3.8. Suggest a way to determine the value of water.
Ans:

By using Kohlrausch's law, Λ^o_m for H_2O can be calculated, we can write,

$$\Lambda^o_m = \Lambda^o_m(HCl) + \Lambda^o_m(NaOH) - \Lambda^o_m(NaCl)$$

Being strong electrolytes, Λ^o_m values of HCl, NaOH and NaCl are known. By substituting their values, we can obtain Λ^o_m for H_2O.

3.9. The molar conductivity of 0.025 mol L^{-1} methanoic acid is 46.1 S cm^2 mol^{-1}. Calculate its degree of dissociation and dissociation constant Given $\lambda^\circ(H^+)$=349.6 S cm^2 mol^{-1} and $\lambda^\circ(HCOO^-)$ = 54.6 S cm^2 mol^{-1}.
Ans:

$$\Lambda^o_m(HCOOH) = \lambda^o(H^+) + \lambda^o(HCOO^-)$$
$$= 349.6 + 54.6$$
$$= 404.2\ S\ cm^2\ mol^{-1}$$
$$\Lambda^C_m = 46.1\ S\ cm^2\ mol^{-1}$$
$$\therefore \quad \alpha = \frac{\Lambda^C_m}{\Lambda^o_m} = \frac{46.1}{404.2} = 0.114$$

	HCOOH $\rightleftharpoons$	$HCOO^-$ +	H^+
Initial conc.	c	0	0
at equi,	$c(1-\alpha)$	$c\alpha$	$c\alpha$

$$\therefore \quad K_a = \frac{c\alpha . c\alpha}{c(1-\alpha)} = \frac{c\alpha^2}{1-\alpha}$$
$$= \frac{0.025 \times (0.114)^2}{1-0.114} = 3.67 \times 10^{-4}$$

3.10. If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many electrons would flow through the wire?
Ans:

We know, $Q = It$

$$= 0.5 \times (2 \times 60 \times 60)$$
$$= 3600\,C$$

$1F \Rightarrow 96500C \Rightarrow 1$ mole of e^{-1} s

$\Rightarrow 6.02 \times 10^{23}\ e^{-1}$ s

$\therefore$ 3600 C is equivalent to the flow of e^{-1}'s

$$= \frac{6.02 \times 10^{23}}{96500} \times 3600$$
$$= 2.246 \times 10^{22}\ e^{-1}\ s$$

3.11. Suggest a list of metals that are extracted electrolytically.
Ans: Na, Ca, Mg and Al

3.12. Consider the reaction: $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr_3+ + 7H_2O$
What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$?
Ans:

From the reaction, 1 mol of $Cr_2O_7^{2-}$ require 6F

$$= 6 \times 96500 = 579000\,C$$

$\therefore$ 579000 C of electricity are required for reduction of $Cr_2O_7^{2-}$ to Cr^{3+}

3.13. Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging.
Ans: A lead storage battery consists of anode of lead, cathode of a grid of lead packed with lead dioxide (PbO_2) and 38% H_2SO_4 solution as electrolyte. When the battery is in use, the reaction taking place are:

Anode : $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

Cathode : $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

Overall Reaction : $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

On charging the battery, the reverse reaction takes place, i.e., $PbSO_4$ deposited on electrodes is converted back to Pb and PbO_2 and H_2SO_4 is regenerated.

3.14. Suggest two materials other than hydrogen that can be used as fuels in fuel cells.
Ans: Methane and Methanol.

3.15. Explain how rusting of iron is envisaged as setting up of an electrochemical cell.
Ans: The water present on the surface of iron dissolves acidic oxides of air like CO_2, SO_2, etc. to form acids which dissociate to give H^+ ions :

$$H_2O + CO_2 \rightarrow H_2CO_3 \rightleftharpoons 2H^+ + CO_3^{2-}$$

In the presence of H^+, iron looses e^{-1}s to form Fe^{3+}. Hence, this spot acts as anode:

$$Fe\,(s) \rightarrow Fe^{2+}\,(aq) + 2e^-$$

The e^{-1}s released move through the metal to reach another spot where H^+ ions and dissolved oxygen take up these e^{-1} s and reduction occurs. This spot, thus, acts as cathode :

$$O_2\,(g) + 4H^+\,(aq) + 4e^- \rightarrow 2H_2O\,(l)$$

The overall reactio nis :

$$2Fe\,(s) + O_2\,(g) + 4H^+\,(aq) \rightarrow 2Fe^{2+}\,(aq) + 2H_2O\,(l)$$

Thus, an electrochemical cell is set up on the surface.
Ferrous ions are further oxidised by atmospheric oxygen to ferric ions which combine with water to form hydrated ferric oxide, $Fe_2O_3.xH_2O$, which is rust.

*********** END **********