Parishram (2025)

Chemistry

Solutions

DPP: 6

Q1 If the density of some lake water is 1.25g mL^{-1} and contains 92 g of Na^+ ions per kg of water, calculate the molarity of Na^+ ions in the lake.

Q2 In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M $MgCl_2$ solution is _____.

(A) the same

(B) about twice

(C) about three times

(D) about six times

Q3 15.0 g of an unknown molecular material was dissolved in 450 g of water. The resulting solution was found to freeze at −0.34 °C. What is the molar mass of this material? (K_f for water = 1.86 K kg mol^{-1})

Q4 Calculate the amount of KCl which must be added to 1 kg of water so that the freezing point is depressed by 2K. (K_f for water = 1.86 K kg mol^{-1})

Answer Key

Q1	(5)	Q3	(182 to 182.4)
Q2	(C)	Q4	(40 to 40.3)

Hints & Solutions

Q2 Text Solution:

about three times

Explanation: A colligative property is a decrease in freezing point. In the case of $MgCl_2$, the can't Hoff factor will be higher. When a molecule of $MgCl_2$ dissociates in its aqueous solution, it produces 3 ions. One molecule of 0.01M $MgCl_2$ produces three particles/ions in solution, resulting in a threefold increase in the number of particles present in the solution. As a result, the freezing point of 0.01M $MgCl_2$ will be three times lower than that of 0.01M glucose solution, because there will be no dissociation of the molecule

Q3 Text Solution:

$\text{As } \Delta T_f = K_f \times m$

$\mathrm{T}_f^{\circ} - \mathrm{T}_f = 1.86\ \mathrm{K\ kg\ mol^{-1}} \times \frac{15\ \mathrm{g}}{\mathrm{M}} \times \frac{1000}{450\ \mathrm{kg}}$

$[0-(-0.34)]\mathrm{K} = 1.86\ \mathrm{K\ kg\ mol^{-1}} \times \frac{15\ \mathrm{g}}{\mathrm{M}} \times \frac{1000}{450\ \mathrm{kg}}$

$\mathrm{M} = 1.86\ \mathrm{K\ kg\ mol^{-1}} \times \frac{15\ \mathrm{g}}{0.34\ \mathrm{K}} \times \frac{1000}{450\ \mathrm{kg}}$

$M = 1.86 \times \frac{15}{34} \times \frac{1000}{450} \times 100$

$\mathrm{M} = \frac{9300}{51} = 182.35\ \mathrm{g\ mol^{-1}}$

∴ Molar mass of material, M = 182.35 g mol^{-1}

Q4 Text Solution:

Since one mol of KCI gives 2 mole particles, the value of i = 2, ΔT_f, = 2K, K_f = 1.86 kg mol^{-1}

Applying equation, ΔT_f = iK_f . m

$m = \frac{\Delta T_f}{ik_f} = \frac{2}{2\times 1.86} = \frac{1}{1.86} = 0.54$

∴ 0.54 mole of KC1 should be added to 1 kg of water

Molar mass of KCI = 39+ 35.5 = 74.5 g

∴ Amount of KCI = 0.54 × 74.5 g = 40.23g