Q1 2021 (01 Sep Shift 2)

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

Q2 2021 (31 Aug Shift 2)

Match List−I with List−II

	List-I (Parameter)	**List-II (Unit)**
(a)	Cell constant	(i) S cm^2 mol^{-1}
(b)	Molar conductivity	(ii) Dimensionless
(c)	Conductivity	(iii) m^{-1}
(d)	Degree of dissociation of electrolyte	(iv) Ω^{-1} 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 :

$$Cd_{(s)} + Hg_2SO_{4(s)} + \frac{9}{5}H_2O_{(l)} \rightleftharpoons CdSO_4 \cdot \frac{9}{5}H_2O_{(s)} + 2Hg_{(l)}$$

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

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

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

Q4 2021 (27 Aug Shift 2)

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

(Integer answer)

Q5 2021 (26 Aug Shift 2)

For the galvanic cell,

$\mathrm{Zn(s) + Cu^{2+}(0.02M) \rightarrow Zn^{2+}(0.04M) + Cu(s)}$,

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

$\left[\text{Use : } \mathrm{E^0_{Cu/Cu^{2+}} = -0.34\ V,\quad E^0_{Zn/Zn^{2+}} = +0.76\ V}\right.$

$\left.\frac{2.303RT}{F} = 0.059\ \mathrm{V}\right]$

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 KCl (strong electrolyte) is higher compared to that of $\mathrm{CH_3COOH}$ (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.

Answer Key

Q1 (26) **Q2** (1) **Q3** (25) **Q4** (760)

Q5 (109) **Q6** (3) **Q7** (4)

Q1 (26)

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

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

$k = G \times G^*$

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

Q2 (1)

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

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

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

Degree of dissociation $(\alpha) \rightarrow$ Dimensionless

$\therefore$ (a) - (iii)

(b) - (i)

(c) - (iv)

(d) - (ii)

Q3 (25)

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

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

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

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

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

$\therefore$ Nearest integer answer is 25

Q4 (760)

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

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

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

$\Rightarrow 760$

Q5 (109)

Galvanic cell:

$$\underset{0.02M}{Zn_{(s)} + Cu^{+2}_{(aq.)}} \rightarrow \underset{0.04M}{Zn^{+2}} + Cu(s)$$

Nernst equation $= F_{cell} = E^{o}_{cell} - \frac{0.059}{2}\log\frac{[2n^{+2}]}{[Cu^{+2}]}$

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

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

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

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

$= 109$

Q6 (3)

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

Q7 (4)

Ion	H^+	K^+	Cl^-	CH_3COO^-
$\Lambda^{\infty}_{m\ Scm^2/mole}$	349.8	73.5	76.3	40.9

So

$$\Lambda^{\infty}_{mCH_3COOH} = \Lambda^{\infty}_{m(H^*)} + \Lambda^{\infty}_{mCH_3COO^-}$$
$$= 349.8 + 40.9$$
$$= 390.7 Scm^2/mole$$
$$\Lambda^{\infty}_{mKCl} = \Lambda^{\infty}_{m(K^+)} + \Lambda^{\infty}_{m(C^-)}$$
$$= 73.5 + 76.3$$
$$= 149.3 Scm^2/mole$$

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.