Q1 - 24 June - Shift 1

The osmotic pressure of blood is 7.47 bar at 300 K. To inject glucose to a patient intravenously, it has to be isotonic with blood. The concentration of glucose solution in gL^{-1} is _____(Molar mass of glucose = 180 g mol^{-1}

R = 0.083 L bar K^{-1} mol^{-1}) (Nearest integer)

Space for your notes:

Q2 - 24 June - Shift 2

A company dissolves 'X' amount of CO_2 at 298 K in 1 litre of water to prepare soda water

X =____ $\times 10^{-3}$g. (nearest integer)

(Given: partial pressure of CO_2 at 298 K= 0.835 bar.

Henry's law constant for CO_2 at 298 K = 1.67 kbar.

Atomic mass of H,C and O is 1, 12 and 6 g mol^{-1}, respectively)

Space for your notes:

Q3 - 25 June - Shift 1

1 L aqueous solution of H_2SO_4 contains 0.02 m mol H_2SO_4. 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A), 0.01 m mol of H_2SO_4 are added. Total m mols of H_2SO_4 in the final solution is ____________ $\times 10^3$ m mols.

Space for your notes:

Q4 - 25 June - Shift 2

Solute A associates in water. When 0.7 g of solute A is dissolved in 42.0 g of water, it depresses the freezing point by 0.2°C. The percentage association of solute A in water, is

[Given : Molar mass of A = 93 g mol^{-1}. Molal depression constant of water is 1.86 K kg mol^{-1}]

(A) 50 % (B) 60 %

(C) 70 % (D) 80 %

Space for your notes:

Q5 - 26 June - Shift 1

A 0.5 percent solution of potassium chloride was found to freeze at –0.24°C. The percentage dissociation of potassium chloride is ________. (Nearest integer)

(Molal depression constant for water is 1.80 K kg mol^{-1} and molar mass of KCl is 74.6 g mol^{-1})

Space for your notes:

Q6 - 26 June - Shift 2

The osmotic pressure exerted by a solution prepared by dissolving 2.0 g of protein of molar mass 60 kg mol^{-1} in 200 mL of water at 27°C is ________ Pa. [integer value]

(use R = 0.083 L bar mol^{-1} K^{-1})

Space for your notes:

Q7 - 27 June - Shift 1

Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**

Assertion (A) : At 10°C, the density of a 5M solution of KCl [atomic masses of K and Cl are 39 & 35.5 g mol^{-1}. The solution is cooled to -21°C. The molality of the solution will remain unchanged.

Reason (R) : The molality of a solution does not change with temperature as mass remains unaffected with temperature.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(B) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**

(C) **(A)** is true but **(R)** is false

(D) **(A)** is false but **(R)** is true

Space for your notes:

Q8 - 27 June - Shift 1

2g of a non-volatile non-electrolyte solute is dissolved in 200 g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1 : 8. The elevation in boiling points of A and B are in the ratio $\frac{x}{y}$ (x : y). The value of y is__________ (Nearest integer)

Space for your notes:

Q9 - 27 June - Shift 2

A solution containing 2.5×10^{-3} kg of a solute dissolved in 75×10^{-3} kg of water boils at 373.535 K. The molar mass of the solute is ______ g mol^{-1}. [nearest integer] (Given: K_b (H_2O) = 0.52 K Kg mol^{-1}, boiling point of water = 373.15K)

Space for your notes:

Q10 - 28 June - Shift 1

The vapour pressures of two volatile liquids A and B at 25°C are 50 Torr and 100 Torr, respectively. If the liquid mixture contains 0.3 mole fraction of A, then the mole fraction of liquid B in the vapour phase is $\frac{x}{17}$. The value of x is ________.

Space for your notes:

Q11 - 29 June - Shift 1

1.2 mL of acetic acid is dissolved in water to make 2.0 L of solution. The depression in freezing point observed for this strength of acid is 0.0198°C. The percentage of dissociation of the acid is ________ . (Nearest integer)

[Given : Density of acetic acid is 1.02 g mL^{-1}
Molar mass of acetic acid is 60 g mol^{-1}
K_f (H_2O) =1.85 K kg mol^{-1}]

Space for your notes:

Q12 - 29 June - Shift 2

Elevation in boiling point for 1.5 molal solution of glucose in water is 4K. The depression in freezing point for 4.5 molal solution of glucose in water is 4K. The ratio of molal elevation constant to molal depression constant (K_b/K_f) is____.

Space for your notes:

Answer Key

Q1 (54)	**Q2** (1221)	**Q3** (15)	**Q4** (D)
Q5 (99 or 98)	**Q6** (415)	**Q7** (A)	**Q8** (8)
Q9 (45)	**Q10** (14)	**Q11** (5)	**Q12** (3)

Q1 (54)

$$\pi = C.R.T$$

$$7.47 = C \times 0.083 \times 300$$

$$C = 0.3\ M$$

$$= 0.3 \times 180\ gL^{-1}$$

$$= 54\ gL^{-1}$$

Q2 (1221)

From Henry law

$$P = K_H X_{CO_2}$$

$$0.835 = 1.67 \times 10^3 \times 1.67 \times 10^3 \times \frac{w_{CO_2}/44}{\frac{w_{CO_2}}{44} + \frac{1000}{18}}$$

$$w_{CO_2} = 1.2228g = 1222.8 \times 10^{-3} g$$

Or

$$P = K_H X_{CO_2}$$

$$0.835 = 1.67 \times 10^3 \times \frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}}$$

$$0.835 = 1.67 \times 10^3 \times \frac{w_{CO_2}/44}{\frac{1000}{18}}$$

$$w_{CO_2} = 1.2222g = 1222.2 \times 10^{-3} g$$

Q3 (15)

$n_{H_2SO_4}$ in Sol^n A = 50% of original solution

$= 0.01$ m mol.

$n_{H_2SO_4}$ in Final solution $= 0.01 + 0.01$

$= 0.02$ mmol

$= 0.00002 \times 10^3$ mmol

The answer 0

Q4 (D)

$\Delta T = i\ k_f \times m$

$0.2 = i \times 1.86 \times \frac{0.7}{93} \times \frac{1000}{42}$

$i = \frac{0.2 \times 93 \times 6}{1.86 \times 100}$

$i = 0.60$

$2A \rightleftharpoons A_2$

$1 - \alpha \qquad \frac{\alpha}{2}$

$i = 1 - \alpha + \frac{\alpha}{2}$

$i = 1 - \frac{\alpha}{2}$

$1 - \frac{\alpha}{2} = 0.60$

$1 - 0.60 = \frac{\alpha}{2}$

$\alpha = 0.80$

Q5 (99 or 98)

0.5% solution of KCl

$\text{So } m = \frac{0.5}{74.6} \times \frac{1}{0.1}$

$\Delta T_f = i \times m_f$

$0.24 = i \cdot \frac{0.5}{74.6} \times \frac{1.80}{0.1}$

$i = \frac{0.24 \times 74.6}{0.5 \times 1.80} \times 0.1$

$= 1.989$

$1.989 = 1 + \alpha \ (n-1)$

$1.989 = 1 + \alpha$

$\alpha = .989$

$\% \alpha = 98.9\%$

Ans 99%

If mass of $H_2O = 99.5$

$m = \frac{0.5}{74.5} \times \frac{1}{.0995}$

$i = \frac{0.24 \times 74.6 \times .0995}{.5 \times 1.80}$

$= 1.979$

$1.979 = 1 + \alpha \ (n-1)$

$1.979 = 1 + \alpha$

$\alpha = .979$

$\% \alpha = 97.9 \%$

Q6 (415)

$\pi = iCRT$

$= \frac{1 \times 2}{60000 \times 0.2} \times 0.083 \times 300$

$= 0.00415$ bar $\quad (\because \; 1 \text{ bar} = 10^5 \text{ Pa})$

So, 0.00415×10^5 Pa $= 415$ Pa

Q7 (A)

Molality is independent of temperature and hence both assertion and reason are true.

Q8 (8)

Given : $\frac{(K_b)_A}{(K_b)_B} = \frac{1}{8}$

$\therefore \frac{(\Delta T_B)_A}{(\Delta T_B)_B} = \frac{(K_b)_A . m}{(K_b)_B . m} = \frac{1}{8} = \frac{x}{y}$

$\because \frac{x}{y} = \frac{1}{8}$

$\therefore y = 8$ (nearest integer)

Q9 (45)

$w = 2.5$ g $\quad K_b = 0.52$

$w_{solvent} = 75$ g $\quad M = $ Mol. Wt. of solute

$T'_B = 373.535\text{ K}$

$T_B^o = 373.15\text{ K}$

$\Delta T_B = 0.385 = K_b$ molality

$$0.385 = 0.52 \times \left(\frac{2.5}{M} \times \frac{1000}{75}\right)$$

$M = 45\text{ g mol}^{-1}$

Q10 (14)

$$\frac{y_B}{1-y_B} = \frac{P_B^o}{P_A^o}\left[\frac{X_B}{1-X_B}\right]$$

$$\Rightarrow \frac{y_B}{1-y_B} = \frac{100}{50}\left[\frac{0.7}{0.3}\right] = \frac{14}{3}$$

$$\Rightarrow y_B = \frac{14}{17}$$

Ans. 14

Q11 (5)

$M = d \times V = 1.02 \times 1.2 = 1.224$ gm

Moles of acetic acid = 0.0204 moles in 2L

So molality = 0.0102 mol/kg

Now $\Delta T_f = i \times K_f \times M$

$i = 1 + \alpha$ for acetic acid

$0.0198 = (1 + \alpha) \times 1.85 \times 0.0102$

$\alpha = 0.04928$

$\cong 5\%$

Q12 (3)

$$\Delta T_b = iK_b m$$

$$\Delta T_f = iK_f m$$

$$\frac{4}{4} = \frac{K_b\,1.5}{K_f\,4.5}$$

$$\frac{K_b}{K_f} = 3$$