## SOLUTIONS - JEE-MAINS (2022) PYQS

**1.** The depression in freezing point observed for a formic acid solution of concentration $0.5 \mathrm{~mL} \mathrm{~L}^{-1}$ is $0.0405^{\circ} \mathrm{C}$. Density of formic acid is $1.05 \mathrm{~g} \mathrm{~mL}^{-1}$. The Van't Hoff factor of the formic acid solution is nearly : (Given for water $\mathrm{k}_{\mathrm{f}}= 1.86 \mathrm{~K} \mathrm{~kg} \mathrm{~mol}^{-1}$)

**(A)** 0.8 **(B)** 1.1 **(C)** 1.9 **(D)** 2.4

**2.** Two solutions A and B are prepared by dissolving $1 \mathrm{~g}$ of non-volatile solutes $\mathrm{X}$ and $\mathrm{Y}$. respectively in $1 \mathrm{~kg}$ of water. The ratio of depression in freezing points for $A$ and $B$ is found to be $1: 4$. The ratio of molar masses of $\mathrm{X}$ and $\mathrm{Y}$ is :

**(A)** $1: 4$ **(B)** $1: 0.25$ **(C)** $1: 0.20$ **(D)** $1: 5$

**3.** Boiling point of a $2 \%$ aqueous solution of a nonvolatile solute $\mathrm{A}$ is equal to the boiling point of $8 \%$ aqueous solution of a non-volatile solute $\mathrm{B}$. The relation between molecular weights of $A$ and $B$ is.

**(A)** $\mathrm{M}_{\mathrm{A}}=4 \mathrm{M}_{\mathrm{B}}$ **(B)** $\mathrm{M}_{\mathrm{B}}=4 \mathrm{M}_{\mathrm{A}}$ **(C)** $\mathrm{M}_{\mathrm{A}}=8 \mathrm{M}_{\mathrm{B}}$ **(D)** $\mathrm{M}_{\mathrm{B}}=8 \mathrm{M}_{\mathrm{A}}$

**4.** Solute A associates in water. When $0.7 \mathrm{~g}$ of solute $\mathrm{A}$ is dissolved in $42.0 \mathrm{~g}$ of water, it depresses the freezing point by $0.2^{\circ} \mathrm{C}$. The percentage association of solute $A$ in water, is [Given : Molar mass of $\mathrm{A}=93 \mathrm{~g} \mathrm{~mol}^{-1}$. Molal depression constant of water is $1.86 \mathrm{~K} \mathrm{~kg} \mathrm{~mol}^{-1}$ ]

**(A)** $50 \%$ **(B)** $60 \%$ **(C)** $70 \%$ **(D)** $80 \%$

**5.** When a certain amount of solid A is dissolved in $100 \mathrm{~g}$ of water at $25^{\circ} \mathrm{C}$ to make a dilute solution, the vapour pressure of the solution is reduced to one-half of that of pure water. The vapour pressure of pure water is $23.76 \mathrm{mmHg}$. The number of moles of solute $A$ added is . (Nearest Integer) Assume moles of A to be less than moles of B

**6.** $150 \mathrm{~g}$ of acetic acid was contaminated with $10.2 \mathrm{~g}$ ascorbic acid $\left(\mathrm{C}_6 \mathrm{H}_8 \mathrm{O}_6\right)$ to lower down its freezing point by $\left(\mathrm{x} \times 10^{-1}\right)^{\circ} \mathrm{C}$. The value of $\mathrm{x}$ is (Nearest integer) [Given $\mathrm{K}_{\mathrm{f}}=3.9 \mathrm{~K} \mathrm{~kg} \mathrm{~mol}^{-1}$; Molar mass of ascorbic acid $=176 \mathrm{~g} \mathrm{~mol}^{-1}$]

**7.** A gaseous mixture of two substances A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. The mole fraction of substance $A$ is 0.5 in the vapour phase and 0.2 in the liquid phase. The vapour pressure of pure liquid $\mathrm{A}$ is atm. (Nearest integer)

## SOLUTIONS - JEE-MAINS (2022) PYQS

**8.** If $O_2$ gas is bubbled through water at 303 K, the number of millimoles of $O_2$ gas that dissolve in 1 litre of water is . (Nearest Integer) (Given : Henry's Law constant for $O_2$ at 303 K is 46.82 k bar and partial pressure of $O_2 = 0.920$ bar) (Assume solubility of $O_2$ in water is too small, nearly negligible)

**9.** ' x ' g of molecular oxygen $(O_2)$ is mixed with 200 g of neon (Ne). The total pressure of the non- reactive mixture of $O_2$ and Ne in the cylinder is 25 bar. The partial pressure of Ne is 20 bar at the same temperature and volume. The value of ' $x$ ' is [Given: Molar mass of $O_2 = 32\ \mathrm{g\ mol^{-1}}$.Molar mass of $\mathrm{Ne} = 20\ \mathrm{g\ mol^{-1}}$ ]

**10.** 1.80 g of solute A was dissolved in $62.5\ \mathrm{cm^3}$ of ethanol and freezing point of the solution was found to be 155.1 K. The molar mass of solute A is $\mathrm{gmol^{-1}}$.

[Given: Freezing point of ethanol is 156.0 K. Density of ethanol is $0.80\ \mathrm{g\ cm^{-3}}$.

Freezing point depression constant of ethanol is $2.00\ \mathrm{K\ kg\ mol^{-1}}$ ]

**11.** 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 $\mathrm{gL^{-1}}$ is ____(Molar mass of glucose = $180\ \mathrm{g\ mol^{-1}}$ R = 0.083 $\mathrm{L_{bar}}$ $^{-1}$ $\mathrm{mol^{-1}}$ ) (Nearest integer)

**12.** 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 k bar. Atomic mass of H, C and O is 1,12 and 6 $\mathrm{g\ mol^{-1}}$, respectively)

**13.** The elevation in boiling point for 1 molal solution of non-volatile solute A is 3 K. The depression in freezing point for 2 molal solution of $A$ in the same solvent is 6 K. The ratio of $K_b$ and $K_f$ i.e., $K_b/K_f$ is 1: X. The value of X is [nearest integer]

**14.** A 0.5 percent solution of potassium chloride was found to freeze at $-0.24°\mathrm{C}$. The percentage dissociation of potassium chloride is(Nearest integer)(Molal depression constant for water is $1.80\ \mathrm{K\ kg\ mol^{-1}}$ and molar mass of KCl is $74.6\ \mathrm{g\ mol^{-1}}$ )

## SOLUTIONS - JEE-MAINS (2022) PYQS

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

**16.** $2\ \mathrm{g}$ of a non-volatile non-electrolyte solute is dissolved in $200\ \mathrm{g}$ of two different solvents $\mathrm{A}$ and $\mathrm{B}$ whose ebullioscopic constants are in the ratio of $1:8$. The elevation in boiling points of $\mathrm{A}$ and $\mathrm{B}$ are in the ratio $\frac{x}{y}(x:y)$. The value of $y$ is___ (Nearest integer)

**17.** A solution containing $2.5\times10^{-3}\ \mathrm{kg}$ of a solute dissolved in $75\times10^{-3}\ \mathrm{kg}$ of water boils at 373.535 $\mathrm{K}$. The molar mass of the solute is __ $\mathrm{gmol^{-1}}$. [nearest integer] (Given: $\mathrm{K_b(H_2O)} = 0.52\ \mathrm{KKg\ mol^{-1}}$, boiling point of water $= 373.15\ \mathrm{K}$ )

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

**19.** $1.2\ \mathrm{mL}$ of acetic acid is dissolved in water to make $2.0\ \mathrm{L}$ of solution. The depression in freezing point observed for this strength of acid is $0.0198^{\circ}\mathrm{C}$. The percentage of dissociation of the acid is (Nearest integer)[Given : Density of acetic acid is $1.02\ \mathrm{g\ mL^{-1}}$ Molar mass of acetic acid is $60\ \mathrm{g\ mol^{-1}}$ $\mathrm{K_f(H_2O)} = 1.85\ \mathrm{K\ kg\ mol^{-1}}$ ]

**20.** Elevation in boiling point for 1.5 molal solution of glucose in water is $4\ \mathrm{K}$. The depression in freezing point for 4.5 molal solution of glucose in water is $4\ \mathrm{K}$. The ratio of molal elevation constant to molal depression constant $(\mathrm{K_b/K_f})$ is..

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**Answer Key**

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|---|---|---|---|
| **1. (C)** | **2. (B)** | **3. (B)** | **4. (D)** |
| **5. (5.55) or (3)** | **6. (15)** | **7. (2)** | **8. (1)** |
| **9. (80)** | **10. (80)** | **11. (54)** | |
| **12. (1223)** | **13. (1)** | **14. (98)** | |
| **15. (415)** | **16. (8)** | **17. (45)** | |
| **18. (14)** | **19. (5)** | **20. (3)** | |