

DPP – 10**CLASS – 12th****TOPIC – NCERT Ques.**

- Q.1** Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.
- Q.2** Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.
- Q.3** H_2S , a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of H_2S in water at STP is 0.195 m, calculate Henry's law constant.
- Q.4** Henry's law constant for CO_2 in water is 1.67×10^8 Pa at 298 K. Calculate the quantity of CO_2 in 500 mL of soda water when packed under 2.5 atm CO_2 pressure at 298 K.
- Q.5** The vapour pressures of pure liquids A and B are 450 mm and 700 mm of Hg respectively at 350 K. Calculate the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also find the composition in the vapour phase.
- Q.6** Why do gases always tend to be less soluble in liquids as the temperature is raised?

SOLUTION

(CHEMISTRY)

SOLUTIONS AND COLLIGATIVE

DPP – 10

CLASS – 12th

TOPIC – NCERT Ques.

Sol.1 Mass of solution = Mass of C₆H₆ + Mass of CCl₄

$$= 22\text{g} + 122\text{g} = 144\text{g}$$

$$\text{Mass \% of benzene} = 22/144 \times 100 = 15.28\%$$

$$\text{Mass \% of CCl}_4 = 122/144 \times 100 = 84.72\%$$

Sol.2 30% by mass of C₆H₆ in CCl₄ => 30 g C₆H₆ in 100 g solution

$$\therefore \text{no. of moles of C}_6\text{H}_6. (n_{\text{C}_6\text{H}_6}) = 30/78 = 0.385$$

(molar mass of C₆H₆ = 78g)

no. of moles of

$$\text{CCl}_4 \quad n_{\text{CCl}_4} = \frac{70}{154} = 0.455$$

$$x_{\text{C}_6\text{H}_6} = \frac{n_{\text{C}_6\text{H}_6}}{n_{\text{C}_6\text{H}_6} + n_{\text{CCl}_4}}$$

$$\frac{0.385}{0.385 + 0.455} = \frac{0.385}{0.84} = 0.458$$

$$x_{\text{CCl}_4} = 1 - 0.458 = 0.542$$

Sol.3 Solubility of H₂S gas = 0.195 m

$$= 0.195 \text{ mole in 1 kg of solvent} \quad 1 \text{ kg of solvent} = 1000\text{g}$$

$$= \frac{1000}{18} = 55.55 \text{ moles}$$

$$x_{\text{H}_2\text{S}} = \frac{0.195}{0.195 + 55.55}$$

$$= \frac{0.195}{55.745} = 0.0035$$

-Pressure at STP = 0.987 bar

Applying Henry's law,

$$P_{\text{H}_2\text{S}} = K_{\text{H}} \times x_{\text{H}_2\text{S}} \quad K_{\text{H}} = \frac{P_{\text{H}_2\text{S}}}{x_{\text{H}_2\text{S}}} = \frac{0.987}{0.0035} = 282 \text{ bar}$$

Sol.4

$$K_{\text{H}} = 1.67 \times 10^8 \text{ pa}$$

$$P_{\text{CO}_2} = 2.5 \times 101325 \text{ pa}$$

$$\therefore x_{\text{CO}_2} = \frac{P_{\text{CO}_2}}{K_{\text{H}}} = \frac{2.5 \times 101325}{1.67 \times 10^8} = 1.517 \times 10^{-3}$$

For 500ml of soda water, water present \approx 500ml

$$= 550 \text{ g} = 500/18 = 27.78 \text{ moles}$$

$$n_{\text{H}_2\text{O}} = 27.78 \text{ moles}$$

$$\frac{n_{\text{CO}_2}}{27.78} = 1.517 \times 10^{-3}$$

$$n_{\text{CO}_2} = 42.14 \times 10^{-3} \text{ mole}$$

$$= 42.14 \text{ m mol}$$

$$= 42.14 \times 10^{-3} \times 44 \text{ g}$$

$$= 1.854 \text{ g}$$

Sol.5 Vapour pressure of pure liquid A (P_A) = 450 mm

Vapour pressure of pure liquid B (P_B) = 700 mm

Total vapour pressure of the solution (P) = 600 mm

According to Raoult's Law, $P = P_A^\circ x_A + P_B^\circ x_A = P_A^\circ x_A + P_B^\circ (1 - x_A)$

$$(600 \text{ mm}) = 450 \text{ mm} \times x_A + 700 \text{ mm} (1 - x_A)$$

$$= 700 - x_A (450 - 700) \text{ mm}$$

$$= 700 - x_A (250 \text{ mm})$$

$$x_A = \frac{(600 - 700) \text{ mm}}{-(250 \text{ mm})} = 0.40$$

Mole fraction of A(X_A)-0.40

Mole fraction of B (X_B)=1- 0.40=0.60

$P = P_A^\circ X_A = (450 \text{ mm}) \times 0.40 = 180 \text{ mm}$

$P_B = P_B^\circ X_B = (700 \text{ mm}) \times 0.60 = 420 \text{ mm}$

Mole fraction of A in the vapour phase = $\frac{P_A}{P_A + P_B} = \frac{(180 \text{ mm})}{(180 + 420) \text{ mm}} = 0.30$

Mole fraction of B in the vapour phase = $\frac{P_B}{P_A + P_B} = \frac{(420 \text{ mm})}{(180 + 420) \text{ mm}} = 0.70$

Sol.6 When gases are dissolved in water, it is accompanied by a release of heat energy, i.e., process is exothermic. When the temperature is increased, according to Lechatlier's Principle, the equilibrium shifts in backward direction, and thus gases becomes less soluble in liquids.