

## Q1 2021 (01 Sep Shift 2)

If the conductivity of mercury at  $0^\circ\text{C}$  is  $1.07 \times 10^6 \text{ S m}^{-1}$  and the resistance of a cell containing mercury is  $0.243 \Omega$ , then the cell constant of the cell is  $x \times 10^4 \text{ m}^{-1}$ . The value of  $x$  is \_\_\_\_\_. (Nearest integer)

## Q2 2021 (31 Aug Shift 2)

Match List-I with List-II

## List-I

## List-II

## (Parameter)

## (Unit)

(a) Cell constant (i)  $\text{S cm}^2 \text{ mol}^{-1}$

(b) Molar conductivity (ii) Dimensionless

(c) Conductivity (iii)  $\text{m}^{-1}$

(d) Degree of dissociation of electrolyte (iv)  $\Omega^{-1} \text{ m}^{-1}$

Choose the most appropriate answer from the options given below :

(1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

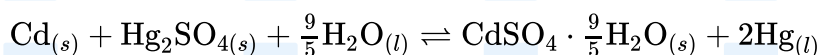
(2) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

(3) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)

(4) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

## Q3 2021 (31 Aug Shift 1)

Consider the following cell reaction :



The value of  $E_{\text{cell}}^0$  is 4.315 V at  $25^\circ\text{C}$ .

If  $\Delta H^\circ = -825.2 \text{ kJ mol}^{-1}$ , the standard entropy change  $\Delta S^\circ$  in  $\text{JK}^{-1}$  is \_\_\_\_\_. (Nearest integer)

[Given : Faraday constant =  $96487 \text{ C mol}^{-1}$  ]

## Q4 2021 (27 Aug Shift 2)

The resistance of a conductivity cell with cell constant  $1.14 \text{ cm}^{-1}$ , containing  $0.001 \text{ M KCl}$  at  $298 \text{ K}$  is  $1500 \Omega$ . The molar conductivity of  $0.001 \text{ M KCl}$  solution at  $298 \text{ K}$  in  $\text{S cm}^2 \text{ mol}^{-1}$  is \_\_\_\_\_.

(Integer answer)

**Q5 2021 (26 Aug Shift 2)**

For the galvanic cell,



$E_{\text{cell}} = \dots \times 10^{-2} \text{ V}$ . (Nearest integer)

$$\left[ \text{Use : } E_{\text{Cu/Cu}^{2+}}^0 = -0.34 \text{ V}, \quad E_{\text{Zn/Zn}^{2+}}^0 = +0.76 \text{ V} \right. \\ \left. \frac{2.303RT}{F} = 0.059 \text{ V} \right]$$

**Q6 2021 (26 Aug Shift 1)**

These are physical properties of an element

- (A) Sublimation enthalpy
- (B) Ionisation enthalpy
- (C) Hydration enthalpy
- (D) Electron gain enthalpy

The total number of above properties that affect the reduction potential is \_\_\_\_\_ (Integer answer)

**Q7 2021 (26 Aug Shift 1)**

Given below are two statements :

*Statement I* : The limiting molar conductivity of  $\text{KCl}$  (strong electrolyte) is higher compared to that of  $\text{CH}_3\text{COOH}$  (weak electrolyte).

*Statement II* : Molar conductivity decreases with decrease in concentration of electrolyte.

In the light of the above statements, choose the *most appropriate* answer from the options given below :

(1) *Statement I* is true but *Statement II* is false.

(2) *Statement I* is false but *Statement II* is true.

(3) Both *Statement I* and *Statement II* are true.

(4) Both *Statement I* and *Statement II* are false.

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# Answer Key

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**Q1 (26)**

**Q2 (1)**

**Q3 (25)**

**Q4 (760)**

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**Q5 (109)**

**Q6 (3)**

**Q7 (4)**

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#MathBoleTohMathonGo

Q1 (26)

$$k = 1.07 \times 10^6 \text{ Sm}^{-1}, \quad R = 0.243 \Omega$$

$$G = \frac{1}{R} = \frac{1}{0.243} \Omega^{-1}$$

$$k = G \times G^*$$

$$G^* = \frac{k}{G} = \frac{1.07 \times 10^6}{\frac{1}{0.243}} \simeq 26 \times 10^4 \text{ m}^{-1}$$

Q2 (1)

$$\text{Cell constant} = \left( \frac{\ell}{A} \right) \Rightarrow \text{Units} = \text{m}^{-1}$$

$$\text{Molar conductivity} (\Lambda_m) \Rightarrow \text{Units} = \text{Sm}^2 \text{ mole}^{-1}$$

$$\text{Conductivity} (K) \Rightarrow \text{Units} = \text{S m}^{-1}$$

$$\text{Degree of dissociation} (\alpha) \Rightarrow \text{Dimensionless}$$

∴ (a) - (iii)

(b) - (i)

(c) - (iv)

(d) - (ii)

Q3 (25)

$$\Delta G^\circ = -nFE^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$= \frac{\Delta H^\circ + nFE^\circ}{T}$$

$$= \frac{(-825.2 \times 10^3) + (2 \times 96487 \times 4.315)}{298}$$

$$= \frac{-825.2 \times 10^3 + 832.682 \times 10^3}{298}$$

$$= \frac{7.483 \times 10^3}{298} = 25.11 \text{ JK}^{-1} \text{ mol}^{-1}$$

∴ Nearest integer answer is 25

Q4 (760)

$$K = \frac{1}{R} \times \ell/A = \left( \left( \frac{1}{1500} \right) \times 1.14 \right) \text{ S cm}^{-1}$$

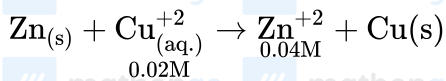
$$\Rightarrow \Lambda_m = 1000 \times \frac{\left( \frac{1.14}{1500} \right)}{0.001} \text{ S cm}^2 \text{ mol}^{-1}$$

$$= 760 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Rightarrow 760$$

**Q5 (109)**

Galvanic cell:



$$\text{Nernst equation} = E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.059}{2} \log \frac{[\text{Zn}^{+2}]}{[\text{Cu}^{+2}]}$$

$$\Rightarrow E_{\text{cell}} \left[ E_{\text{cell}}^{\circ} - E_{\text{Zn}^{+2}/\text{Zn}}^{\circ} \right] - \frac{0.059}{2} \log \frac{0.04}{0.02}$$

$$\Rightarrow E_{\text{cell}} [0.34 - (-0.76)] - \frac{0.059}{2} \log 2$$

$$\Rightarrow E_{\text{cell}} 1 - 1 - \frac{0.059}{2} \times 0.3010$$

$$= 1.0911 = 109.11 \times 10^{-2}$$

$$= 109$$

**Q6 (3)**

Sublimation enthalpy, Ionisation enthalpy and hydration enthalpy affect the reduction potential.

**Q7 (4)**

Ion	H <sup>+</sup>	K <sup>+</sup>	Cl <sup>-</sup>	CH <sub>3</sub> COO <sup>-</sup>
$\Lambda_{\text{m}}^{\infty} \text{ Scm}^2/\text{mole}$	349.8	73.5	76.3	40.9

So

$$\Lambda_{\text{mCH}_3\text{COOH}}^{\infty} = \Lambda_{\text{m}(\text{H}^+)}^{\infty} + \Lambda_{\text{mCH}_3\text{COO}^-}^{\infty}$$

$$= 349.8 + 40.9$$

$$= 390.7 \text{ Scm}^2/\text{mole}$$

$$\Lambda_{\text{mKCl}}^{\infty} = \Lambda_{\text{m}(\text{K}^+)}^{\infty} + \Lambda_{\text{m}(\text{Cl}^-)}^{\infty}$$

$$= 73.5 + 76.3$$

$$= 149.8 \text{ Scm}^2/\text{mole}$$

So *Statement – I* is wrong or False.

As the concentration decreases, the dilution increases which increases the degree of dissociation, thus

increasing the no. of ions, which increases the molar conductance.

So *Statement – II* is False.

