

Electrochemistry - (Lecture-8)

Faraday's laws of electrolysis

→ Michael Faraday was the Scientist who described the quantitative aspects of electrolysis. Gives two laws:-

First law $\Rightarrow$ In the process of electrolysis the amount of substance deposited or liberated at an electrode (anode or cathode) is directly proportional to the quantity of electricity passing through cell.

$$W \propto Q$$

$$W = Z \cdot Q$$

$$W = Z \cdot It$$

Z = Electrochemical equivalent.

I = Current

t = time

Q = charge

Electrochemical equivalent

If $I = 1 \text{ amp}$, $t = 1 \text{ Sec.}$ then

$$W = Z \cdot I \cdot t$$

$$W = Z \cdot 1 \cdot 1$$

$$\boxed{W = Z}$$

Electrochemical equivalent of a substance is amount of substance deposited or liberated at the electrode when one ampere of current passed through the electrolyte for one second.

calculation of amount of substance at electrode

charge of one electron = $1.6 \times 10^{-19} \text{ C}$

charge of 6.022×10^{23} electron = $1.6 \times 10^{-19} \times 6.022 \times 10^{23} \text{ C}$
 $= 96487 \text{ C}$ approximately
 96500 C .

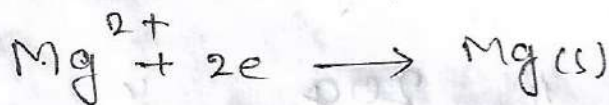
* Magnitude of charge carried by one mole of electron is 96500 C which is also called one faraday.

$1 \text{ Faraday} = 96500 \text{ C}$

Ques $\Rightarrow$ How much charge is required for the following reduction of

(i) one mole of Mg^{2+} to Mg

(ii) one mole of Ca^{2+} to Ca



(i) one atom Mg^{2+} required 2 electrons.
∴ one mole Mg^{2+} " 2 mole electron

$$\begin{aligned} &= 2 F \\ &= 2 \times 96500 C \\ &= 193000 C \end{aligned}$$

(ii) $Ca^{2+} + 2e \rightarrow Ca(s)$
(10) one atom of Ca^{2+} required 2 electron

$$\begin{aligned} \therefore \text{one mole of } Ca^{2+} & \text{ " 2 mole electron} \\ &= 2 F \text{ charge} \\ &= 2 \times 96500 C \\ &= \underline{193000 C} \end{aligned}$$

N.C.E.R.T.

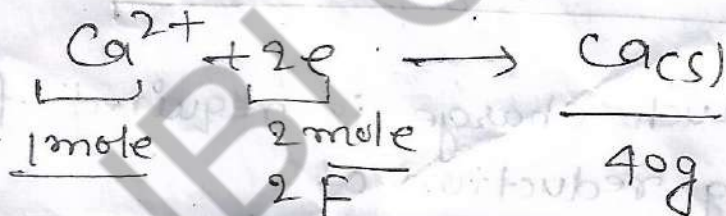
Ques ³¹³

How much electricity in terms of faraday is required to produce :-

(i) 20g of calcium from molten CaCl_2

(ii) 40.0g of Al from molten Al_2O_3

(i) The electrode reaction is :-



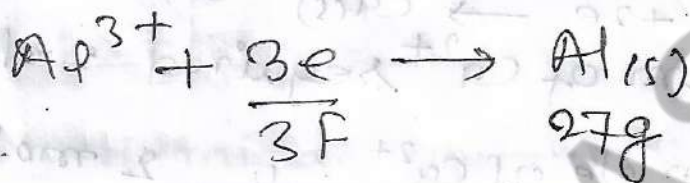
Production of 40g calcium required 2F

" " 1g " " $\frac{2}{40}$ F

" " 20g " " $\frac{2}{40} \times 20$

= 1F Ans.

(ii) The electrode reaction is :-
 $\text{Al}_2\text{O}_3 \longrightarrow 2\text{Al}^{3+} + 3\text{O}^{2-}$



Production of 27g aluminium required 3F

$$\begin{array}{ccccccc} \text{"} & \text{"} & 1g & \text{"} & \text{"} & \frac{3}{27} \\ \text{"} & \text{"} & 40g & \text{"} & \text{"} & \frac{3}{27} \times 40 \\ & & & & & = \frac{40}{9} = \underline{4.44F} \end{array}$$