Q1 - 25 July - Shift 1

The cell potential for $Zn|Zn^{2+}(aq)||Sn^{x+}|Sn$ is 0.801 V at 298 K. The reaction quotient for the above reaction is 10^{-2}. The number of electrons involved in the given electrochemical cell reaction is. . . . . .

(Given $E^0_{Zn^{2+}|Zn} = -0.763V$, $E^0_{Sn^{x+}|Sn} = +0.008V$ and $\frac{2.303RT}{F} = 0.06V$)

Space for your notes:

Q2 - 25 July - Shift 2

The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{m1} and that of 20 moles another identical cell heaving 80 mL NaCl solution is Λ_{m2}, The conductivities exhibited by these two cells are same.

The relationship between Λ_{m2} and Λ_{m1} is

(A) $\Lambda_{m2} = 2\Lambda_{m1}$ (B) $\Lambda_{m2} = \Lambda_{m1}/2$

(C) $\Lambda_{m2} = \Lambda_{m1}$ (D) $\Lambda_{m2} = 4\Lambda_{m1}$

Space for your notes:

Q3 - 25 July - Shift 2

$$E^0_{Cr^{+3}|Cr^{+2}} = -0.41V$$

Space for your notes:

$$[Cr^{+3}] = 4s^0 3d^3$$

$$\mu = \sqrt{n(n+2)}\ B.M$$

$$= \sqrt{15}\ B.M \sim 4\ B.M$$

Q4 - 26 July - Shift 1

The amount of charge in F (Faraday) required to obtain one mole of iron from Fe_3O_4 is _____. (Nearest Integer)

Space for your notes:

Q5 - 27 July - Shift 2

Given below are two statements:

Statement I: For KI, molar conductivity increases steeply with dilution.

Statement II: For carbonic acid, molar conductivity increases slowly with dilution.

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

(A) Both **Statement I** and **Statement II** are true

(B) Both **Statement I** and **Statement II** are false

(C) **Statement I** is true but **Statement II** is false

(D) **Statement I** is false but **Statement II** is true

Space for your notes:

Q6 - 28 July - Shift 1

Match List-I with List-II.

	List-I		List-II
(A)	$Cd(s) + 2Ni(OH)_3(s) \rightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$	(I)	Primary battery
(B)	$Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$	(II)	Discharging of secondary battery
(C)	$2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$	(III)	Fuel cell
(D)	$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$	(IV)	Charging of secondary battery

Choose the correct answer from the options given below :

(A) (A) – (I), (B) – (II), (C) – (III), (D) – (IV)

(B) (A) – (IV), (B) – (I), (C) – (II), (D) – (III)

(C) (A) – (II), (B) – (I), (C) – (IV), (D) – (III)

(D) (A) – (II), (B) – (I), (C) – (III), (D) – (IV)

Space for your notes:

Q7 - 29 July - Shift 1

Resistance of a conductivity cell (cell constant 129 m^{-1}) filled with 74.5 ppm solution of KCl is 100 Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50 Ω (labelled as solution 2). The ratio of molar conductivity of solution 1 and solution 2 is i.e. $\frac{\wedge_1}{\wedge_2} = x \times 10^{-3}$. The value of x is _____.

(Nearest integer)

Given, molar mass of KCl is 74.5 g mol^{-1}

Space for your notes:

Q8 - 29 July - Shift 2

For a cell, Cu(s) $|Cu^{2+}(0.001M)| |Ag^{+}(0.01M)|$ Ag(s) the cell potential is found to be 0.43 V at 298 K. The magnitude of standard electrode potential for Cu^{2+}/Cu is ___ $\times 10^{-2}$ V.

$$\left[\text{Given}: E^{\ominus}_{Ag^+/Ag} = 0.80\text{V and } \frac{2.303RT}{F} = 0.06\text{V}\right]$$

Space for your notes:

Answer Key

Q1 (4)	**Q2** (A)	**Q3** (4)	**Q4** (3)
Q5 (B)	**Q6** (C)	**Q7** (1000)	**Q8** (34)

Q1 (4)

$$E = E^0 - \frac{2.303\,RT}{nF}\log Q$$

Here, $E = +0.801\,V$, $E^0 = 0.008 - (-0.763)$

$= +0.771\ V$

$$\therefore 0.801 = +0.771 - \frac{0.06}{n}\ \log 10^{-2}$$

$\Rightarrow n = 4$

Q2 (A)

$$\Lambda_m = \kappa \times \frac{1000}{M}$$

$$\Rightarrow \Lambda_m \propto \frac{1}{M}$$

$$\frac{\Lambda_{m_1}}{\Lambda_{m_2}} = \frac{M_2}{M_1} = \frac{\frac{20}{80}}{\frac{10}{20}} = \frac{1}{4} \times \frac{2}{1} = \frac{1}{2}$$

$$\Rightarrow \Lambda_{m_2} = 2\Lambda_{m_1}$$

Q3 (4)

$$E^{0}_{Cr^{+3}|Cr^{+2}} = -0.41V$$

$$[Cr^{+3}] = 4s^{0}3d^{3}$$

$$\mu = \sqrt{n(n+2)}\ B.M$$

$$= \sqrt{15}\ B.M \sim 4\ B.M$$

Q4 (3)

$$Fe_3O_4 \xrightarrow{+8e^-} 3Fe$$

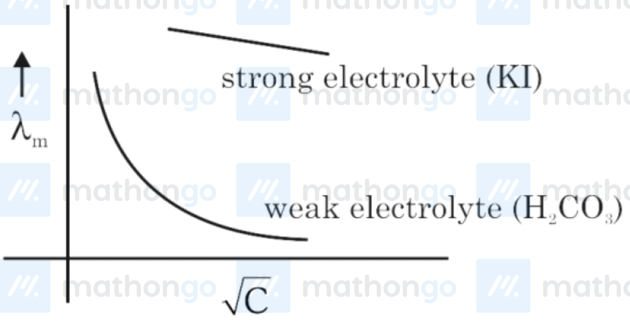
Charge for 1 mole Fe = 8/3 F

= 2.67 F

Q5 (B)

Statement I: KI is strong electrolyte thus almost constant on dilution.

Statement II: In weak electrolyte it increases, sharply.



Q6 (C)

(a) $Cd(s) + 2Ni(OH)_3(s) \rightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$

Discharge of secondary Battery

(b) $Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$

(Primary Battery Mercury cell)

(c) $2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$

Charging of secondary Battery

(d) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ – Fuel cell

Q7 (1000)

$$\frac{\ell}{A} = 129 m^{-1}$$

KCl solution 1 :

74.5 ppm, $R_1 = 100\,\Omega$

KCl solution 2 :

149 ppm, $R_2 = 50\,\Omega$

149 ppm, $R_2 = 50\,\Omega$

Here, $$\frac{ppm_1}{ppm_2} = \frac{M_1}{M_2}\left(= \frac{W_1/M_0}{V} \times \frac{V}{W_2/M_0} \right)$$

$$\frac{\wedge_1}{\wedge_2} = \frac{\kappa_1 \times \frac{1000}{M_1}}{\kappa_2 \times \frac{1000}{M_2}}$$

$$= \frac{\kappa_1}{\kappa_2} \times \frac{M_2}{M_1}$$

$$= \frac{50}{100} \times 2$$

$$= \frac{\wedge_1}{\wedge_2} = 1{,}000 \times 10^{-3}$$

Q8 (34)

At anode

$Cu \rightarrow Cu^{2+} + 2e^-$

At cathode

$2Ag^+ + 2e^- \rightarrow 2Ag$

Cell reaction $\rightarrow Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$

$$E_{cell} = E^0_{cell} - \frac{0.06}{2}\log\frac{[Cu^{2+}]}{[Ag^+]^2}$$

$$0.43 = E^0_{cell} - \frac{0.06}{2}\log\frac{(0.001)}{(0.01)^2}$$

$$E^0_{cell} = 0.46$$

$$E^0_{cell} = E^0_{Ag^+/Ag} - E^0_{Cu^{2+}/Cu}$$

$$0.46 = 0.80 - E^0_{Cu^{2+}/Cu}$$

$$E^0_{Cu^{2+}/Cu} = 0.34\,\text{volt}$$

$$E^0_{Cu^{2+}/Cu} = 34 \times 10^{-2}$$