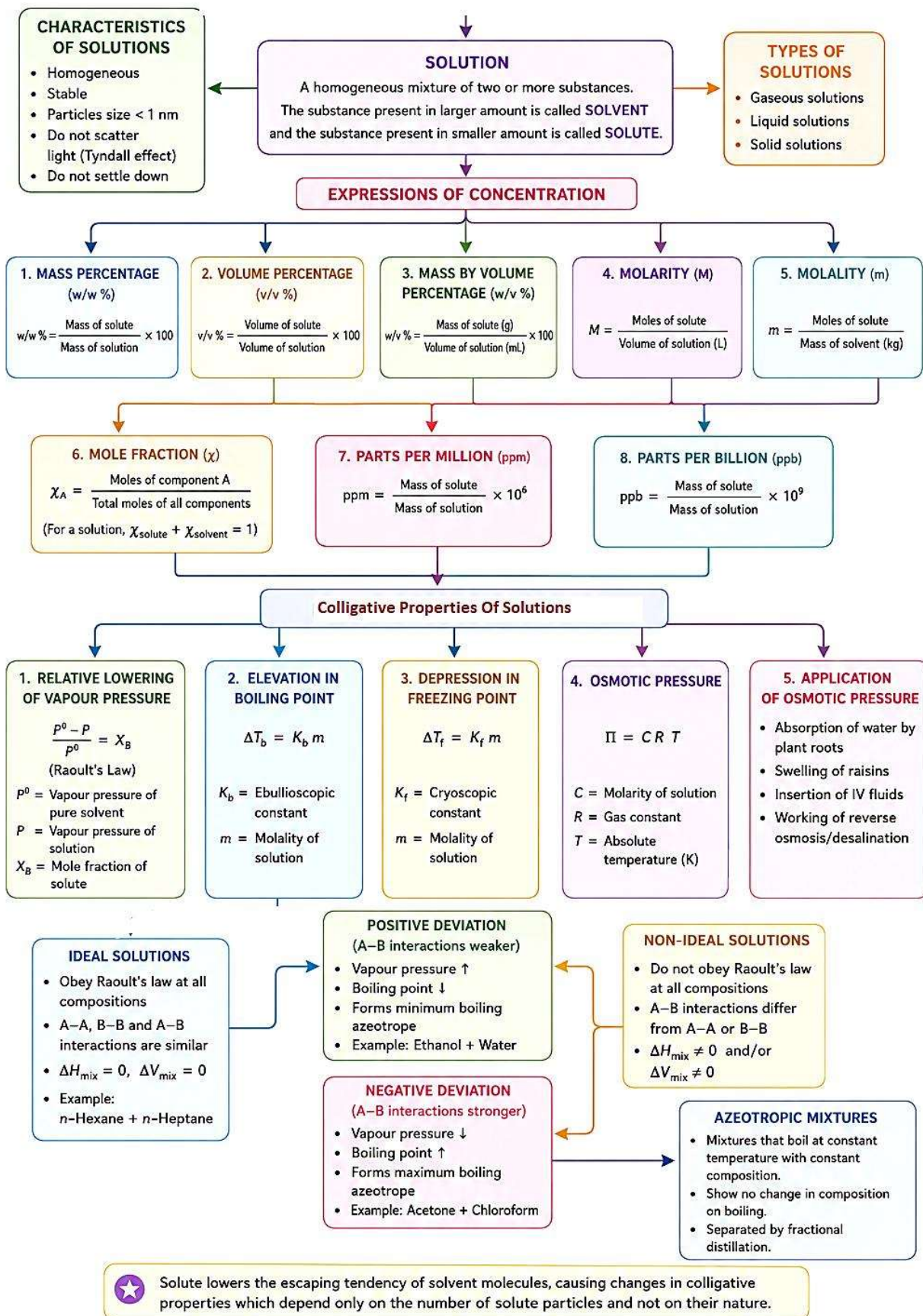


Unit-1: Solutions



SECTION -A (1 Mark)

Q1. K_H value for Ar(g) , $\text{CO}_2\text{(g)}$, HCHO (g) and $\text{CH}_4\text{(g)}$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility.

- a) $\text{HCHO} < \text{CH}_4 < \text{CO}_2 < \text{Ar}$ b) $\text{HCHO} < \text{CO}_2 < \text{CH}_4 < \text{Ar}$
c) $\text{Ar} < \text{CO}_2 < \text{CH}_4 < \text{HCHO}$ d) $\text{Ar} < \text{CH}_4 < \text{CO}_2 < \text{HCHO}$

Q2. If a molecule AB undergoes dimerization in Benzene, its van't Hoff factor is found to be 0.60. The degree of association of AB is

- (a) 20% (b) 60% (c) 80% (d) 50%

Q3. Water- HCl mixture will

- I. shows positive deviations
II. forms minimum boiling azeotrope
III. Shows negative deviations
IV. forms maximum boiling azeotrope
- a) I and II b) II and III c) I and IV d) III and IV

Q4. An unripe mango placed in a concentrated salt solution to prepare pickles shrinks because

- (a) It gains water due to osmosis
(b) It loses water due to reverse osmosis
(c) It gains water due to reverse osmosis
(d) It loses water due to osmosis

Q5. Which of the following salt will have same value of Van't Hoff's factor (i) as that of $K_4[Fe(CN)_6]$

- (a) $\text{Al}_2(\text{SO}_4)_3$ (b) NaCl (c) $\text{Al}(\text{NO}_3)_3$ (d) Na_2SO_4

Q6. An azeotropic solution of two liquids has boiling point lower than either of them when solute solvent interactions are:

- a) Equal to solute solute and solvent solvent interactions
- b) Stronger than solute solute and solvent solvent interactions
- c) Weaker than solute-solute and solvent-solvent interactions
- d) None of the above

Q7. The value of van't Hoff factor for ethanoic acid in benzene is

- (a) 1.0 (b) 1.5 (c) 0.5 (d) 2

Q8. The system that forms maximum boiling azeotropes is:

- (a) ethyl alcohol-water
(b) benzene-toluene
(c) acetone-chloroform
(d) carbon disulphide-acetone

Q9. Which has the lowest boiling point at 1 atm pressure?

- (a) 0.1 M KCl (b) 0.1 M Urea (c) 0.1 M CaCl_2 (d) 0.1 M AlCl_3

Q10.The molal elevation constant depends upon

- (a) Nature of solute. (b) Nature of the solvent.
(c) Vapour pressure of the solution. (d) Enthalpy change.

Assertion and Reason Questions

- (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.
(b) Assertion and reason both are correct statements but the reason is not a correct explanation for assertion.
(c) Assertion is a correct statement but the reason is the wrong statement.
(d) Assertion is a wrong statement but the reason is a correct statement

Q11.Assertion (A): Cooking time is reduced in pressure cooker.

Reason (R): Boiling point of water inside the pressure cooker is elevated

Q12.Assertion(A):Azeotropic mixtures cannot be separated by fractional distillation.

Reason(R): Azeotropes boil at a constant temperature and have the same composition in liquid and vapour phase

Q13.Assertion(A): the aquatic species more comfortable in cold water in comparison to warm water

Reason(R): the solubility of oxygen in water decreases with decrease in temperature.

Q14. **Assertion(A)** : mercuric iodide is added to an aqueous solution of KI, the freezing point is raised

Reason(R): the formation of complex $K_2[HgI_4]$, number of particles in the solution decreases

Q15. **Assertion (A)**: In an ideal solution, $\Delta_{mix}H$ is zero.

Reason (R): In an ideal solution, A–B interactions are lower than A–A and B–B interactions.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	C	D	D	A	C	C	C	B	B	A	A	C	A	C

SECTION - B (2 Marks)

Q1. What type of deviation is shown by ethanol and acetone mixture? Give reason. What type of azeotropic mixture is formed by that deviation?

Hint : Positive deviation, minimum boiling azeotrope.

Q2. a) How the osmotic pressure of 5 % aqueous solution of glucose (π_1) is related to that of 5 % aqueous solution of urea (π_2)?

b) Why do salt water fish die when they are suddenly transferred to a fresh water aquarium?

Hint : a) $\pi_1 < \pi_2$

b) Water from aquarium enters in cell causing them to expand and get ruptured

Q3. Explain why on addition of 1 mol of NaCl to 1L of water, the boiling point of water increases, while the addition of 1 mol of methyl alcohol to one litre of water decreases its boiling point

Hint : NaCl is nonvolatile while methyl alcohol is more volatile than water.

Q4. (i) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?

(ii) What happens when we place the blood cell in water (hypotonic solution)? Give reason.

Hint: i) The solution will show negative deviation from Raoult's law. Temperature will rise.

(ii) Due to endosmosis water enters into the cell.

Q5. a) Ram's father is suffering from high blood pressure, he is advised to consume less quantity of common salt. Why?

b) Two solutions A and B are separated by semi-permeable membrane. If the liquid flows from A to B then which solution is more concentrated?

Hint : a) More salt use will increase ions in the body fluid which increases blood pressure

b) B

SECTION- C (3 Marks)

Q1. Calculate the boiling point of solution when 2 g of Na_2SO_4 ($M = 142 \text{ g mol}^{-1}$) was dissolved in 50 g of water, assuming Na_2SO_4 undergoes complete ionisation. (K_b for water = $0.52 \text{ K kg mol}^{-1}$)

Hint: $i = 3$, $T_s = T^\circ + \Delta T_b$, &

$$\Delta T_b = \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A}$$

Q2. a) Compare and contrast the properties of ideal and non-ideal solutions.

b) 30 g of urea is dissolved in 846 g of water, calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298K is 23.8 mm Hg.

Hint ; b) Apply formula

$(P_0 - P_s)/P_0 = X_B$ (Relative lowering in vapour pressure)

$P_s = 23.55 \text{ mmHg}$

Q3. A 0.01m aqueous solution of $AlCl_3$ freezes at -0.068°C . calculate the percentage of dissociation. (given K_f for water = 1.86 K kg/mol).

Hint: $\Delta T_f = i K_f m$, $\alpha = (i-1)/(n-1)$ ($n=4$), $i=3.65$, $\alpha=0.8833$

Q4. a) Why do Scuba divers use Oxygen cylinders diluted with He. Explain

- b) Which cold drink you prefer one chilled or other one at room temperature and why?
 c) At the same temperature hydrogen is more soluble in water than Helium. Which of them will have higher value of K_H and why?

Hint: refer summary page-2

Q5.a) Why the colligative property of an electrolyte solution is always greater than that of non-electrolyte solution?

b) Which type of deviation is shown by Carbon tetra chloride and chloroform mixture?

c) What is the unit of eulioscopic constant?

Hint: a) No of ions increases in case of electrolyte.

b) Positive deviation. c) $K \text{ Kg/mol}$

SECTION D: Case based Study Question(4 Marks)

Q1. Read the passage carefully and answer the questions that follow:

Certain membranes allow solvent molecules to pass through them but not solute molecules, particularly not those of large molecular mass. Such a membrane is called semipermeable and might be an animal bladder, a vegetable tissue, or a piece of cellophane. Osmosis is the phenomenon of solvent flow through a semipermeable membrane to equalize the solute concentrations on both sides of the membrane. When two solutions of the same solvent are separated by a semipermeable membrane, solvent molecules migrate through the membrane in both directions. However, the solvent migration is faster from the solution of low concentration to the solution of high concentration. The osmotic pressure is a colligative property of a solution equal to the pressure that, when applied to the solution, just stops osmosis. The osmotic pressure, π , of a solution is related to the molar concentration of solute, C :

$$\pi = CRT$$

Here R is the gas constant and T is the absolute temperature.

(Source : General Chemistry by Ebbing)

Answer the following questions-

- Name one artificial and one natural SPM which can be used in the process of reverse osmosis.
- Which one of the following will have higher osmotic pressure in 1 M KCl or 1 M urea solution?
- Calculate the osmotic pressure at 20°C of an aqueous solution containing 5.0 g of sucrose, $C_{12}H_{22}O_{11}$, in 100.0 mL of solution. ($R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

Hints-

b) 1M KCl , electrolyte > dissociation , c) $\pi = CRT = \frac{nRT}{V(mL)} \times 1000$

Q2. Read the passage carefully and answer the questions that follow:

Arushi was performing an experiment in her school laboratory to determine the boiling point elevation of a sugar solution. She prepared two solutions by dissolving 34.2 g of sucrose ($C_{12}H_{22}O_{11}$) in 500 g of water and 58.5 g of NaCl in another 500 g of water. She observed that the NaCl solution had a higher boiling point than the sucrose solution. Her teacher explained that this difference was due to the **van't Hoff factor** and the number of particles into which a solute dissociates in solution.

Sucrose is a non-electrolyte and does not dissociate in water, while NaCl is an electrolyte and dissociates into Na^+ and Cl^- ions.

The elevation in boiling point is a colligative property and is given by: $\Delta T_b = i K_b m$

- a) Sucrose is a non-electrolyte that dissolves in water without dissociating into ions. Based on this understanding, determine the van't Hoff factor (i) for sucrose and explain your reasoning. (1M)

- b) Why does the NaCl solution exhibit a higher boiling elevation compared to the sucrose solution, even though both are dissolved in the same amount of water? (1M)
- c) Calculate the molality of sucrose solution. (2M)
- Hint : a) $i=1$ b) NaCl is an electrolyte c) molality = 0.2

SECTION - E (5 Marks)

Q1. a) Describe the effect of temperature and pressure on solubility of solids and gases in liquids.

b) When 2.56 g of sulphur was dissolved in 100 g of CS₂, the freezing point lowered by 0.383

K. Calculate the formula of sulphur (S_x).

[K_f for CS₂ = 3.83 K kg mol⁻¹, Atomic mass of Sulphur = 32 g mol⁻¹]

Hint : b) calculate molar mass of associated molecule (S_x),

$$M_B = \frac{K_f \times W_B \times 1000}{\Delta T_f \times W_A} \quad x = \frac{\text{molar mass of } S_x}{\text{molar mass of } S}$$

Q2. a) Blood cells are isotonic with 0.9 % sodium chloride solution. What happens if we place blood cells in a solution containing

- (i) 1.2% sodium chloride solution? (ii) 0.4% sodium chloride solution?

b) 2 g of benzoic acid (C₆H₅COOH) dissolved in 25 g of benzene shows a depression in freezing point equal to 1.62 K. Molal depression constant for benzene is 4.9 K kg mol⁻¹. What is the percentage association of acid if it forms dimer in solution?

Hints- a) (i) cell shrink, exosmosis (ii) cells swell, endosmosis

b) $\Delta T_f = i K_f m$, calculate i

$$\alpha (\text{asso.}) = \frac{i - 1}{\frac{1}{n} - 1} ; \quad \alpha = 0.992 \text{ or } 99.2 \%$$

UNIT-2. ELECTROCHEMISTRY (9 MARKS)