TREND

WRITERS

- **Current** - The amount of charge flowing through any cross-section area of conductors per unit time is called Electric current.

$$I = \frac{Q}{T}$$ - time

Q = electric flux

S.I unit = $\frac{C}{t}$ amphere

- **Current density** - The electric current flowing per unit area of cross-section of conductor is called current density it is denoted by j.

$$J = \frac{I}{A}$$

S.I Unit A/m2

D.F = $[M^0 L^{-2} T^2]$

$$j = \frac{Q}{At}$$

area → A, t → time

Q. electric current has scalar quantity - Electric current has magnitude and direction both but its a scalar quantity because.

1. It obeys the law of addition of scalar.
2. If cofire is folded in different shapes. The value of current does note change

Dipth velocity :- Dipth velocity is define as a average velocity with which the free electron get (dripted) to woards, the positive end of conductor under the influnce of an external electric field it is denoted by V_d.

- **OHM's law** - If the physical condition of a conductor remains unchange the patential difference is proportional to current flowing through it.

$$V \propto I$$

$$V = RI$$

$$\frac{V}{I} = R$$

Limitation of OHM's law -

- Temperature of conductor should be constant.
- They should not be strains in conductor
- It is applicable only for metalic conductor.

• **Electrical resistance** - The obstruction (रुकावट) offered by the Conductor in the flow of current through it self is Called electrical resistance of that conductor.

$R = \frac{V}{I}$ S.I. unit = Ω

D.f → $[ML^2T^{-3}A^{-2}]$

★ • **Dependence of Electrical resistance** -

1. Length - The resistance of conductor is propendicalonal to the its length $R \propto l$ so a long wire will have greater resistance than short wire.
2. Area of cross-section - Resistance is inversly proportional to are a of cross-section $R \propto \frac{1}{A}$
   - A thin wire will have high resistance then thick wire.
3. The material of the Conductor - no. of $R \propto \frac{1}{n}$ free electron n will be differente material.
4. Temperature - The resistance of a conductor decreases of the relaxation time increases at higher temp. relaxation time dencrease and resistance increases ~~$R \propto \frac{1}{\tau}$~~

$$R \propto \frac{1}{\tau}$$

• **Electrical Condenser** - The reciprocal of electrical resistance is called Electrical condenser of the conductor. It is denoted by G.

$G = \frac{1}{R}$

S.I. Unit - Ω^{-1} or

D.f = $[M^{-1}L^{-2}T^3A^2]$

• **Specific resistance (Resistivity)** - Resistance of a unit cube of that material.

The electrical resistance of a conductor is proportional to the length of Conductor and inversely proportional to the area of Conductor. S.I. unit $\frac{\Omega m^2}{m}$

$= \Omega m$ D.f = $[ML^3T^{-3}A^{-2}]$

$R \propto l$ — (I)

$R \propto \frac{1}{A}$ — (II)

by eq (I) & (II)

$R \propto \frac{l}{A}$

$R = \rho \frac{l}{A}$ $\rho = \frac{RA}{l}$

1. Dependence specific resistance - $\rho \propto \frac{1}{n}$; specific resistance ρ is less for conductors having large number of free electrons.

2. Dependence on temperature - It is inversely proportional to relaxation time it increases with increase in temp. of conductor.

* **Relation between current and drift velocity** -

$V = Al$

$N = n\,Al$

Net charge $= n \times Al \times e$

$V = \frac{l}{t}$

$t = \frac{l}{v_d}$

$t = \frac{l}{V} = \frac{l}{v_d}$

$I = \frac{nAl\,e}{\frac{l}{v_d}}$

$$I = nA\,v_d e$$

* **Electrical Conductivity** - The reciprocal of resistivity is known as electrical conductivity. It is denoted by σ

$\sigma = \frac{1}{\rho}$

S.I unit $= \Omega^{-1} m^{-1}$

D.F $= [M^{-1} L^{-3} A^{2}]$

$\sigma = \frac{1}{\frac{RA}{l}}$

$\sigma = \frac{l}{RA}$

$I = ne\,Av_d$

$I = ne\,A\mu E$

* **Relation between resistivity & electron mobility.**

$\frac{I}{A} = \frac{E}{\rho}$

$\frac{E}{\rho} = \frac{ne\,Av_d}{A}$

$\frac{E}{\rho} = ne\,v_d$, $\mu = \frac{v_d}{E}$

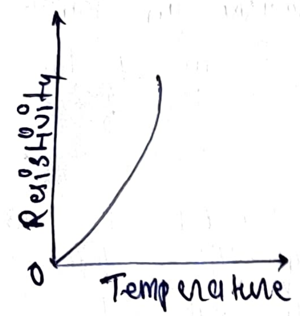
$\frac{E}{\rho} = ne\,\mu E$, $v_d = \mu E$

$\frac{1}{\rho} = ne\mu$

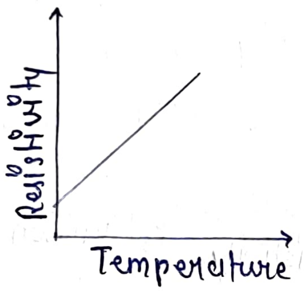
$$\rho = \frac{1}{ne\mu}$$

• Write effect of temp. of resistivity for metals

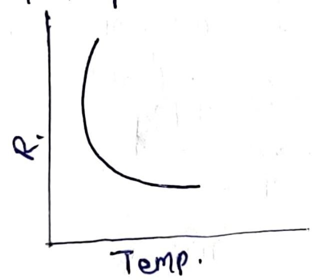
• Metals - with increase in temp. the resistivity of metal also increase.



• For alloys. - In case of alloys the resistivity have very large and they have very weak dependence on temp.



• For semi-conductors - Insulators & electrolytes - In case of semi conductor insulators and electrolytes with the increase in temp. there resistivity ~~den~~ decreases.



* • Ohmic and non-ohmic resistance -

1. Ohmic - The conductors which obey ohms law are called ohmic conductor. The resistance of ohmic conductors is called ohmic resistence.
2. Non ohmic resistence - The conductors which do not obey ohms law are called non-ohmic conductors the resistance of non-ohmic conductors is called non-ohmic resistance.

Q. Electric power - The rate of work on passing electrical current through an electrical circuit is called Electrical power. It is denoted by P.P.

S.I unit (watt)

$P = \frac{W}{T}$

1 K watt = 10^3 watt

1 mega watt = 10^6 watt

$P = VI$, $P = \frac{V^2}{R}$

1 hours power = 746 watt

... potential difference power if 100 watt what be the value of current.

$P = VI$

$V = 200$

$P = 100$

$I = \frac{V}{P}$ $\Rightarrow$ $I = \frac{100}{200}$ 0.5 ampere.

Energy consume in electric circuit

$P = \frac{W}{t}$

$W = Pt$

Electrical energy = power × Time

S.I Unit = watt × second.

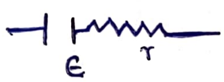
$\frac{\text{Joule} \times \text{Second}}{\text{Second}}$

= Joule

Internal resistance of cell.

1. Electric resistance - Electric cell is a device which converted chemical energy into electric energy.
2. Internal resistance - The resistance applied by electrolyte inside a cell to applied by flow of current is called internal resistance of a cell. It is denoted by r.

Its Unit is = Ω

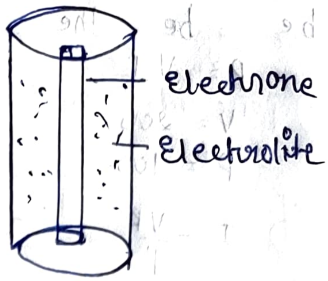


Factors affecting internal resistance.

1. Concentration of Electrolyte - On increasing the concentration of Electrolyte no. of molecular affering resistance to flow of current increases therefore Internal resistance of cell increases.
2. Distance between the Electrodes - when the distance between Electrodes of a cell is increase the length of path of electrons between the two electrodes increases therefore internal resistance of a cell increases.
3. Area of electrode which is dipped into electrolyte - If the area of electrodes dipped into the electrolyte we more that the no. of electrons flowing per second through the internal resistance of a cell decreases.
4. Temperature of Electrolyte - Increase in the temperature of Electrolyte decreases its viscosity and mobility of ions increases therefore internal resistance of cell decreases.

• Electromotive force (EMF) -

The E.M.F of a cell in the amount of work done in carrying a unit positive charge from one pole of the battery to another in the open circuit.



$$E = \frac{W}{Q}$$

S.I unit = J/C or volt

D.F = $[ML^2T^{-3}A^{-1}]$

• Terminal potential difference - when the cell is open circuit the potential difference between its two electrodes is called terminal potential difference of the cell.

E.M.F

• E.M.F is the maximum potential difference btw two poles of an cell in an open circuit.

• E.M.F exists of the circuit is broken.

• It is greater than terminal voltage of the cell.

• It does not depend upon the resistance of the circuit.

Potential difference

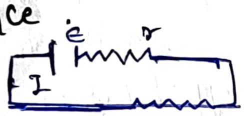
• The difference of potential btw the two terminals of cell when current is drawn from the cell.

• It doesn't exists after circuit is broken.

• It is always less than the E.M.F of the cell.

• It depends on resistance btw the points.

The relation between internal resistance e.m.f and potential difference



A

B

By Ohm's law $V = \frac{I}{R}$

$I = \frac{V}{R}$ — (I)

e.m.f

$I = \frac{E}{r+R}$ —(II)

by eq (I) & (II)

$\frac{V}{R} = \frac{E}{r+R}$

$r+R = \frac{E}{V}R$

$r = \frac{E}{V}R - R$

$r = R\left(\frac{E}{V} - 1\right)$

by eq (I) & (II)

$R+r$

$E = I(R+r)$
$= IR + Ir$

$V = IR$

$E = V + Ir$

$V = E - Ir$

- Combination of cell -

1. Series Combination - In series combination cathode of first cell joint with anode of second cell cathode of second show on finally external resistance is joint between anode of first cell and cathode of the last cell due to which current flow through external resistance.

let n cells connected in series the e.m.f internal resistance of each cell E and r total EMF = $E+E+E$ n term → nE

total internal resistance in the circuit.

$= r+r+r$ --- n term.

The current flowing in the circuit.

$$I = \frac{\text{Total EMF}}{\text{Total resistance}}$$

$$I = \frac{nE}{R+nr}$$

where R is external resistance of circuit Case 1st $= r$ is $<<R$.

$$I = \frac{nE}{R}$$

$$I = \frac{n \times E}{R}$$

Case IInd $= r >>> R$

$$I = \frac{\cancel{n}E}{\cancel{n}r}$$

$$I = \frac{E}{r}$$

- Parallel Combination of cell -

In the parallel combination of cell the anode of cell the cells are connected at point A and cathode of all cell are connected with point B external resistance is connected btw. point A & B.

- let the EMF and internal resistance of each cell E and r respectively.

- total internal resistance $= \frac{1}{r} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r}$ ---- n term.

$$\frac{1}{r} = \frac{n}{r}$$

$$r = \frac{r}{n}$$

Total resistance of circuit $= R + r = \frac{R+r}{n}$

current flowing through the circuit

$I = \frac{\text{Total EMF}}{\text{total resistance}}$

$I = \frac{E}{R + \frac{r}{n}}$

$I = \frac{E}{\frac{Rn + r}{n}}$ $I = \frac{nE}{Rn + r}$

Case I

$r <<< R$

$I = \frac{nE}{Rn}$ $I = \frac{E}{R}$

Case II

$r >>> R$

$I = \frac{nE}{r}$, $I = \frac{nE}{r}$

* • Kirchhoff's law of current distribution -

1. first law - In a network of conductors the algebraic sum of all current meeting at any junction of any circuit is always zero.

$$\Sigma I = 0$$

Explanation - current reaching towards the junction are taken as positive and current leaving the junction are taken as negative.

∴ By Kirchhoff's law.

$\Sigma I = 0$

or $I_1 + I_2 + I_3 + I_4 + I_5 = 0$

or $I_1 + I_4 = I_2 + I_3 + I_5$

• Kirchhoff's second law - Sum of emf in close circuit equals the sum of products of current and corresponding resistance.

applying Kirchhoff's voltage law to loop ABCEFA we get i.e

$E_1 - E_2 + I_2 R_2 - I_1 R_1 = 0$

or $E_1 - E_2 = I_1 R_1 - I_2 R_2$ — (I)

applying Kirchhoff's voltage law to loop BCDEB we get.

$E_2 - (I_1 + I_2) R - I_2 R_2 = 0$

$E_2 = (I_1 + I_2) R + I_2 R_2$ — (II)

Solving eq (I) and (II) I_1 and I_2 can be determined

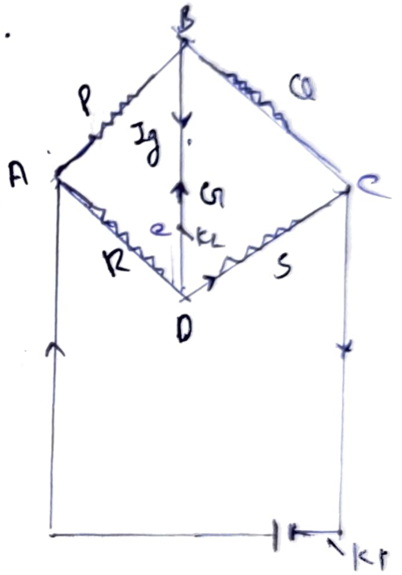
~~Write~~ working and principal of ~~wheat~~ stone bridge.

for resistance PQR and S are joined such that they forms a quadrilateral ABCD between point A and C a cell E and key K1 are joined between the point B and D. a galvanometer G and key are K2 are joined the current to flow vibrating key K1 a value of P and Q are so adjusted that on pressing key K2 the galvanometer shows not reflection In this condition bridge is set to be under equilibrium condition - In this condition $\frac{P}{Q} = \frac{P}{S}$ this is principle of ~~be~~ wheat stone.

Derivation-

let ~~on~~ on passing the cell key K1 and galvanometer key K2 the current flowing through PQRS are I_1, I_2, I_3, I_4 respectivly let current flowing through galvanometer is I_G.

By kirchhoff's first law at point B.



Derivation.

$I_1 - I_2 - I_g = 0$

$[I_g = 0]$

$I_1 = I_2$ — (I)

at point D

$I_3 - I_4 + I_g = 0$

$[I_g = 0]$

$I_3 = I_4$ — (II)

By kirchhoff's second law in close circuit ABDA.

$I_1 P + I_g G - I_3 R$

$[I_g = 0]$

$I_1 P = I_3 R$ — (III)

In closed circuit BCDB

$I_2 Q - I_4 S - I_g G = 0$

$[I_g = 0]$

$I_2 Q = I_4 S$ — (IV)

eq (III) divided by (IV)

$\frac{I_1 P}{I_2 Q} = \frac{I_3 R}{I_4 S}$

by eq (I) & (II)

$\frac{I_1 P}{I_1 Q} = \frac{I_3 R}{I_3 S}$

$\frac{P}{Q} = \frac{R}{S}$