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Physical Chemistry

DPP: 8

Solutions

Q1 The values of Van't Hoff factors for KCl, NaCl and K_2SO_4, respectively, are;
(A) 2, 2 and 2 (B) 2, 2 and 3
(C) 1, 1 and 2 (D) 1, 1 and 1

Q2 Calculate the osmotic pressure of 0.25 M solution of urea at 37°C. R = 0.083 L bar K^{-1} mol^{-1}.

Q3 The vapour pressure of two liquids P and Q are 80 and 60 torr respectively. The total vapour pressure of solution obtained by mixing 3 moles of P and 2 moles of Q would be;
(A) 140 torr (B) 20 torr
(C) 68 torr (D) 72 torr

Q4 34.2 g of cane sugar is dissolved in 180g of water. The relative lowering of vapour pressure of two pure liquids will be;
(A) 0.0099 (B) 1.1597
(C) 1.1697 (D) 0.9901

Q5 The boiling point of a solution containing 68.4 g of sucrose (molar mass = 342 g mol^{-1}) in 100 g of water is;
[K_b for water = 0.512 K kg mol^{-1}]
(A) 101.02°C (B) 100.512°C
(C) 100.02°C (D) 98.98°C

Q6 The depression in freezing point of 1 m NaCl solution, assuming NaCl to be 100% dissociated in water, is;
(K_f = 1.86 K m^{-1})
(A) –1.86°C
(B) –3.72°C
(C) +1.86°C
(D) +3.72°C

Q7 For an ideal solution of two components A and B, which of the following is true?
(A) $\Delta H_{mixing} < 0\,(zero)$
(B) $\Delta H_{mixing} > 0\,(zero)$
(C) A – B interaction is stronger than A – A and B – B interactions
(D) A – A, B – B and A – B interactions are identical

Answer Key

Q1	(B)
Q2	(6.4 to 6.43)
Q3	(D)
Q4	(A)
Q5	(A)
Q6	(D)
Q7	(D)

Hints & Solutions

Q1 Text Solution:

KCl (k^+ + Cl) ionize to give 2 ions and NaCl (Na^+ + Cl) ionize to give 2 ions and K_2SO_4 ($2K^+$ + SO) ionizes to give 3 ions thus, van't Hoff factors for KCl, NaCl and K_2SO_4 are 2, 2 and 3 respectively.

Q2 Text Solution:

$\mathrm{T} = 37^{\circ}\mathrm{C} = 310\mathrm{K}$

$T_1 = CRT = \frac{n}{v}\mathrm{RT}$

$= 0.25 \times 0.083 \times 310 = 6.43 \text{ bar.}$

Q3 Text Solution:

Mole fraction of $\mathrm{P} = \frac{3}{3+2} = \frac{3}{5}$

Mole fraction of $\mathrm{Q} = \frac{2}{3+2} = \frac{2}{5}$

Hence total vapour pressure = (Mole fraction of P × Vapour pressure of P) + (Mole fraction of Q × Vapour pressure of Q

$= \left(\frac{3}{5} \times 80 + \frac{2}{5} \times 60\right) = 48 + 24$

72 torr

Hence, the correct option is (4).

Q4 Text Solution:

Molar masses of cane sugar and water are 342 g / mol and 18 g/ mol respectively.

Number of moles of can sugar

$= \frac{34.2g}{342g/\text{mol}} = 0.1 \text{ mol}$

Number of moles of water

$= \frac{180 \text{ g}}{18 \text{ g/mol}} = 10 \text{ mol}$

Mole fraction of cane sugar

$= \frac{0.1}{0.1+10} = 0.0099$

The relative lowering of vapour of pressure of solution is equal to the mole fraction of cane sugar.

The relative lowering of vapour of pressure will be 0.0099.

Q5 Text Solution:

Number of moles of sucrose is the ratio of mass to molar mass.

$n = \frac{68.4}{342} = 0.2 \text{ moles}$

Molality of solution is the ratio of the number of moles of sucrose to the volume of water (in kg) is;

$m = \frac{0.2}{0.1} = 2$

The elevation in the boiling point of the solution is;

$\Delta T_b = K_b m = 0.512 \times 2 = 1.024^o C$

The boiling point of the solution is;

$100 + 1.024 = 101.02^{\circ} C.$

Q6 Text Solution:

Since, NaCl is 100% dissociated,

$NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

$\therefore$ i = 2 for NaCl

We have,

$\Delta T_f = iK_f m$

$\Delta T_f = 2 \times 1.86 \times 1$

So, depression in freezing point of NaCl, $\Delta T_f = 3.72^{\circ} C.$