Electrolysis

Conductors → The substance through which electric current can pass are called conductor.

non- conductors →

[Faraday's law of Electrolysis]

It state that " The amount of any substance liberated from or deposited on the electrode during electrolysis is directly proportional to the quantity of ~~charge~~ electricity pass through the electrolytic solution.

If m be the mass deposited on or liberated from an electrode & Q be the charge passed throgh the soln,

Mathmatically

$$m \propto Q$$

$$m = Z Q$$

$$m = ZIt \qquad [Q = It]$$

where,

Z = proportionality constant, known as electrochemical equivalent

Quantity of charge passed. & It is equal to product of current & time for which the current pass.

$1F = 96500\,C$

Page No.

Date: / /

I = current in ampere
Q = charge passed in columb
m = mass of substance deposite or liberated in gram.

we have,

$$m = ZIt \quad \text{or} \quad Z = \frac{m}{It}$$

If one ampere current is passed through the electrolyte for one second. then m = Z so. electrochemical equivalent of substance is defined as the weight of substance deposited or liberated by passage of one ampere current for one second.

since, 1 Faraday (96500c) charge deposite one gm equivalent

Let E = equivalent weight of substance then,

96500 columb deposites E g substance
1 columbe $\frac{E}{96500}$ g of substance,

By defination, mass deposited or liberated by one columb charge is called electrochemical equivalent. Therefore,

$$Z = \frac{E}{96500}.$$

we have

$$m = ZIt$$

$$m = \frac{EIt}{96500} \text{ or } \frac{EQ}{96500}$$

[Faraday second Law]

This law states that "When the same quantity of electricity is passed through different electrolytes connected in series, the amount of substances deposited or liberated from the respective electrodes are proportional to their equivalent weight"

$$m \propto E.$$

$$m = KE$$

$$m/E = K \text{ (constant)}.$$

Verification,

let the same quantity of electricity is passed through different voltameters connected in series containing aqueous solution of H_2SO_4, $CuSO_4$ & $AgNO_3$ as, shown in fig.

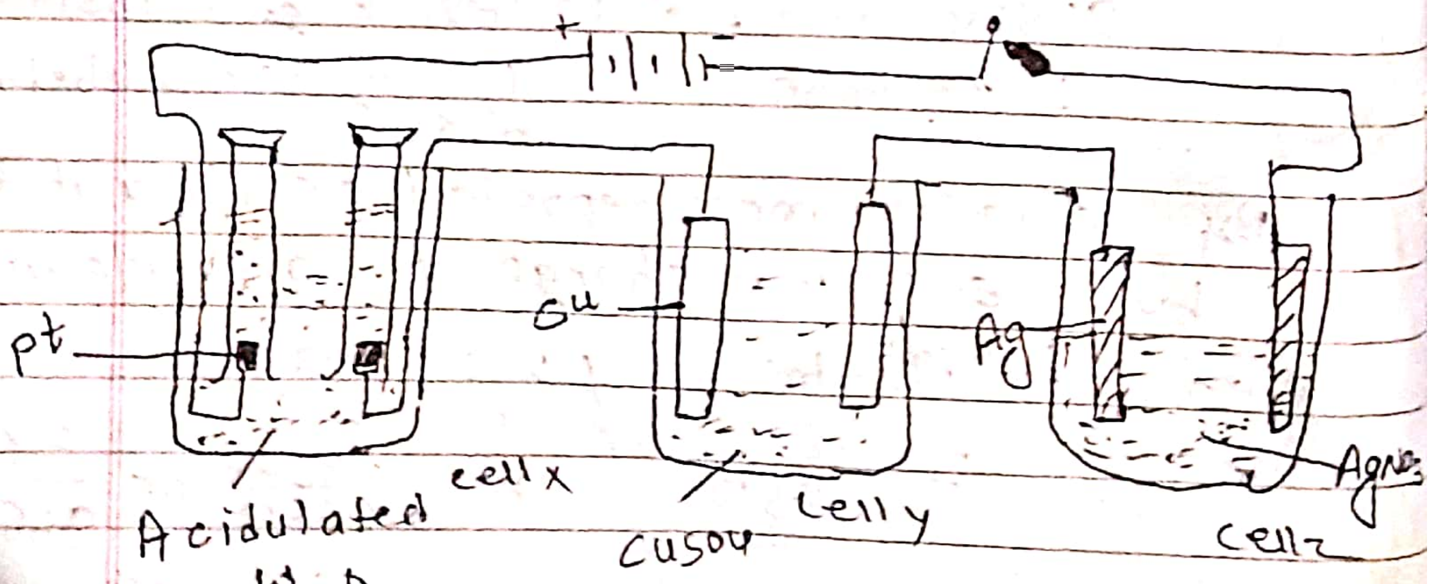

Fig - varification of Faraday's second Law of

Page No.
Date: / /

The mass of hydrogen, copper & silver deposited at the respective electrodes are in the ratio, of their equivalent weights.

For cell x :,

$$\frac{\text{mass of hydrogen deposite (liberated or)}}{\text{equivalent weight of hydrogen}} = \text{constant} \quad \text{---(I)}$$

For cell y :- $$\frac{\text{mass of copper deposited}}{\text{eq. wt of copper}} = \text{constant} \quad \text{---(II)}$$

For cell z. $$\frac{\text{mass of silver deposited}}{\text{eq. wt of silver}} = \text{constant.} \quad \text{---(III)}$$

from eqn (I), (II) & (III)

$$\frac{\text{mass of hydrogen displaced}}{\text{eq. wt of hydrogen}} = \frac{\text{mass of copper deposited}}{\text{eq. wt of copper}} = \frac{\text{mass of silver deposited}}{\text{eq. wt of silver.}}$$

From the above relation,

$$\frac{\text{mass of hydrogen displace}}{\text{mass of copper deposite}} = \frac{\text{eq. wt of hydrogen}}{\text{eq. wt of copper}}$$

$$\frac{\text{mass of hydrogen}}{\text{mass of silver}} = \frac{\text{eq. wt of hydrogen}}{\text{eq. wt of silver}}$$

$$\frac{\text{mass of copper}}{\text{mass of silver}} = \frac{\text{eq. wt of copper}}{\text{eq. wt of silver.}}$$

Page No.
Date: / /

An electric current is passed through three Cells in series containing respective Soln. of $CuSO_4$, $AgNO_3$, & KI, . what weight of silver & Iodine will be liberated while 1.25g of copper is being deposite.

$CuSO_4$ $AgNO_3$, KI.

1.25g.

Soln

$$\frac{\text{wt of copper}}{\text{wt of Iodine}} = \frac{31.7}{127}$$

$X = 50g$ of Iodine.

&

$$\frac{\text{wt of copper}}{\text{wt of silver}} = \frac{31.7}{107.8}$$

$$\frac{1.25}{y} = \frac{31.7}{107.8}$$

$y = 4.25g$ silver

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Q. 0.1978 g of copper is deposite by a current of 0.2 ampere in 50 minute. what is electrochemical equivalent of copper?

Sol^n. Given. $t = 50$ min. $50 \times 60 = 3000$ sec.

$I = 0.2$ ampere

$Q = It = 0.2 \times 3000 = 600$ columb

Amount of copper deposite by 600 columb = 0.1978

~~I 600 columbe deposited~~ .

" " " " " 1 columb = $\frac{0.1978}{600}$

$= 0.0003296$ gm

Electrochemical eq. of Cu = 0.0003296 g