Parishram (2025)

Chemistry

Solutions

DPP: 7

Q1 What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.5°C? The freezing point depression constant (K_f) for water is 1.86°C/m. Assume van't Hoff factor for NaCl is 1.87. (Molar mass of NaCl = 58.5 g)

Q2 What mass of ethylene glycol (molar mass = 62.0 g mol^{-1}) must be added to 5.50 kg of water to lower the freezing point of water from 0°C to –10.0°C? (K, for water = 1.86 K kg mol^{-1})?

Q3 Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2L of water at 25°C, assuming that it is completely dissociated. (R = 0.0821 L atm K^{-1} mol^{-1}, Molar mass of K_2SO_4 = 174 g mol^{-1})

Q4 Osmotic Pressure of 0.4% urea solution is 1.64 atm and that of 3.42% cane sugar is 2.46 atm, the OP of the solution is;

(A) 0.82 atm (B) 2.05 atm
(C) 1.64 atm (D) 4.10 atm

Q5 4L of 0.02 M aqueous solution of NaCl was diluted by adding one litre of water. The molarity of the resultant solution is

(A) 0.004 (B) 0.008
(C) 0.012 (D) 0.016

Q6 Which of the following units is useful in relating the concentration of a solution with its vapour pressure?

(A) mole fraction
(B) parts per million
(C) mass percentage
(D) molarity

Q7 Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?

(A) Methanol and acetone.
(B) Chloroform and acetone.
(C) Nitric acid and water.
(D) Phenol and aniline.

Answer Key

Q1	**(8.19 to 8.2)**
Q2	**(1833 to 1833.4) gm**
Q3	(5.2×10^{-3}) atm
Q4	(B)
Q5	(D)
Q6	(A)
Q7	(A)

Hints & Solutions

Q1 Text Solution:

Given: M_2 = 58.5 g mol^{-1} w_1 = 65 g

ΔT_f = 7.5°C K_f = 1.86 K kg mol^{-1} i = 1.87

Substituting these values in the formula

$\Delta T_f = i\,K_f\,m \qquad \Delta T_f = iK_f\frac{w_2 \times 1000}{M_2 \times w_1}$

$\therefore 7.5 = 1.87 \times 1.86 \times \frac{w_2 \times 1000}{58.5 \times 65}$

or $w_2 = \frac{7.5 \times 58.5 \times 65}{1.87 \times 1.86 \times 1000}$

or $w_2 = \frac{28518.75}{3478.2} = 8.199$

∴Mass of NaCl to be dissolved, w_2 = 8.199 g.

Q2 Text Solution:

According to the formula:

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

Where [M_2 = 62, w_1 = 5.50, K_f = 1.86]

Substituting the values in the formula, we get

$62 = \frac{1000 \times 1.86 \times w_2}{1000 \times 5.50 \times 10}$

or $w_2 = \frac{62 \times 5.50 \times 10 \times 1000}{1.86 \times 1000} = \frac{3410}{1.86}$

$= 1833\text{gm} = 1.833\ \text{kg}$

∴Mass of ethylene glycol, w_2 = 1.833 kg.

Q3 Text Solution:

(5.2×10^{-3}) atm

and $M_2 = 174\ \text{gmol}^{-1}$

$T = 25^{\circ}C = 298K$

Osmotic pressure, $= \frac{i \times w_2 RT}{M_2 V}$

$\pi = \frac{3 \times 2.5 \times 10^{-2} \times 0.0821 \times 298}{174 \times 2}$

$\pi = \frac{183.49 \times 10^{-2}}{348}$

$= 5.27 \times 10^{-3}$ atm.

Q4 Text Solution:

When two solutions are mixed.

$\pi_1 = 1.64$ atm

$\pi_2 = 2.46$ atm

$\pi = \frac{\pi_1 + \pi_2}{2}$

$= \frac{1.64 + 2.46}{2}$

$= 2.05$ atm.

Q5 Text Solution:

Molarity $= \frac{n}{V} = 0.02 = \frac{n}{4}$ or n = 0.08

$M = \frac{n}{\text{Mass of water in kg}} = \frac{0.08}{5} = 0.016.$

Q6 Text Solution:

Mole fraction is useful in relating vapour pressure with a concentration of the solution. According to Raoult's law, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction present in solution.

A is one component.

$p_A \propto x_A, x_A = \frac{n_A}{n_A + n_B}$

Q7 Text Solution:

A mixture of Methanol and acetone shows positive deviation because methanol-methanol and acetone-acetone interactions are stronger than methanol- acetone. The more hydrogen bonds are broken the less number of new H-bonds are formed.