Chemistry Class 12 NCERT Solutions: Chapter 2 Solutions Part 4

Q: 9. Vapour pressure of pure water at $298K$ is 23.8 mm Hg. 50 g of urea (NH_2CONH_2) is dissolved in $850g$ of water. Calculate the vapour pressure of water for this solution and its relative lowering.

Answer:

It is given that vapour pressure of water, $P_1^0 = 23.8\text{mm of Hg}$

Weight of water taken, $w_1 = 850g$

Weight of urea taken, $w_2 = 50g$

Molecular weight of water, $M_1 = 18gmol^{-1}$

Molecular weight of urea, $M2 = 60gmol^{-1}$

Now, we have to calculate vapour pressure of water in the solution. We take vapour pressure as p_1 .

Now, from Raoult's law, we have:

$$\frac{p_1^0 - p_1}{P_1^0} = \frac{n_2}{n_1 + n_2}$$

$$\Rightarrow \frac{p_1^0 - p_1}{p_1^0} = \frac{\frac{w_2}{M_2}}{\frac{w_1}{M_1} + \frac{w_2}{M_2}}$$

$$\Rightarrow \frac{23.8 - p_1}{23.8} = \frac{\frac{50}{60}}{\frac{850}{18} + \frac{50}{60}}$$

$$\Rightarrow \frac{23.8 - p_1}{23.8} = \frac{0.83}{47.22 + 0.83}$$

$$\Rightarrow \frac{23.8 - p_1}{23.8} = 0.0173$$

$$\Rightarrow p_1 = 23.4\text{mm of Hg}$$

Hence, the vapour pressure of water in the given solution is 23.4 mm of Hg and its relative lowering is 0.0173 .

Q: 10. Boiling point of water at 750 mm Hg is $99.63°C$. How much sucrose is to be added to 500 g of water such that it boils at $100°$ C. Molal elevation constant for water is $0.52K\ kgmol^{-1}$.

Answer:

Here, elevation of boiling point $\Delta T_b = (100 + 273) - (99.63 + 273)$

$= 0.37K$

Mass of water, $w_l = 500g$

Molar mass of sucrose $(C_{12}H_{22}O_{11})$, $M_2 = 11 \times 12 + 22 \times 1 + 11 \times 16$

$= 342gmol^{-1}$

Molal elevation constant, $K_b = 0.52K\ kgmol^{-1}$

We know that:

$$\Delta T_b = \frac{K_b \times 1000 \times w_2}{M_2 \times w_1}$$

$$\Rightarrow w_2 = \frac{\Delta T_b \times M_2 \times w_1}{K_b \times 1000}$$

$$= \frac{0.37 \times 342 \times 500}{0.52 \times 1000}$$

$= 121.67g$ (Approximately)

Hence, 121.67 g of sucrose is to be added.

Note: There is a slight variation in this answer and the one given in the NCERT textbook.

Q: 11. Calculate the mass of ascorbic acid (Vitamin $C, C_6H_8O_6$) to be dissolved in $75g$ of acetic acid to lower its melting point by $1.5°C.\ Kf = 3.9K\ kg\ mol - 1.$

Answer:

Mass of acetic acid, $w_1 = 75g$

Molar mass of ascorbic acid $(C_6H_8O_6)$, $M_2 = 6 \times 12 + 8 \times 1 + 6 \times 16$

$= 176gmol^{-}1$

Lowering of melting point, $\Delta T_f = 1.5K$

We know that:

$$\Delta T_f = \frac{K_f \times w_2 \times 1000}{M_2 \times w_1}$$

$$= \frac{1.5 \times 176 \times 75}{3.9 \times 1000}$$

$= 5.08g$ (Approx)

$\text{Hence}, 5.08g$ of ascorbic acid is needed to be dissolved.

None: There is a slight variation in this answer and the one given in the NCERT textbook.

Q: 12. Calculate the osmotic pressure in Pascal's exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass $185,000$ in $450\,mL$ of water at $37°C$.

Answer:

It is given

Volume of water, $V = 450\,ml = 0.45L$

Temperature, $T = (37 + 273)\,K = 310K$

Number of moles of the polymer, $n = \frac{1}{185000} mol$

We know that:

Osmotic pressure, $\pi = \frac{n}{V}RT$

$= \frac{1}{185000} mol \times \frac{1}{0.45L} \times 8.314 \times 10^3\, Pa\, LK^{-1} mol^{-1} \times 310K$

$= 30.98\, Pa$

$= 31\, Pa$ (Approximately)