. The freezing point of the solution is – 0.74°C ; K_f = 1.86 K molality^{-1}. The degree of dissociation of electrolyte is

(A) 50%

(B) 75%

(C) 100%

(D) Zero

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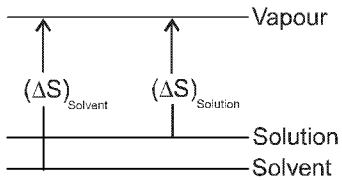
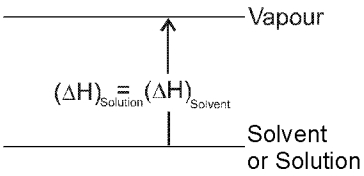
6. At 12°C the osmotic pressure of a urea solution is 500 mm. The solution is diluted and the temperature is raised to 27°C, when the osmotic pressure is found to be 100 mm. Determine the extent of dilution.

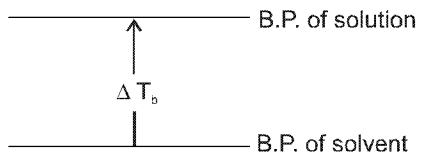
(A) 2.3 (B) 5.0

(C) 5.3 (D) cannot be calculated

7.* Which of the following diagrams represent the correct difference when non-volatile solute is present in an ideal solution ?

(A) 

(B) 

(C) 

(D) only (A) & (B)

8.* If cost per gram were not a concern, arrange the following arrangement(s) of the substances in the order in which they would be the most efficient per unit mass for melting snow from side walks and roads :

(P) glucose, (Q) LiCl, (R) NaCl, (S) $CaCl_2$

[C – 12, O – 16, Li – 7, Cl – 35.5, Na – 23, Ca – 40]

(A) R < S (B) P > S

(C) P > Q > S > R (D) Q < R

9. 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 $\frac{°C}{m}$, the atomicity of the molecule is : (As – 75)

10.

	Column-I		**Column-II**
(A)	n-hexane + n-heptane.	(p)	Can be separated by fractional distillation.
(B)	Acetone + chloroform	(q)	Maximum boiling azeotrope.
(C)	Chloro-benzene and bromo-benzene	(r)	Cannot be separated by fractional distillation completely.
(D)	Ethanol + water.	(s)	Minimum boiling azeotrope.

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Answer Key

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1.	(D)	**2.**	(C)	**3.**	(C)	**4.**	(C)	**5.**	(D)
6.	(C)	**7.***	(ABC)	**8.***	(ABC)	**9.**	4		
10.	[A – p] ; [B – q,r] ; [C – p] ; [D – r,s].								

Hints & Solutions

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

(A) For KCl, $i = 1 + 0.5 = 1.5$

(B) For K_2SO_4, $i = 1 + 2 \times 0.4 = 1.8$

(C) For $SnCl_4$, $i = 1 + 4 \times 0.2 = 1.8$

(D) For $FeCl_3$, $i = 1 + 3 \times 0.3 = 1.9$

2. Osmotic pressure will be same for equimolar solutions if Van't Hoff factor is same.

$K_4[Fe(CN)_6] \rightarrow i = 1 + (n-1)\alpha = 1 + 4 = 5$

$Al_2(SO_4)_3 \rightarrow i = 1 + (n-1)\alpha = 1 + 4 = 5$

3. The loss in weight should be proportional to vapour pressure above that solution :

So, $P_{S_A} \propto 2gm \Rightarrow P_{S_B} \propto 1.5gm \Rightarrow P_{S_C} \propto 2.5gm$

So, maximum vapour pressure is above C solution hence, it is having minimum lowering and hence minimum mole fraction (hence minimum number of moles of solute) So max. molar mass of substance.

4. Boiling point of solution = boiling point + $\Delta T_b = 100 + \Delta T_b$

Freezing point of solution = freezing point $- \Delta T_f = 0 - \Delta T_f$

Difference in temperature (given) = $100 + \Delta T_b - (-\Delta T_f)$

$103.57 = 100 + \Delta T_b + \Delta T_f = 100 + \text{molality} \times K_b + \text{molality} \times K_f$

$= 100 + \text{molality}\ (0.52 + 1.86)$

$$\text{Molality} = \frac{103.57-100}{2.38} = \frac{3.57}{2.38} = 1.5\ m$$

$$\text{and molality} = \frac{\text{moles} \times 1000}{W_{gm\ (solvent)}} ; 1.5 = \frac{\text{moles} \times 1000}{500}$$

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Moles of solute = $\frac{1.5 \times 500}{1000}$ = 0.75 moles

Ans. 750 mmoles

5. $\Delta T_f = iK_f m$

$0.74 = i \times 1.36 \times 0.4 \Rightarrow i = 0.9945 \approx 1 \Rightarrow i = 1 + \alpha \approx 1 \Rightarrow \alpha \approx 0$

6. Suppose V_1 litres of the solution contains n moles of the solute at 12°C which was diluted to V_2 litres at 27°C.

Thus we have

$$\frac{500}{760} = \frac{n}{V_1} \times 0.082 \times 285 \quad \ldots(i)$$

and $$\frac{100}{760} = \frac{n}{V_2} \times 0.082 \times 300$$

Dividing (1) by (2), we get $\frac{V_2}{V_1} = 5.3$.

8.* The substance which will produce maximum particles pergram will be most efficient.

Particles produced by 1 g of LiCl = $\frac{1}{42.5} \times 2 = 0.047$

Particles produced by 1 g of NaCl = $\frac{1}{58.5} \times 2 = 0.034$

Particles produced by 1 g of glucose = $\frac{1}{180} \times 2 = 0.011$

Particles produced by 1 g of $CaCl_2$ = $\frac{1}{111} \times 3 = 0.027$

Answer is LiCl.

9. $\Delta T_f = K_f m$

$$0.19 = 4.9 \times \frac{\frac{1}{M}}{\frac{86}{1000}}.$$

$$0.19 = 4.9 \times \frac{1000}{M \times 86}. \Rightarrow M = \frac{4.9 \times 1000}{86 \times 0.19} = 300. \Rightarrow \text{Atomicity} = \frac{300}{75} = 4.$$

10. Hexane & Heptane solution do not form azeotrope, but have different boiling points, so can be separated by fractional distillation. Acetione & chloroform form maximum boiling azeotrope ethanol & water form minimum boiling azeotrope. Azeotropes cannot be separated completely by fractional distillation chlorobenzene & bromobenzene do not form azeotrope but have different boiling points. so can be separated by fractional distillation.

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