Blue Print (As per PU Board)

Topic	1 mark questions	2 marks questions	3 marks questions	5 marks questions	Total Marks
Solutions	2	–	–	1	7

One mark questions

1. **What is a Binary solution?**
   Answer: A solution containing 2 components is called a binary solution.
2. **At a given temperature and pressure, nitrogen gas is more soluble in water than helium gas. Which one of them has higher value of K_H ?**
   Answer: Helium or *He*
3. **On mixing equal volumes of acetone, and ethane. What type of deviation from Raoult's law is expected?**
   Answer: Positive deviation

Two marks questions

4. **Define isotonic solution. What happens when the blood cell is dipped in a solution containing more than normal saline concentration?**
   Answer: Two solutions having same osmotic pressure at a given temperature are called as isotonic solutions. (1 mark)
   The blood cell shrinks. (1 mark)
5. **What happens to the solubility of a gas in a liquid with increase in temperature? Give reason.**
   Answer: Solubility of a gas Decreases (1 mark)
   Due to its exothermic nature (1 mark)
6. **A sample of drinking water was found to be severely contaminated with chloroform $(CHCl_3)$ supposed to be a carcinogen. The level of contamination was 15 ppm (by mass)**
   (i) Express this in percent by mass
   (ii) Determine the molality of chloroform in the water sample

   Answer: (i) 15 ppm means 15 parts in million $\left(10^6\right)$ parts by mass in the solution.

   $\therefore \%$ by mass $= \frac{15}{10^6} \times 100 = 1.5 \times 10^{-4}$ (1 mark)

   (ii) Taking 15 g chloroform in 10^6 g of the solution,

   Mass of the solvent $= 10^6$ g

   $\text{Molality} = \frac{1\text{g mole of } CHCl_3}{10^6} \times 1000$

   Molar mass of $CHCl_3 = 12 + 1 + (3 \times 35.5) = 119.5$

   $= \frac{119.5}{10^6} \times 1000 = 1.25 \times 10^{-4}$ m (1 mark)

Three marks questions

7. **A solution containing 18g of non-volatile non-electrolyte solute is dissolved in 200 g of water freezes at 272.07K. Calculate the molecular mass of solute. Given : K_f =1.86 K kg/mol. Freezing point of water** $= 273$K

Answer: $\Delta T_f = K_f \times \text{m}$ *or* $\dfrac{K_f \times W_2 \times 1000}{M_2 \times W_1}$ (1 mark)

$\therefore M_2 = \dfrac{K_f \times W_2 \times 1000}{\Delta T_f \times W_1} = \dfrac{1.86 \times 18 \times 1000}{(273 - 272.07) \times 200}$ (1 mark)

$M_2 = 180\,\text{g/mol}$ (1 mark)

8. **On dissolving 2.34 g of solute in 40 g of benzene, the boiling point of solution was higher than that of benzene by 0.81 K. K_b value of benzene is 2.53 K** kg/mol **. Calculate the molar mass of the solute.**

Answer: $M_2 = \dfrac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$ (1 mark)

$= \dfrac{2.53 \times 2.34 \times 1000}{0.81 \times 40}$ (1 mark)

$= 182.72\ \text{g mol}^{-1}$ (1 mark)

(Answer without unit, deduct one mark)

9. **The vapour pressure of pure benzene at certain temperature is 0.850 bar. A non-volatile, non-electrolyte solid weighing 0.5 g when added to 39 g of benzene (molar mass 78 g), vapour pressure of the solution, then is 0.845 bar. What is the molar mass of the solid substance?**

Answer: $\dfrac{P_A^\circ - P_A}{P_A^\circ} = \dfrac{W_B M_A}{W_A M_B}$ (1 mark)

$\dfrac{0.85 - 0.845}{0.85} = \dfrac{0.5 \times 78}{39 \times M_B}$ (1 mark)

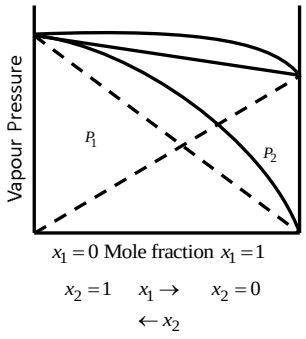
$M_B = \dfrac{0.5 \times 78 \times 0.85}{39 \times 0.005}$ (1 mark)

$= 170\,\text{g mol}^{-1}$ (1 mark)

Five marks questions

10. **(a) For a non-ideal solution having positive deviation from Raoult's law.**
(i) Plot a graph of vapour pressure against mole fraction
(ii) What type of azeotrope is formed by this solution?
(iii) Give one example for the above solution **(3 marks)**

Answer: (a) (i)



(1 mark)

(ii) Minimum boiling azeotrope is formed (1 mark)

(iii) Ethanol + Acetone (1 mark)

(b) The vapour pressure of ethyl alcohol at 298 K is 40 mm of Hg. Its mole fraction in a solution with methyl alcohol is 0.80. What is its vapour pressure in solution if the mixture obeys Raoult's law? (2 marks)

Answer: According to Raoult's law

$P = P^\circ \times x$ (1 mark)

$= 40 \times 0.80 \quad = 32$ mm of Hg (1 mark)

11. **(a) At 298 K, the vapour pressure of water is 23.75 mm of Hg. Calculate the vapour pressure at the same temperature over 5% aqueous solution of urea. Given molar mass of urea** = 60

(3 marks)

Answer: 5% aqueous solution of urea means 5g of urea in 95 g of water.

$\therefore \frac{(P^\circ - P)}{P^\circ} = \frac{W_2 \times M_1}{W_1 \times M_2}$ (1 mark)

$\frac{23.75 - P}{23.75} = \frac{5 \times 18}{95 \times 60}$ (1 mark)

$\therefore P = 23.75 - 0.375 = 23.37 \text{ mm of } Hg$ (1 mark)

(b) Mention any two applications of Henry's law (2 marks)

Answer: (1) To increase the solubility of CO_2 in soft drinks, soda water, the bottles are sealed under high pressure. (1 mark)

(2) To avoid the disease 'bends' and also the toxic effects of high concentration of Nitrogen in the blood, sea divers carry oxygen diluted with helium in the cylinder.

(Or any other application) (1 mark)

12. **(a) Find the boiling point of a solution containing 0.52 g of glucose dissolved in 80.2 g of water (Molar mass of glucose = 180 g/mol and K_b for water = 0.52 K kg/mol)** (3 marks)

Answer: $\Delta T_b = \frac{K_b \times W_2 \times 1000}{M_2 \times W_1}$ W_1 = Mass of solvent

$= \frac{0.52 \times 0.52 \times 1000}{180 \times 80.2}$ W_2 = Mass of solute (1 mark)

$= 0.0187 \text{ K}$ M_1 = Molar mass of solvent (1 mark)

$\Delta T_b = T_b - T_b^\circ$ M_2 = Molar mass of solute.

$\therefore T_b = T_b^\circ + \Delta T_b = 373 + 0.0187$ [B.P of water = 373 K]

= 373.0187 K (1 mark)

(b) K_H value for $Ar(g), CO_{2(g)}, HCHO_{(g)}$ and $CH_{4(g)}$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility. (2 marks)

Answer: $Ar < CO_2 < CH_4 < HCHO$ (2 marks)