Current

By current we mean flow of charge. The rate of flow of charge is defined as current i.e. i=dq/dt = q/t (ampere = coulomb/sec).

We have different types of conduction

(1) Metallic conduction: Current flowing through a metallic conduction.

(2) Electrolytic conduction: Current flowing through an electrolyte i.e. liquid

(3) Gaseous conduction: discharge of electricity through gases.

(4) Vacuum conduction: Flow of charge through vacuum.

Metallic conduction: To flow charge between two points we must always maintain a potential difference between those points.

Let V = Potential difference between the points between A & B of the metallic conductor.

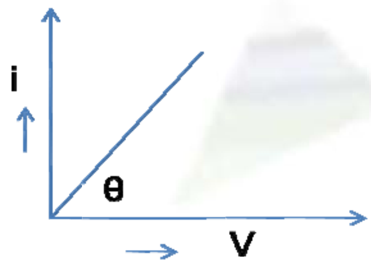
i = current flowing through the conductor.

Ohm's law: "At a constant temperature current flowing between two points of a conductor is proportional to potential difference between those points"

$V \propto i$

$V = Ri$

Where R is constant of proportionality known as resistance of the conductor.



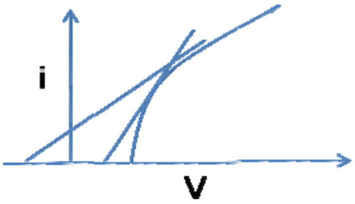
$$i = \frac{1}{R}V$$

$$y = mx, m = \frac{1}{R} = \tan\theta$$

The reciprocal of the slow of the straight line gives resistance of the conductor.

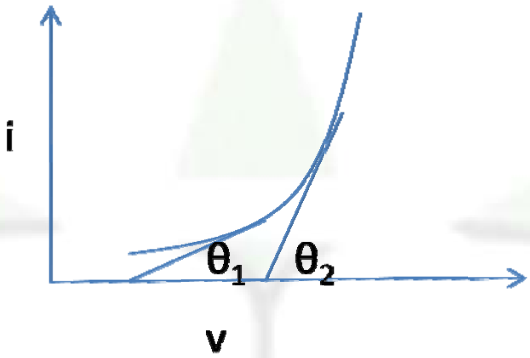
Remark: Ohms law is valid only for metallic conduction.

For electrolytic conduction from the graph we find that as the potential difference increases θ decreases, tanθ decreases and 1/tanθ=R increases



Thus the resistance of an electrolyte increases with the increases in the applied potential difference.

For vacuum conduction:



From the graph we see that as the applied potential difference increases the value of θ also increases and tanθ increases, 1/tanθ=R decreases.

Thus resistance decreases with the increase in potential difference.

For metallic conduction resistance of a conductor depends on

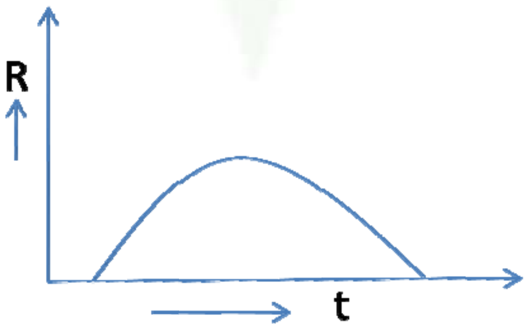
(1) The temperature

(2) Size i.e. length and diameter

(3) Temperature: Resistance of a conductor increases with increase in temperature in a parabolic fashion and is given by

$R_t = R_0(1+\alpha t + \beta t^2 + \ldots)$

Where α , β ,.. are constant of elements of the conductor.



If temperature is not too large then β is very small (10^{-7}) so βt^2 can be neglected compared to αt hence equation reduces to $R_t = R_0(1+\alpha t)$

(ii) At constant temperature resistance of a conductor

(a) Increases with the length of the conductor $R \propto l$

(b) Decreases with the increase in area of cross section

$$R \propto \frac{1}{A}$$
$$\therefore R \propto \frac{l}{A}$$
$$R = \rho \frac{l}{A}$$

Where ρ is a constant of proportionality and is known as resistivity or the specific resistance of the conductor.

$$\rho = \frac{RA}{l} = \frac{ohm\ \mathrm{m}^2}{\mathrm{m}} = ohm\ \mathrm{m}$$

For good conductor ρ is of the order of 10^{-8} ohm m and for bad conductor 10^{+4} ohm m