DPP - Daily Practice Problems

Name : _____ Date : _____

Start Time : _____ End Time : _____

CHEMISTRY 32

SYLLABUS : Solution-II : Azeotropic mixtures, Osmosis and osmotic pressure of solution, Elevation of boiling point of the solvent, Depression of freezing point, Collegative properties of electrolysis, Abnormal molecular masses

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 The concentration in gms per litre of a solution of cane sugar (M = 342) which is isotonic with a solution containing 6 gms of urea (M = 60) per litre is

(a) 3.42 (b) 34.2 (c) 5.7 (d) 19

Q.2 Osmotic pressure of a solution containing 0.1 mole of solute per litre at 273 K is (in atm)

(a) $\frac{0.1}{l} \times 0.0821 \times 273$ (b) $0.1 \times 1 \times 0.0821 \times 273$

(b) $\frac{1}{0.1} \times 0.0821 \times 273$ (d) $\frac{0.1}{l} \times \frac{273}{0.0821}$

Q.3 A solution contains non-volatile solute of molecular mass M_p. Which of the following can be used to calculate molecular mass of the solute in terms of osmotic pressure (m = mass of solute, V = Volume of solution and π = Osmotic pressure)

(a) $M_p = \left(\frac{m}{\pi}\right) VRT$ (b) $M_p = \left(\frac{m}{V}\right) \frac{RT}{\pi}$

(c) $M_p = \left(\frac{m}{V}\right) \frac{\pi}{RT}$ (d) $M_p = \left(\frac{m}{V}\right) \pi RT$

Q.4 The solution containing 4.0 gm of a polyvinyl chloride polymer in 1 litre of dioxane was found to have an osmotic pressure 6.0×10^{-4} atmosphere at 300 K, the value of R used is 0.082 litre atmosphere $mole^{-1}K^{-1}$. The molecular mass of the polymer was found to be

(a) 3.0×10^2 (b) 1.6×10^5

(c) 5.6×10^4 (d) 6.4×10^2

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

Space for Rough Work

Q.5 Which of the following solution in water possesses the highest value of elevation in Boiling point ?
(a) 0.1 M NaCl (b) 0.1 N $BaCl_2$
(c) 0.1 M KCl (d) None of these

Q.6 The molal elevation constant of water = 0.52°C mol^{-1}. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl) should be
(a) 100.52°C (b) 101.04°C
(c) 99.48°C (d) 98.96°C

Q.7 The molal boiling point constant for water is 0.513°C kg mol^{-1}. When 0.1 mole of sugar is dissolved in 200 ml of water, the solution boils under a pressure of one atmosphere at
(a) 100.513°C (b) 100.0513°C
(c) 100.256°C (d) 101.025°C

Q.8 The elevation in boiling point of a solution of 13.44g of $CuCl_2$ in 1 kg of water using the following information will be (Molecular weight of $CuCl_2$ = 134.4 and K_b = 0.52 K $molal^{-1}$)
(a) 0.16 (b) 0.05 (c) 0.1 (d) 0.2

Q.9 When common salt is dissolved in water
(a) melting point of the solution increases
(b) boiling point of the solution increases
(c) boiling point of the solution decreases
(d) both melting point and boiling point decreases

Q.10 A solution of 1 molal concentration of a solute will have maximum boiling point elevation when the solvent is
(a) Ethyl alcohol (b) Acetone
(c) Benzene (d) Chloroform

Q.11 Molal cryoscopic constant of water is 1.80 K kg $mole^{-1}$. A solution containing 6.00 g of pure acetic acid in 1 kg of water will show a depression of freezing point which is
(a) 0.18K
(b) 0.36K
(c) Slightlygreater than 0.18K
(d) Slightly less than 0.36 K

Q.12 The freezing point of a solution prepared from 1.25 gm of a non-electrolyte and 20 gm of water is 271.9 K. If molar depression constant is 1.86K mol^{-1}, then molarmass of the solute will be
(a) 105.7 (b) 106.7 (c) 115.3 (d) 93.9

Q.13 Dry air was passed successively through a solution of 5 gm of a solute in 80 gm of water and then through pure water. The loss in weight of solution was 2.50 gm and that of pure solvent 0.04 gm. What is the molecular weight of the solute?
(a) 70.31 (b) 7.143 (c) 714.3 (d) 80

Q.14 Given that ΔT_f is the depression in freezing point of the solvent in a solution of a non-volatile solute of molality m, the quantity $\lim_{m\to 0}\left(\frac{\Delta T_f}{m}\right)$ is equal to
(a) zero (b) one
(c) three (d) None of the above

Q.15 What is the effect of the addition of sugar on the boiling and freezing points of water ?
(a) Both boiling point and freezing point increases
(b) Both boiling point and freezing point decreases
(c) Boiling point increases and freezing point decreases
(d) Boiling point decreases and freezing point increases

Q.16 0.440g of a substance dissolved in 22.2 g of benzene lowered the freezing point of benzene by 0.567°C. The molecular mass of the substance (K_f = 5.12°C kg mol^{-1}).
(a) 178.9 (b) 177.8
(c) 176.7 (d) 175.6

Q.17 The relationship between the values of osmotic pressure of 0.1 M solutions of KNO_3(P_1) and CH_3COOH(P_2) is :
(a) $\frac{P_1}{P_1+P_2}=\frac{P_2}{P_1+P_2}$ (b) $P_1 > P_2$
(c) $P_2 > P_1$ (d) $P_1 = P_2$

Q.18 Which of the following salt has the same value of van't Hoff factor i 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.19 The van't Hoff factor calculated from association data is always... than calculated from dissociation data.
(a) less (b) more
(c) same (d) more or less

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ

Space for Rough Work

Q.20 Van't Hoff factor i

(a) $\frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$

(b) $\frac{\text{Observed molecular mass}}{\text{Normal molecular mass}}$

(c) Less than one in case of dissociation

(d) More than one in case of association

Q.21 The molecular mass of aceticacid dissolved in water is 60 and when dissolved in benzene it is 120. This difference in behaviour of CH_3COOH is because

(a) water prevents association of acetic acid

(b) acetic acid does not fully dissolve in water

(c) acetic acid fully dissolves in benzene

(d) acetic acid does not ionize in benzene

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 Which one of the following statements is true ?

(1) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose.

(2) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$, where M is the molarity of the solution.

(3) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction.

(4) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression.

Q.23 At the same temperature, which of the following solution will not be isotonic?

(1) 3.24 gm of sucroseper litre of water and 0.18 gm glucose per litre of water

(2) 3.24 gm of sucrose per litre of water and 0.585 gm of sodium chloride per litre of water

(3) 3.42 gm of sucrose per litre of water and 1.17 gm of sodium chloride per litre of water

(4) 3.42 gm of sucrose per litre and 0.18 gm glucose in 0.1 litre water

Q.24 Which statements are correct regarding osmotic pressure (P), volume (V) and temperature (T) ?

(1) $P \propto \frac{1}{V}$ if T is constant

(2) $P \propto T$ if V is constant

(3) PV is constant if T is constant

(4) $P \propto V$ if T is constant

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

A system of greater disorder of molecules is more probable. The disorder of molecules is reflected by the entropy of the system. A liquid vapourises to form a more disordered gas. When a solute is present, there is additional contribution to the entropy of the liquid due to increased randomness. As the entropy of solution is higher than that of pure liquid, there is weaker tendency to form the gas. Thus, a solute (non volatile) lowers the vapour pressure of a liquid, and hence a higher boiling point of the solution.

Similarly, the greater randomness of the solution opposes the tendency to freeze. In consequence, a lower the temperature must be reached for achieving the equilibrium between the solid (frozen solvent) and the solution.

Elevation of B. Pt. (ΔT_b) and depression of F.Pt (ΔT_f) of a solution are the colligative properties which depend only on the concentration of particles of the solute, not on their identity. For dilute solutions, ΔT_b and ΔT_f are proportional to the molality of the solute in the solution.

$\Delta T_b = K_b m$; K_b = Ebullioscopic constant = $\frac{RT_b^{\circ 2} M}{1000\,\Delta H_{vap}}$

and $\Delta T_f = K_f m$; K_f = Cryoscopic constant = $\frac{RT_f^{\circ 2} M}{1000\,\Delta H_{fus}}$

(M = Molecular mass of the solvent)

RESPONSE GRID	20.ⓐⓑⓒⓓ	21.ⓐⓑⓒⓓ	22.ⓐⓑⓒⓓ	23.ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ

Space for Rough Work

The values of K_b and K_f both depend on the properties of the solvent. For liquids, $\frac{\Delta H_{vap}}{T_b^0}$ is almost constant.

[Troutan's rule, this constant for most of the unassociated liquids (not having any strong bonding like hydrogen bonding in the liquid state is equal to 90 J/mol]

For solutes undergoing change of molecular state in solution (ionization or association), the observed ΔT values differ from the calculated ones using the above relations. In such situations, the relationships are modified as

$$\Delta T_b = i K_b m$$
$$\Delta T_f = i K_f m$$

where i = Van't Hoff factor, greater than unity for ionization and smaller than unity for association of the solute molecules.

Q.25 Depression of freezing point of which of the following solutions does represent the cryoscopic constant of water?
(a) 16% (w/w) aqueous solution of urea
(b) 100g of aqueous solution containing 18g of glucose
(c) 59g of aqueous solution containing 9g of glucose
(d) 1M KCl solution in water.

Q.26 Dissolution of non-volatile solute into a liquid leads to the–
(a) decrease of entropy
(b) increase in tendency of the liquid to freeze
(c) increase in tendency to pass into the vapour phase
(d) decrease in tendency of the liquid to freeze

Q.27 To aqueous solution of NaI, increasing amounts of solid HgI_2 is added. The vapour pressure of the solution –
(a) decreases to a constant value
(b) increases to a constant value
(c) increases first and then decreases
(d) remains constant because HgI_2 is sparingly soluble in water.

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement-1 is False, Statement-2 is True.
(d) Statement-1 is True, Statement-2 is False.

Q.28 Statement-1 : Reverse osmosis is used in the desalination of sea water.
Statement-2 : When pressure more than osmotic pressure is applied, pure water is squeezed out of the sea water through the membrane.

Q.29 Statement-1 : Molecular mass of benzoic acid when determined by colligative properties is found high.
Statement-2 : Benzoic acid dimerises.

Q.30 Statement-1 : Isotonic solutions do not show the phenomenon of osmosis.
Statement-2 : Isotonic solutions have equal osmotic pressure.

RESPONSE GRID	25.ⓐⓑⓒⓓ 26.ⓐⓑⓒⓓ 27.ⓐⓑⓒⓓ 28.ⓐⓑⓒⓓ 29.ⓐⓑⓒⓓ 30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 32 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	68
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

32

1. **(b)** Isotonic solution, $(Conc.)_1 = (Conc.)_2$

$$= \frac{w_1}{m_1 V_1} = \frac{w_2}{m_2 V_2} = \frac{w_1}{342 \times 1} = \frac{6}{60 \times 1}; \; W_1 = \frac{342 \times 6}{60} = 34.2$$

2. **(a)** $\pi = \frac{n}{V} \times RT = \frac{0.1}{1} \times 0.0821 \times 273$

3. **(b)** $\pi = \frac{n}{V} RT \Rightarrow M_p = \left(\frac{m}{V}\right) \frac{RT}{\pi}$

4. **(b)** $\pi V = \frac{w}{m} RT$

$$\therefore \; 6 \times 10^{-4} \times 1 = \frac{4}{m} \times 0.0821 \times 300; \; m = 1.64 \times 10^5$$

5. **(b)** $BaCl_2$ gives maximum (3) ions hence it shows highest elevation in boiling point.

6. **(b)** $\Delta T_b = imK_b = 2 \times 1 \times 0.52 = 1.04$

$\therefore \quad T_b = 100 + 1.04 = 101.04°C$

7. **(c)** $\Delta T_b = K_b \times m = 0.513 \times \left(\frac{0.1}{200} \times 1000\right)$

$= 0.2565°C, T_b = 100 + 0.2565°C, \; T_b = 100.256°C$

8. **(a)** $\Delta T_b = i.K_b.m$

$CuCl_2 \rightarrow Cu^{2+} + 2Cl^-$

Assuming 100% ionization, $i = 3$

$\Delta T_b = 3 \times 0.52 \times 0.1 = 0.156 \simeq 0.16$

9. **(b)** Common salt is non-volatile and its b.p. increases.

10. **(c)** As benzene shows no association or dissociation thus the solute has maximum boiling point in benzene.

11. **(c)** Normal value of $\Delta T_f = K_f m = 1.80 \times \frac{6}{60} = 0.18°$

Acetic acid is a weak electrolyte and ionizes feebly, hence i is slightly greater than unity.

12. **(a)** Molar mass $= \frac{K_f \times 1000 \times w}{\Delta T_f \times W} = \frac{1.86 \times 1000 \times 1.25}{20 \times 1.1}$

$= 105.68 = 105.7$

13. **(a)** $m = \frac{5 \times 18 \times 2.5}{0.04 \times 80} = 70.31$

14. **(d)** It comes out to be constant depending on the nature of solute.

15. **(c)** On adding solute the boiling point of solution increases while freezing point of solution decreases.

16. **(a)** $m = \frac{K_f \times w \times 1000}{\Delta T_f \times W} = \frac{5.12 \times 0.440 \times 1000}{0.567 \times 22.2} = 178.9$

17. **(b)** KNO_3 is strong electrolyte which dissociates into two ions. Therefore, its vant Hoff factor is 2. Acetic acid (CH_3COOH) is a weak electrolyte, it does not dissociate.

So, its vant Hoff factor is less than that of KNO_3

$\therefore$ Osmotic pressure of 0.1 M KNO_3 > Osmotic pressure of 0.1 M CH_3COOH

or $P_1 > P_2$

18. **(d)** $K_3[Fe(CN)_6]$ dissociates as $3K^+ + [Fe(CN)_6]^{3-}$, thus 1 molecule dissociates into four particles, in the similar way $Al(NO_3)_3$ also gives four particles per molecule.

19. **(a)** In case of association $i < 1$ while in dissociation $i > 1$

20. **(a)**

21. **(a)** Water prevents dimerization of acetic acid.

22. **(a)** The extent of depression in freezing point varies with the number of solute particles for a fixed solvent only and it is a characteristic feature of the nature of solvent also. So for two different solvents the extent of depression may vary even if number of solute particles is dissolved. Thus, statements (1), (2) and (3) are correct.

23. **(a)** Pair in the statement (4) is not the pair of isotonic solutions thus statements (1), (2) and (3) are correct.

24. **(a)** Statement (4) is the only incorrect statement.

25. **(c)** Cryoscopic constant $K_f = \Delta T_f$ of solution having unit molality of normal solutes.

Molality of glucose solution, $m = \frac{9 \times 1000}{(59 - 9) \times 180} = 1$

26. **(d)** Since the solution has greater entropy (disorder) than the pure liquid, so former has lesser tendency to freeze i.e., the temperature has to be lowered to freeze the solution.

27. **(b)** $2Na^+(aq) + 2I^-(aq) + HgI_2(s) \rightarrow 2Na^+(aq) + HgI_4^{2-}(aq)$

The number of mole particle decreases from 4 ($2Na^+ + 2I^-$) to 3 ($2Na^+ + HgI_4^{2-}$).

Hence, the colligative property will decrease or the vapour pressure will increase to a constant value until NaI is completely consumed.

28. **(a)** If a pressure larger than the osmotic pressure is applied to the solution side, the pure solvent flows out of the solution through semi-permeable membrane and this phenomenon is called as reverse osmosis.

29. **(a)** Colligative properties are the properties of solutions containing non volatile solute. It is correct that molecular mass of benzoic acid when determined by colligative properties is found abnormally high. This is because dimerisation of benzoic takes place in solution resulting high molecular mass. Therefore, Statement 1 and Statement 2 are true and statement 2 is correct explanation.

30. **(a)** It is true that isotonic solutions don't show the phenomenon of osmosis. Isotonic solutions are those solution which have same osmotic pressure. Here both statement 1 and statement 2 are true and statement 2 is correct explanation.