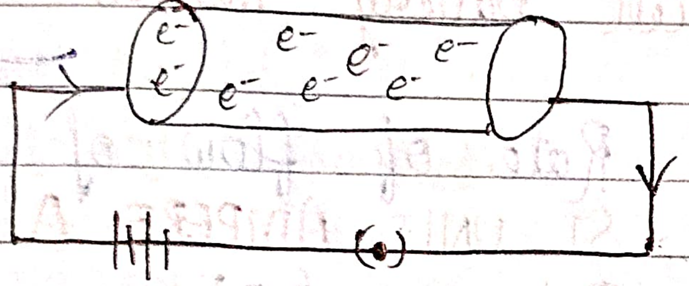
CHAPTER - 12
ELECTRICITY

ELECTRICITY And ELECTRIC CURRENT

Flow of charges in a conductor is Electric Current.
This phenomena or effect is electricity.

CHARGE : Number of flow of electron in CRT.



SI UNIT OF CHARGE COULOMB (C)
Charge is denoted by 'Q'

$$\boxed{Q = n \times e}$$

n = no. of e^-
e = charge of electron
$[1.6 \times 10^{-19} C]$

$1C =$ ______________ e^-

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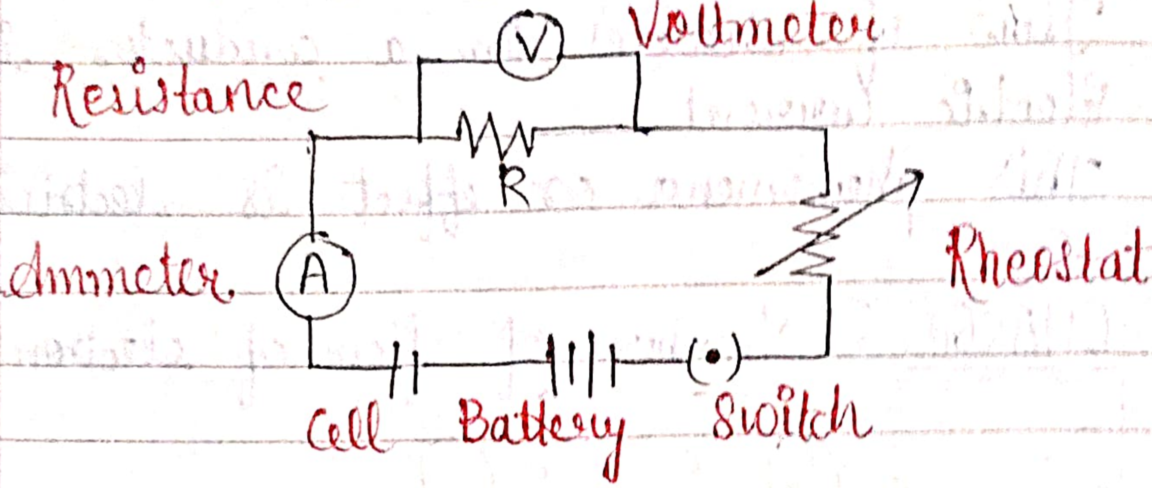
CIRCUIT [CKT]

Closed loop of conducting wire includes voltmeter, ammeter, switch, Rheostat and cell is called electric circuit.



CURRENT: Rate of flow of charge
SI UNIT AMPERE A
Denoted by 'I'

$\boxed{I \times t = Q}$ $\boxed{I = \frac{Q}{t}}$

Q = charge (total)
t = time
I = Current

Direction of current → +ve terminal to -ve

NOTE Direction of current is opposite to flow of electrons.

AMMITER :

→ Used to measure electric current
→ Connected in series
→ Very small resistance

VOLTMETER :

→ Used to measure potential difference
→ Connected in parallel
→ High resistance

GALVANOMETER :

Detect the presence of electric current

Potential Difference :

Work done to move a unit charge from one to another point

SI UNIT VOLT V

Denoted by 'V'

$$\boxed{V = \frac{W}{Q}} \qquad \boxed{V = \frac{W}{ne}}$$

W = Energy
Q = charge
V = Potential Difference

n = no. of electron
e = charge on 1 electron

Source of potential difference :
cell, battery, generator, powerhouse etc.

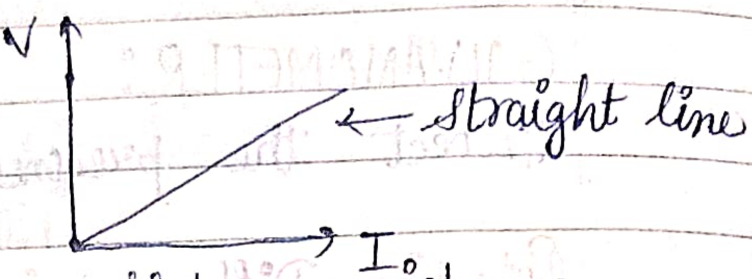
OHM'S LAW

The potential difference across two points on a conductor is directly proportional to the current passing through the circuit provided the temperature remains constant.

$V \propto I$

$\boxed{V = IR}$

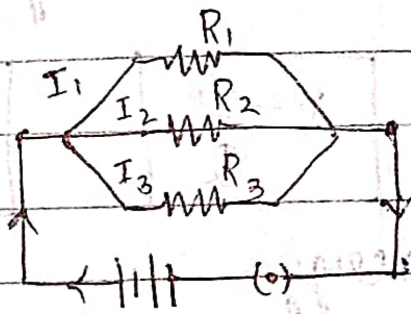
V = Potential Difference
I = Current
R = Resistance



Slope - resistance

COMBINATION OF RESISTANCE

PARALLEL COMBINATION



* Potential Difference remains same.
* Current gets divided.

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According to Ohm's Law

$$V = IR$$

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

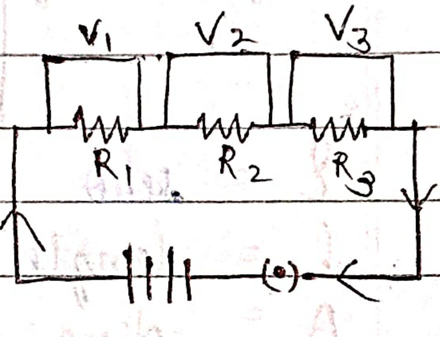
$$I = I_1 + I_2 + I_3$$

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$V\left[\frac{1}{R}\right] = V\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]$$

$$\boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

SERIES COMBINATION



* Current remains same
* Potential difference change or divided.

According to Ohm's Law

$$V = IR$$

$$V = V_1 + V_2 + V_3$$

$$IR = IR_1 + IR_2 + IR_3$$

$$IR = I(R_1 + R_2 + R_3)$$

$$\boxed{R = R_1 + R_2 + R_3}$$

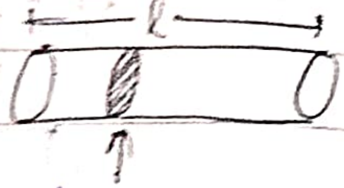
Resistance :

Property of conductor to resist the flow of charges.

SI UNIT 'Ohm Ω'

Denoted by 'R'

Factors on which resistors depends :



$R \propto l$ —(I)

$R \propto \frac{1}{A}$ —(II)

Area of cross-section

From equation (I) & (II)

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

ρ = rho

l = length of conductor

A = area of cross-section

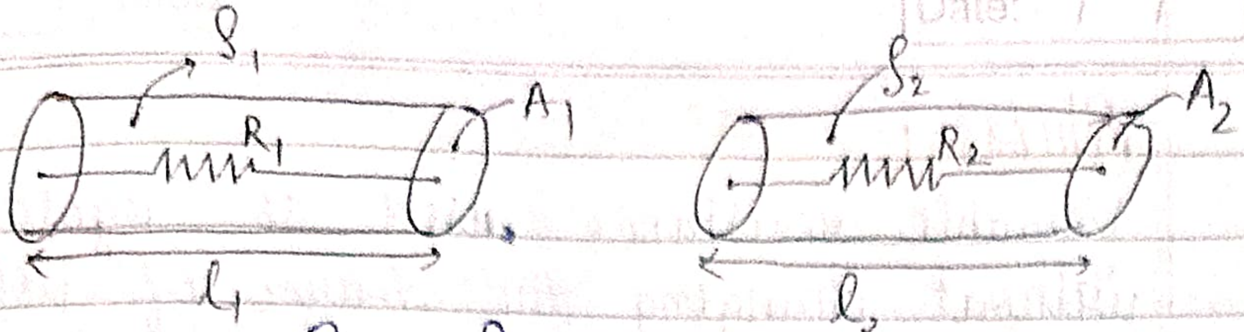
Depends upon :

→ Length of conductor

→ Nature of material

→ Cross-sectional area

→ On Temperature



$$R_1 = \frac{\rho_1 l_1}{A_1} \quad \text{— (I)}$$

$$R_2 = \frac{\rho_2 l_2}{A_2} \quad \text{— (II)}$$

On dividing equation (I) & (II)

$$\frac{R_1}{R_2} = \frac{\left(\frac{\rho_1 l_1}{A_1}\right)}{\left(\frac{\rho_2 l_2}{A_2}\right)} = \frac{\rho_1 l_1}{A_1} \times \frac{A_2}{\rho_2 l_2}$$

$$\boxed{\frac{R_1}{R_2} = \frac{\rho_1 l_1 A_2}{\rho_2 l_2 A_1}}$$

$$\boxed{\frac{R_1}{R_2} = \frac{\rho_1 l_1 A_2}{\rho_2 l_2 A_1}}$$

→ If material is same $\rho_1 = \rho_2$

$$\frac{R_1}{R_2} = \frac{l_1 A_2}{l_2 A_1}$$

→ If material and thickness (A.ρ) is same $\rho_1 = \rho_2$, $A_1 = A_2$

$$\boxed{\frac{R_1}{R_2} = \frac{l_1}{l_2}}$$

→ If resistance is same

$$\boxed{\rho_2 l_2 A_1 = \rho_1 l_1 A_2}$$

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Rheostat :

Variable resistance used to regulate current without changing the source of voltage.

Resistivity : (TEMPERATURE)

Resistance offered by material of a conductor.
SI UNIT '$\Omega \cdot m$' ohm metre.
Denoted by 'ρ' rho

→ Resistivity doesn't change with change in 'l' and 'A.S', it changes in temperature.
→ Resistivity of metals & alloys 10^{-8} to 10^{-6} Ωm.
→ Resistivity of insulators 10^{12} to 10^{17} Ωm.
→ Alloy do not oxidize (burn) at ↑ temperature, they used in electrical heating devices.
Eg :- NICHROME for heating rod, gezer etc.
→ Cu & Al used for electrical transmission, they have low resistivity.

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JOULE'S HEATING LAW

Heat produced in resistor :

- directly proportional to square of current.
- directly proportional to resistance.
- directly proportional to time.

$$\boxed{H = I^2Rt} \qquad \boxed{E = P \times T}$$

H = Heat
I = Current
R = Resistance
t = Time

E = Energy
P = Power
T = Time

✓ Heating effect electric heater, bulb, fuse, etc.
✗ Heating effect computer, Refrigerator, etc.

Filament of electric bulb is made of TUNGSTEN
Doesn't oxidize at high temperature
High melting point (3380°C).

ELECTRIC FUSE :

Safety device protects electrical appliances in case of short cirkit or overloading.

- Made of pure tin or alloy of Cu or tin.
- Always with series connection
- Low melting point.

ELECTRIC POWER :-

Rate of doing of electric work.

$\boxed{P = \frac{E}{T}}$ $\boxed{P = \frac{W}{T}}$ $\boxed{P = \frac{QV}{T}}$ $\boxed{P = IV}$

P = Power

E = Energy

T = Time

W =

Q = Charge

V = Voltage (P.D)

I = Current

SI UNIT OF POWER 'WATT' W.

1 Watt = 1 volt × 1 Ampere

1 KW = 1000 W

Commercial unit of electric energy = KWh

1 KWh = 3.6×10^6 J

1 KWh = 1 unit of electric energy

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1 AMPERE $\boxed{I = 1Q/1t}$

1 coulomb of charge flows in 1 second

1 VOLT $\boxed{V = 1W/1Q}$

1 joule of work is done to carry 1 coulomb charge.

1 OHM $\boxed{\Omega = 1V/1A}$

1 V of potential difference and current is 1 Ampere.