

Q1 2021 (01 Sep Shift 2)

If 80 g of copper sulphate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is $x \times 10^{-3} \text{ mol L}^{-1}$.

The value of x is _____.

[Atomic masses Cu : 63.54 u, S : 32 u, O : 16 u, H : 1 u]

Q2 2021 (31 Aug Shift 2)

Sodium oxide reacts with water to produce sodium hydroxide. 20.0 g of sodium oxide is dissolved in 500 mL of water. Neglecting the change in volume, the concentration of the resulting NaOH solution is _____ $\times 10^{-1}$ M. (Nearest integer)

[Atomic mass : Na = 23.0, O = 16.0, H = 1.0]

Q3 2021 (31 Aug Shift 2)

1.22 g of an organic acid is separately dissolved in 100 g of benzene ($K_b = 2.6 \text{ K kg mol}^{-1}$) and 100 g of acetone ($K_b = 1.7 \text{ K kg mol}^{-1}$). The acid is known to dimerize in benzene but remain as a monomer in acetone. The boiling point of the solution in acetone increases by 0.17°C .

The increase in boiling point of solution in benzene in $^\circ\text{C}$ is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic mass : C = 12.0, H = 1.0, O = 16.0]

Q4 2021 (31 Aug Shift 1)

The molarity of the solution prepared by dissolving 6.3 g of oxalic acid ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) in 250 mL of water in mol L^{-1} is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)

[Atomic mass : H : 1.0, C : 12.0, O : 16.0]

Q5 2021 (31 Aug Shift 1)

Which one of the following 0.10M aqueous solutions will exhibit the largest freezing point depression ?

(1) hydrazine

(2) glucose

(3) glycine

(4) KHSO_4

Q6 2021 (27 Aug Shift 2)

40 g of glucose (Molar mass = 180) is mixed with 200 mL of water. The freezing point of solution is ____ K . (Nearest integer)

[Given: $K_f = 1.86 \text{ K kg mol}^{-1}$; Density of water = 1.00 g cm^{-3} ; Freezing point of water = 273.15 K]

Q7 2021 (27 Aug Shift 1)

1 kg of 0.75 molal aqueous solution of sucrose can be cooled up to -4°C before freezing. The amount of ice (in g) that will be separated out is ____ . (Nearest integer)

[Given : $K_f(\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1}$]

Q8 2021 (26 Aug Shift 2)

83 g of ethylene glycol dissolved in 625 g of water.

The freezing point of the solution is ____ K. (Nearest integer)

[Use : Molal Freezing point depression constant of water = $1.86 \text{ K kg mol}^{-1}$]

Freezing Point of water = 273 K

Atomic masses : C : 12.0u, O : 16.0u, H : 1.0u]

Q9 2021 (26 Aug Shift 1)

Of the following four aqueous solutions, total number of those solutions whose freezing point is lower than that of 0.10 M $\text{C}_2\text{H}_5\text{OH}$ is ____ (Integer answer)

(i) 0.10 M $\text{Ba}_3(\text{PO}_4)_2$

(ii) 0.10 M Na_2SO_4

(iii) 0.10 M KCl

(iv) 0.10 M Li_3PO_4

Q1 (64)

$$\text{Moles of CuSO}_4 \cdot 5\text{H}_2\text{O} = \frac{80}{249.54}$$

$$\text{Molarity} = \frac{\frac{80}{249.54}}{5} = 64.117 \times 10^{-3}$$

Nearest integer, $x = 64$

Q2 (13)



$$\frac{20}{62} \text{ moles}$$

$$\text{Moles of NaOH formed} = \frac{20}{62} \times 2$$

$$[\text{NaOH}] = \frac{\frac{40}{62}}{\frac{500}{1000}} = 1.29\text{M} = 13 \times 10^{-1}\text{M}$$

(Nearest integer)

Q3 (13)

With benzene as solvent

$$\Delta T_b = iK_b m$$

$$\Delta T_b = \frac{1}{2} \times 2.6 \times \frac{1.22/M_w}{100/1000} \dots(1)$$

With Acetone as solvent

$$\Delta T_b = iK_b m$$

$$0.17 = 1 \times 1.7 \times \frac{1.22/M_w}{100/1000} \dots(2)$$

(1) / (2)

$$\frac{\Delta T_b}{0.17} = \frac{\frac{1}{2} \times 2.6 + \frac{1.22/M_w}{100/1000}}{1 \times 1.7 \times \frac{1.22/M_w}{100/1000}}$$

$$\Delta T_b = \frac{0.26}{2}$$

$$\Delta T_b = 13 \times 10^2$$

$$\Rightarrow x = 13$$

Q4 (20)

$$[\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}] = \frac{\text{weight}/M_w}{V(L)}$$

$$\Rightarrow x \times 10^{-2} = \frac{6.3/126}{250/1000}$$

$$x = 20$$

Q5 (4)

\therefore Van't Hoff factor is highest for KHSO_4

\therefore colligative property (ΔT_f) will be highest for KHSO_4

Q6 (271)

$$\text{molality} = \frac{\left(\frac{40}{180}\right)^{\text{mol}}}{0.2\text{Kg}} = \left(\frac{10}{9}\right) \text{ molal}$$

$$\Rightarrow \Delta T_f = T_f - T'_f = 1.86 \times \frac{10}{9}$$

$$\Rightarrow T'_f = 273.15 - 1.86 \times \frac{10}{9}$$

$$= 271.08 \text{ K}$$

$$\simeq 271 \text{ K (nearest-integer)}$$

Q7 (518)

Let mass of water initially present = x gm

$$\Rightarrow \text{Mass of sucrose} = (1000 - x)\text{gm}$$

$$\Rightarrow \text{moles of sucrose} = \left(\frac{1000-x}{342}\right)$$

$$\Rightarrow 0.75 = \frac{\left(\frac{1000-x}{342}\right)}{\left(\frac{x}{1000}\right)} \Rightarrow \frac{x}{1000} = \frac{1000-x}{342 \times 0.75}$$

$$\Rightarrow 256.5x = 10^6 - 1000x$$

$$\Rightarrow x = 795.86\text{gm}$$

$$\Rightarrow \text{moles of sucrose} = 0.5969$$

New mass of H_2O = a kg

$$\Rightarrow 4 = \frac{0.5969}{a} \times 1.86 \Rightarrow a = 0.2775 \text{ kg}$$

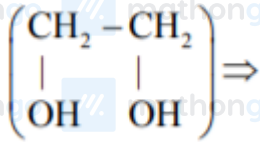
$$\Rightarrow \text{ice separated} = (795.86 - 277.5) = 518.3 \text{ gm}$$

Q8 (269)

$$k_f = 1.86 \text{ k} \cdot \text{kg/mol}$$

$$T_f^\circ = 273 \text{ k}$$

solvent : H_2O (625 g)



Solute : 83 g

Non dissociative solute

$$\Rightarrow \Delta T_f = k_f \times m$$

$$\Rightarrow (T_f^\circ - T_f^1) = 1.86 \times \frac{83/62}{624/1000}$$

$$\Rightarrow 273 - T_f^1 = \frac{1.86 \times 83 \times 1000}{62 \times 625} = \frac{154380}{38750}$$

$$\Rightarrow 273 - T_f^1 = 4$$

$$\Rightarrow T_f^1 = 259 \text{ K}$$

Q9 (4)

As 0.1 M $\text{C}_2\text{H}_5\text{OH}$ is non-dissociative and rest all salt given are electrolyte so in each case effective molarity > 0.1 so each will have lower freezing point.