



DPP –10 [Electrolyte (van't Hoff Factor)]

Chapter: Solution

“Marks ke liye na daantne wale parents, dil se sabse zyada bharosa rakhte hain.”

TYPE–1 : Conceptual – van't Hoff Factor, Dissociation & Association

1. **van't Hoff factor is :**

- (1) Less than one in case of dissociation
- (2) More than one in case of association
- (3) Always less than one
- (4) Less than one in case of association

2. **The vant Hoff factor (i) for a dilute aqueous solution of Glucose is :**

- (1) Zero
- (2) 1.0
- (3) 1.5
- (4) 2.0

3. **The van't Hoff factor for a compound which undergoes dissociation in one solvent and association in other solvent is respectively :**

- (1) Less than one and greater than one
- (2) Less than one and less than one
- (3) Greater than one and less than one
- (4) Greater than one and greater than one

4. **The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression :-**

- (1) $\alpha = \frac{x+y-1}{i-1}$
- (2) $\alpha = \frac{x+y+1}{i-1}$
- (3) $\alpha = \frac{i-1}{(x+y-1)}$
- (4) $\alpha = \frac{i-1}{x+y+1}$

5. **The substance A when dissolved in solvent B shows the molecular mass corresponding to A_3 . The vant Hoff's factor will be -**

- (1) 1
- (2) 2
- (3) 3
- (4) $\frac{1}{3}$

6. **The experimental molecular weight of an electrolyte will always be less than its calculated value because the value of vant Hoff factor, 'i' is :**

- (1) Less than 1
- (2) Greater than 1
- (3) One
- (4) Zero

7. **The molar mass of NaCl determined by the osmotic pressure method will be :-**

- (1) Higher than the theoretical value
- (2) Lower than the theoretical value
- (3) The same as the theoretical value
- (4) None of these

8. **The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to :**

- (1) Ionisation of benzoic acid
- (2) Dimerization of benzoic acid
- (3) Trimerization of benzoic acid
- (4) Solvation of benzoic acid

TYPE-2 : Comparing Colligative Properties of Electrolytes

9. **The ratio of the value of any colligative property for KCl solution to that for sugar solution is nearly time :**
 - (1) 1
 - (2) 0.5
 - (3) 2
 - (4) 2.5
10. **The lowering of vapour pressure of 0.1M aqueous solutions of NaCl, CuSO₄ and K₂SO₄ are :**
 - (1) All equal
 - (2) In the ratio of 1 : 1 : 1.5
 - (3) In the ratio of 3 : 2 : 1
 - (4) In the ratio of 1.5 : 1 : 2.5
11. **The substance when dissolved in water would decrease the vapour pressure of water to the greatest extent is :-**
 - (1) 0.1 M KCl
 - (2) 0.1 M urea
 - (3) 0.1 M BaCl₂
 - (4) 0.1 M NaCl
12. **When equimolar aqueous solutions of glucose, sodium chloride and barium nitrate are compared the vapour pressure of the solutions will be in the following order :-**
 - (1) Glucose > NaCl > Ba(NO₃)₂
 - (2) Glucose = NaCl = Ba(NO₃)₂
 - (3) Ba(NO₃)₂ > NaCl > Glucose
 - (4) NaCl > Ba(NO₃)₂ > Glucose
13. **Which solution will have least vapour pressure :**
 - (1) 0.1 M BaCl₂
 - (2) 0.1 M urea
 - (3) 0.1 M Na₂SO₄
 - (4) 0.1 M Na₃PO₄
14. **The correct relationship between the boiling points of very dilute solutions of AlCl₃(T₁) and CaCl₂(T₂), having the same molar concentration is :**
 - (1) T₁ = T₂
 - (2) T₁ > T₂
 - (3) T₂ = T₁
 - (4) T₂ ≥ T₁
15. **Which of the following solutions will have highest boiling point ?**
 - (1) 1% Glucose in water
 - (2) 1% Sucrose in water
 - (3) 1% NaCl in water
 - (4) 1% Urea in water
16. **Arrange the following aqueous solutions in the order of their increasing boiling points :-**
 - (i) 10⁻⁴ M NaCl
 - (ii) 10⁻⁴ M Urea
 - (iii) 10⁻³ M MgCl₂
 - (iv) 10⁻² M NaCl
 - (1) (i) < (ii) < (iv) < (iii)
 - (2) (ii) < (i) = (iii) < (iv)
 - (3) (ii) < (i) < (iii) < (iv)
 - (4) (iv) < (iii) < (i) = (ii)
17. **Which of the following solution will have highest freezing point**
 - (1) 1M urea
 - (2) 1M Na₂SO₄
 - (3) 1M NaCl
 - (4) 1M Al₂(SO₄)₃
18. **Of the following 0.10m aqueous solutions, which one will exhibit the largest freezing**

point depression?

- (1) KCl (2) $C_6H_{12}O_6$
(3) $Al_2(SO_4)_3$ (4) K_2SO_4
19. **The freezing point of equimolar aqueous solution will be highest for :**
(1) $C_6H_5NH_3Cl$ (2) $Ca(NO_3)_2$
(3) $La(NO_3)_3$ (4) $C_6H_{12}O_6$ (Glucose)
20. **Which aqueous solution has minimum freezing point ?**
(1) 0.01 M NaCl (2) 0.005 M C_2H_5OH
(3) 0.005 M MgI_2 (4) 0.005 M $MgSO_4$
21. **Which of the following 0.1 M aqueous solutions will have the lowest freezing point :**
(1) Potassium Sulphate (2) Sodium Chloride
(3) Urea (4) Glucose
22. **Which has maximum freezing point :**
(1) 1 molar of NaCl solution (2) 1 molar of KCl solution
(3) 1 molar of $CaCl_2$ solution (4) 1 molar of urea solution
23. **The freezing point of 1% aqueous solution of calcium nitrate will be :**
(1) $0^\circ C$ (2) Above $0^\circ C$
(3) $1^\circ C$ (4) Below $0^\circ C$
24. **The following aqueous solution in the correct order of decreasing freezing point is -**
(1) 0.2M $BaCl_2$, 0.2M KCl, 0.1M Na_2SO_4
(2) 0.2M KCl, 0.1M Na_2SO_4 , 0.2M $BaCl_2$
(3) 0.1M Na_2SO_4 , 0.2M KCl, 0.2M $BaCl_2$
(4) 0.1M Na_2SO_4 , 0.2M $BaCl_2$, 0.2M KCl
25. **Which is the correct relation between osmotic pressure of 0.1M NaCl solution and 0.1M Na_2SO_4 solution ?**
(1) The osmotic pressure of Na_2SO_4 is less than NaCl solution
(2) The osmotic pressure Na_2SO_4 is more than NaCl solution
(3) Both have same osmotic pressure
(4) None of the above
26. **Which one of the following solutions will have highest osmotic pressure ? (Assume that all the salts are equally dissociated)**
(1) 0.1M $Al_2(SO_4)_3$
(2) 0.1M $BaCl_2$
(3) 0.1 M Na_2SO_4
(4) The solution obtained by mixing equal volumes of (2) and (3)
27. **The following solutions have equal concentrations. Which one will show minimum osmotic pressure?**
(1) $BaCl_2$ (2) $AgNO_3$
(3) Na_2SO_4 (4) $(NH_4)_3PO_4$
28. **The osmotic pressure of equimolar solutions of $BaCl_2$, NaCl, and glucose will be in the order :**
(1) Glucose > NaCl > $BaCl_2$
(2) $BaCl_2$ > NaCl > Glucose
(3) NaCl > $BaCl_2$ > Glucose

- (4) $\text{NaCl} > \text{Glucose} > \text{BaCl}_2$
29. **Which one of the following pairs of solutions will be expected to be isotonic under the same temperature ?**
- (1) 0.1M urea and 0.1 M NaCl
 (2) 0.1M urea and 0.2 M MgCl_2
 (3) 0.1M NaCl and 0.1M Na_2SO_4
 (4) 0.1M $\text{Ca}(\text{NO}_3)_2$ and 0.1M Na_2SO_4
30. **Two solutions of KNO_3 and CH_3COOH are prepared separately. Molarity of both is 0.1M and osmotic pressures are P_1 and P_2 respectively. The correct relationship between the osmotic pressures is**
- (1) $P_2 > P_1$ (2) $P_1 = P_2$
 (3) $P_1 > P_2$ (4) $\frac{P_1}{P_1 + P_2} = \frac{P_2}{P_1 + P_2}$
31. **Which salt shows maximum osmotic pressure in its 1M solution :**
- (1) AgNO_3 (2) Na_2SO_4
 (3) $(\text{NH}_4)_3\text{PO}_4$ (4) MgCl_2
32. **Which solution will exert highest osmotic pressure?**
- (1) 1M glucose solution (2) 1M urea solution
 (3) 1M Alum solution (4) 1M NaCl solution
33. **Consider separate solution of 0.500 M $\text{C}_2\text{H}_5\text{OH}(\text{aq})$, 0.100 M $\text{Mg}_3(\text{PO}_4)_2(\text{aq})$, 0.250 M $\text{KBr}(\text{aq})$ and 0.125 M $\text{Na}_3\text{PO}_4(\text{aq})$ at 25°C . Which statement is true about these solutions, assuming all salts to be strong electrolytes ?**
- (1) 0.125 M $\text{Na}_3\text{PO}_4(\text{aq})$ has the highest osmotic pressure
 (2) 0.500 M $\text{C}_2\text{H}_5\text{OH}(\text{aq})$ has the highest osmotic pressure
 (3) They all have the same osmotic pressure
 (4) 0.100 M $\text{Mg}_3(\text{PO}_4)_2(\text{aq})$ has the highest osmotic pressure
34. **Among 0.1M solutions of urea, Na_3PO_4 and $\text{Al}_2(\text{SO}_4)_3$:-**
- (a) The vapour pressure and freezing point are the lowest for urea
 (b) The vapour pressure and freezing point are the highest for urea
 (c) The elevation in boiling point is the highest for $\text{Al}_2(\text{SO}_4)_3$
 (d) The depression in freezing point is the highest for $\text{Al}_2(\text{SO}_4)_3$
- (1) Only a (2) b & c both
 (3) b, c and d (4) a, b, c and d

TYPE-3 : Numerical – ΔT_f , ΔT_b , π with van't Hoff Factor

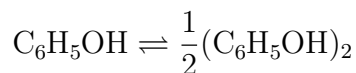
35. **0.5 mol NaCl is dissolved in 500 g H_2O . Then determine freezing point and boiling point of solution.**
- Given $(K_f)_{\text{H}_2\text{O}} = 1.8 \text{ K kg mol}^{-1}$,
 $(K_b)_{\text{H}_2\text{O}} = 0.5 \text{ K kg mol}^{-1}$
- (1) -1.8°C , 100.5°C (2) -3.6°C , 101°C
 (3) -3.6°C , 99°C (4) 0°C , 100°C
36. **The molal elevation constant of water is 0.51. The boiling point of 0.1 molal aqueous NaCl solution is nearly :**
- (1) 100.05°C (2) 100.1°C

- (3) 100.2°C (4) 101.0°C
37. **The molal elevation constant of water is 0.52 K molality⁻¹. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl), should be :**
- (1) 100.52°C (2) 101.04°C
 (3) 99.48°C (4) 98.96°C
38. **The freezing point of 1 molal NaCl solution assuming NaCl to be 100% dissociated in water is: ($K_f = 1.86 \text{ K Molality}^{-1}$)**
- (1) -1.86 °C (2) -3.72 °C
 (3) +1.86 °C (4) +3.72 °C
39. **0.585% NaCl solution at 27°C has osmotic pressure.**
- (1) 2.49 atm (2) 5 atm
 (3) 1.2 atm (4) 3.8 atm
40. **A 0.2 molal aqueous solution of a weak acid (HX) is 20% ionised. The elevation in boiling point of this solution is (given $K_b = 0.52^\circ\text{C kg mol}^{-1}$ for H₂O)**
- (1) 0.81 (2) 0.125
 (3) 0.48 (4) 1.3
41. **0.5 molal aqueous solution of a weak acid (HX) is 20% ionised. If K_f for water is 1.86 K kg mol⁻¹, the lowering in freezing point of the solution is :**
- (1) -0.56 K (2) -1.12 K
 (3) 0.56 K (4) 1.12 K
42. **What is the freezing point of a solution containing 8.1 g of HBr in 100 g water assuming the acid to be 90% ionised (K_f for water = 1.86 K molality⁻¹)**
- (1) 0.85°C (2) -3.53°C
 (3) 0°C (4) -0.35°C
43. **0.1 M solution of K₂SO₄ is dissolved to the extent of 90%. What would be its osmotic pressure at 27°C :-**
- (1) 6.89 atm (2) 0.689 atm
 (3) 0.344 atm (4) 3.4 atm
44. **The concentration of sucrose solution which is isotonic with 0.02 M solution of Na₂SO₄ (assume complete dissociation) at 30°C is**
- [NCERT Pg. 56]
- (1) 0.04 M (2) 0.02 M
 (3) 0.06 M (4) 0.08 M
45. **Solute A is ternary electrolyte and solute B is non-electrolyte. If 0.1 M solution of solute B produces an osmotic pressure of 2P, then 0.05M solution of A at the same temperature will produce an osmotic pressure equal to :**
- (1) P (2) 1.5 P (3) 2 P (4) 3 P
46. **The relationship between the values of osmotic pressure of solutions obtained by dissolving 6.00 g L⁻¹ of CH₃COOH (π_1) and 7.45 g L⁻¹ of KCl (π_2) is :-**
- (1) $\pi_1 > \pi_2$ (2) $\pi_1 < \pi_2$
 (3) $\pi_1 = \pi_2$ (4) None of these
47. **A 5.8% (wt./vol.) NaCl solution will exert an osmotic pressure closest to which one of the following :**
- (1) 5.8% (wt./vol) sucrose solution

- (2) 5.8% (wt./vol) glucose solution
- (3) 2 M sucrose solution
- (4) 1 M glucose solution

TYPE-4 : Calculating van't Hoff Factor (i)

48. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is
 (1) 2 (2) 3 (3) 0 (4) 1
49. The van't Hoff factor (i) for a dilute solution of $K_3[Fe(CN)_6]$ is :
 (1) 10 (2) 4 (3) 5 (4) 0.25
50. Which one has same van't Hoff factor i as that of Hg_2Cl_2 :-
 (1) NaCl (2) Na_2SO_4
 (3) $Al(NO_3)_3$ (4) $Al_2(SO_4)_3$
51. Which one of the following electrolytes has the same value of van't Hoff's factor (i) as that of $Al_2(SO_4)_3$ (if all are 100% ionised) ?
 (1) $K_3[Fe(CN)_6]$ (2) $Al(NO_3)_3$
 (3) $K_4[Fe(CN)_6]$ (4) K_2SO_4
52. The freezing point depression constant for water is $-1.86^\circ C m^{-1}$. If 5 g Na_2SO_4 is dissolved in 45.0 g H_2O , the freezing point is changed by $-3.82^\circ C$. Calculate the van't Hoff factor for Na_2SO_4
 (1) 2.05 (2) 2.63
 (3) 3.11 (4) 0.381
53. A 0.0020 m aqueous solution of an ionic compound $[Co(NH_3)_5(NO_2)]Cl$ freezes at $-0.00732^\circ C$. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ($K_f = 1.86^\circ C m^{-1}$) :-
 (1) 1 (2) 2 (3) 3 (4) 4
54. The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is :-
 (1) 91.3% (2) 87%
 (3) 100% (4) 74%
55. Van't Hoff factor of Hg_2Cl_2 in its aqueous solution will be (Hg_2Cl_2 is 80% ionized in the solution)
 (1) 1.6 (2) 2.6 (3) 3.6 (4) 4.6
56. Phenol associates in benzene as



If degree of association of phenol is 40%. van't Hoff factor i is :-

- (1) 1 (2) 0.8 (3) 1.4 (4) 0.6
57. A 1.17% solution of NaCl is isotonic with 7.2% solution of glucose calculate the value of i of NaCl
 (1) 1 (2) 2 (3) 3 (4) 4
58. A 0.004M solution of Na_2SO_4 is isotonic with a 0.010M solution of glucose at the $25^\circ C$

temperature. The apparent degree of dissociation of Na_2SO_4 is

- (1) 25% (2) 50%
(3) 75% (4) 85%

59. 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 :

- (1) Normal (2) Associated
(3) Hydrolysed (4) Dissociated

60. If α is the degree of dissociation of $\text{K}_4[\text{Fe}(\text{CN})_6]$, then abnormal mass of complex in the solution will be :-

- (1) $M_{\text{normal}} (1 + 2\alpha)^{-1}$ (2) $M_{\text{normal}} (1 + 3\alpha)^{-1}$
(3) $M_{\text{normal}} (1 + \alpha)^{-1}$ (4) $M_{\text{normal}} (1 + 4\alpha)^{-1}$

61. Calculate the percentage degree of dissociation of an electrolyte AB_2 (normal molar mass = 164) in H_2O if observed molar mass is 65.6

- (1) 50% (2) 25% (3) 75% (4) None

62. The values of observed and calculated molecular weight of calcium nitrate are respectively 65.6 and 164. The degree of dissociation of calcium nitrate will be :

- (1) 25% (2) 50%
(3) 75% (4) 60%

TYPE-5 : Miscellaneous – When HgI_2 is added / Special Cases

63. When mercuric Iodide is added to the aqueous solution of potassium iodide ?

- (1) The boiling point does not change
(2) Freezing point is raised
(3) The freezing point is lowered
(4) Freezing point does not change