DPP – 04
CLASS – 12th
TOPIC – NCERT QUESTION

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_2 S, 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 – 04
CLASS – 12th
TOPIC – NCERT QUESTION

Sol.1 Mass of solution = Mass of C_6H_6 + Mass of CCI_4

= 22 g + 122 g = 144 g

Mass % of benzene = 22/144 × 100 =15.28%

Mass % of CCl_4 = 122/144 × 100 = 84.72 %

Sol.2 30% by mass of C_6H_6 in CCl_4 => 30g C_6H_6 in 100g solution

$\therefore$ no. of moles of C_6H_6, $({}^{n}C_6h_6)$ = 30/78 = 0.385

(molar mass of C_6H_6 = 78g)

no. of moles of

$$CCl_4({}^{n}CCl_4)=\frac{70}{154}=0.455$$

$$^{x}C_6H_6=\frac{{}^{n}C_6H_6}{{}^{n}C_6H_6+{}^{n}CCl_4}$$

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

$$^{x}CCl_4=1-0.458=0.542$$

Sol.3 Solubility of H_2S gas = 0.195 m

= 0.195 mole in 1 kg of solvent

1 kg of solvent = 1000g

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

$$\therefore x_{H_2S}=\frac{0.195}{0.195+55.55}$$

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

– Pressure at STP = 0.987 bar

Applying Henry's law,

$$P_{H_2S} = K_H \times x_{H_2S}$$

$$\Rightarrow K_H = \frac{P_{H_2S}}{x_{H_2S}} = \frac{0.987}{0.0035} = 282 \text{bar}$$

Sol.4 $K_H = 1.67 \times 10^8$ Pa

$$P_{co_2} = 2.5 \text{atm} = 2.5 \times 101325 \text{Pa}$$

$$\therefore x_{CO_2} = \frac{P_{CO_2}}{K_H} = \frac{2.5 \times 101325}{1.67 \times 10^8} = 1.517 \times 10^{-3}$$

For 500 mL of soda water, water present $\simeq 500 \text{mL}$

$$= 500 \text{g} = \frac{500}{18} = 27.78 \text{ moles}$$

$$\therefore n_{H_2O} = 27.78 \text{moles}$$

$$\therefore \frac{{}^{n}Co_2}{27.78} = 1.517 \times 10^{-3}$$

, $n_{CO_2} = 42.14 \times 10^{-3}$ mole

= 42.14m mol

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

= 1.854g

Sol.5 Vapour pressure of pure liquid $A(P_A^{\circ}) = 450 \text{mm}$

Vapour pressure of pure liquid $B(P_B^{\circ}) = 700 \text{mm}$

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

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

(600 mm) = 450 mm × x_A + 700 mm (1 – x_A)

= 700 mm + X_A (450 – 700) mm

= 700 – X_A (250 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

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

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

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.