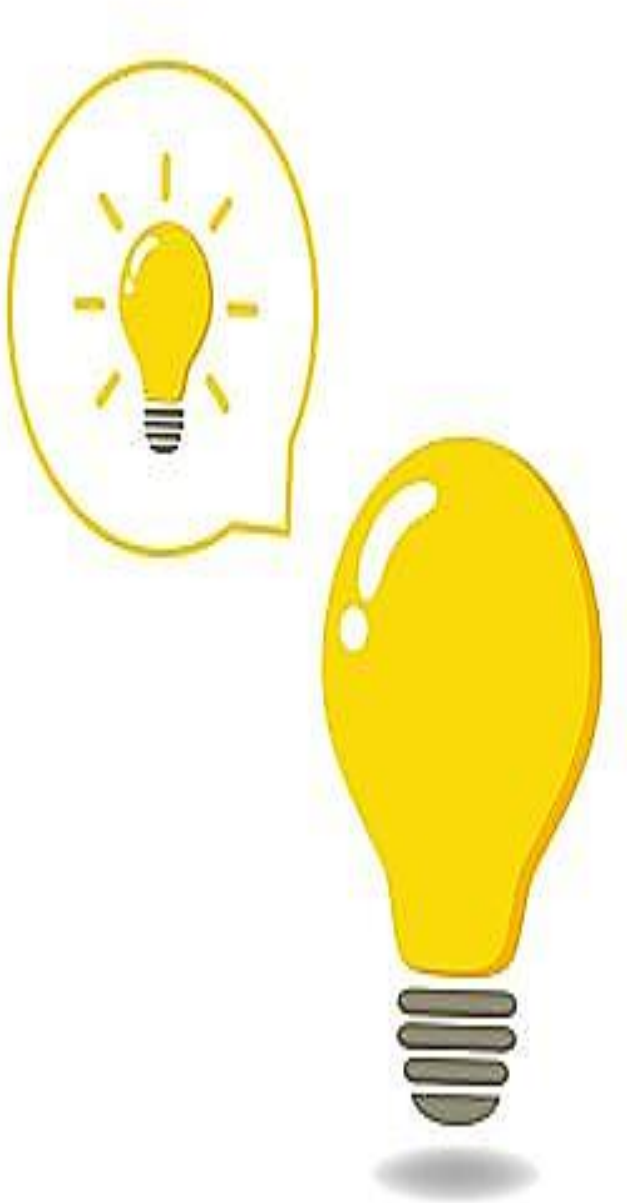


Physics Course

Aden German International University

Aden –Yemen

What is a Charge ?

What is a Charge ?

- Charge is the inherent property of matter that feels force of attraction out repulsion due to excess or deficiency of electrons.
- It is of 2 types :

A. Positive Charge (Due to electron deficiency)

B. Negative Charge (Due to excess of electrons)

- Its S.I. unit is Coulombs denoted by 'C'.
- It is detected and measured using a device called Electroscope.

Properties Of Charge

Properties of Charge

- The total charge of the universe is conserved i.e. constant
- Unlike Charges attract each other and like charges repel each other
- Charges are additive in nature
- Charges are always quantized i.e. $Q = n \times e$

  where q = charge,

  n = no. of electrons

  e = charge on one electron i.e. 1.67×10^{-19} C
- Charge is relativistically constant

What is Electricity ?

What is Electricity ?

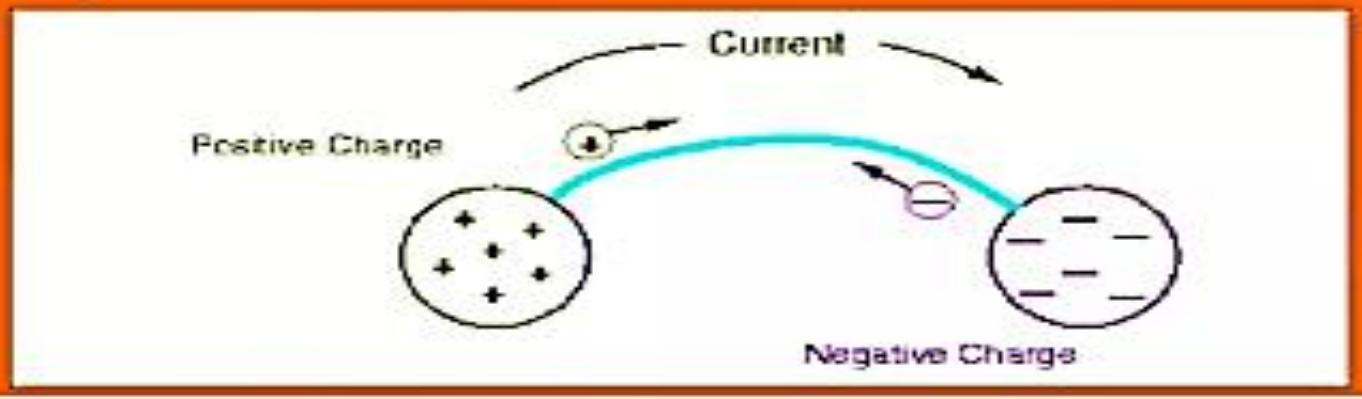
- Electricity is a form of a energy that can be easily changed to many other forms.
- It can also be defined as flow of electrons in a circuit.

Electric Current

Electric Current

- It is the rate of flow of electric charge (or electrons) through a conductor i.e.

  $I = Q/t = ne/t$ where I stands for current
- It is a scalar quantity
- Its S.I. unit is coulomb per second or amperes (A)
- It is measured by a device called Ammeter
- Its direction is taken opposite to the flow of electrons
- It flows as a result of potential difference across the ends of a conductor



Electric Field

Electric Field

- It is the 3 dimensional space around a charge in which the force of attraction or repulsion can be felt.

➢ Electric Field Intensity

❖ It is the force experienced by a unit positive test charge at a given point in an electric field.

- It is denoted by 'E'
- Its S.I. unit is newton per coulomb (N/C)
- It is a vector quantity

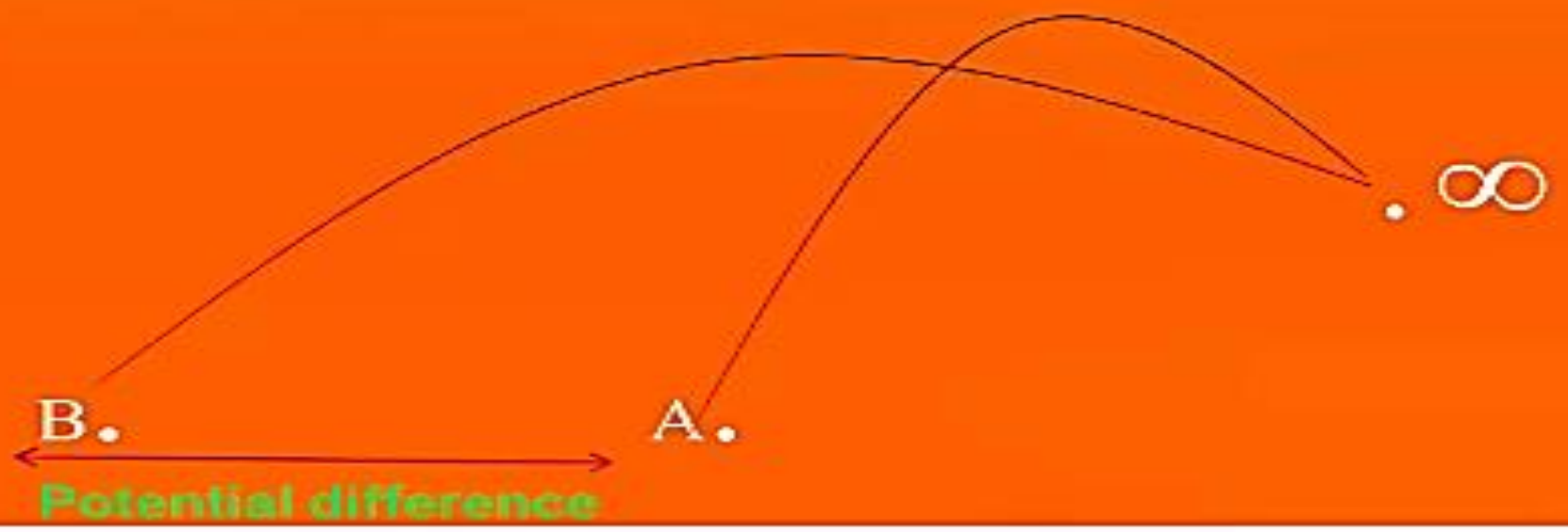
Electric Potential and Potential Difference

Electric Potential

- It is the amount of work done in bringing a unit positive charge from infinity to a given point in the electric field.
- It is a scalar quantity
- Its S.I. unit is joules per coulomb or volts (V)

Potential Difference

- It is the amount of work done in bringing a unit positive charge from one point to another point in an electric field.
- It is a scalar quantity
- Its S.I. unit is joules per coulomb or volts (V)
- It is responsible for the flow of current in a conductor.
- Measured by a device called Voltmeter.



Ohm's Law

Ohm's Law

GEORG SIMON OHM

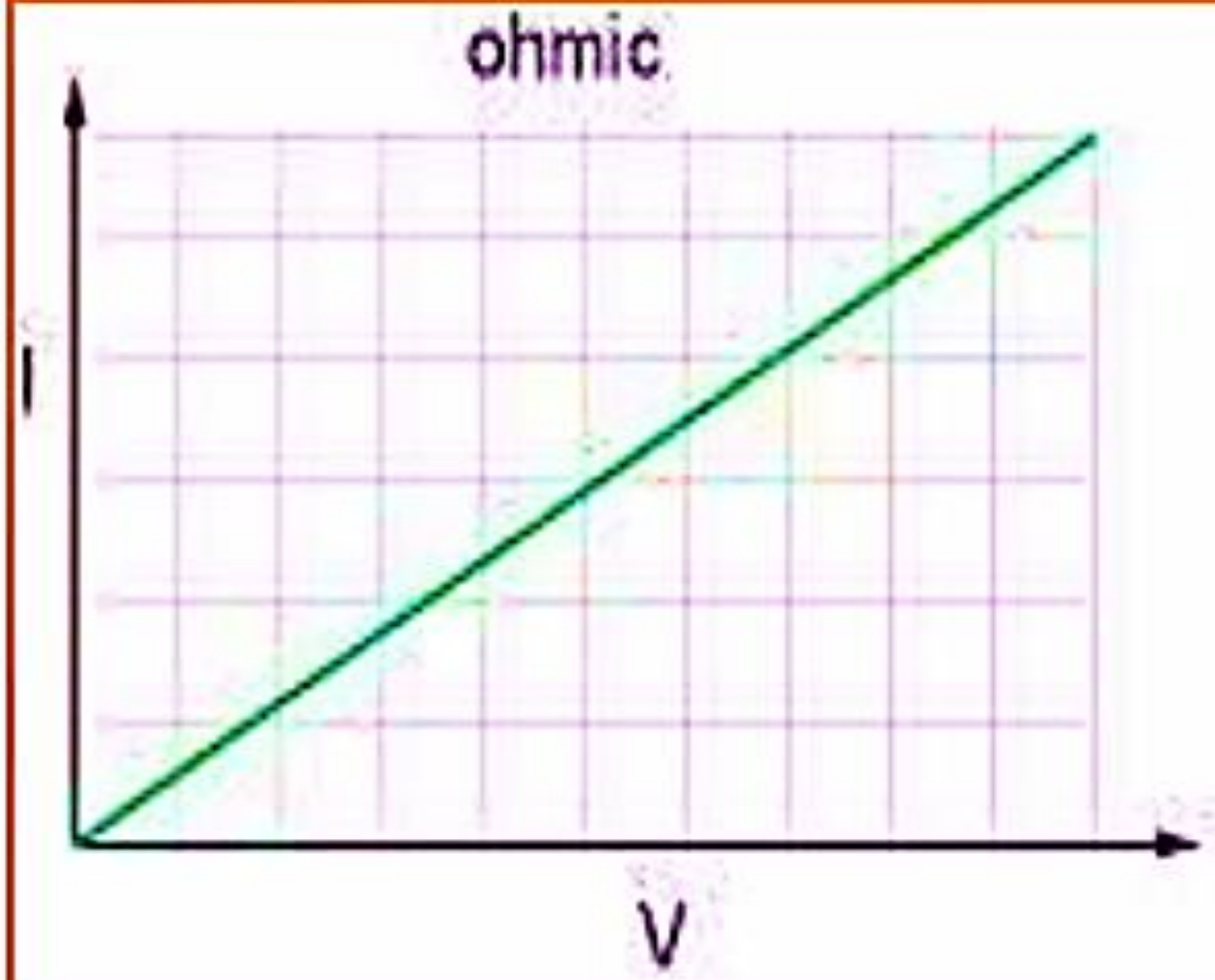
- It was stated by Georg Simon Ohm
- It states that at constant physical conditions like temperature are kept constant then the amount of current flowing through a conductor is directly proportional to the potential difference across its ends i.e.

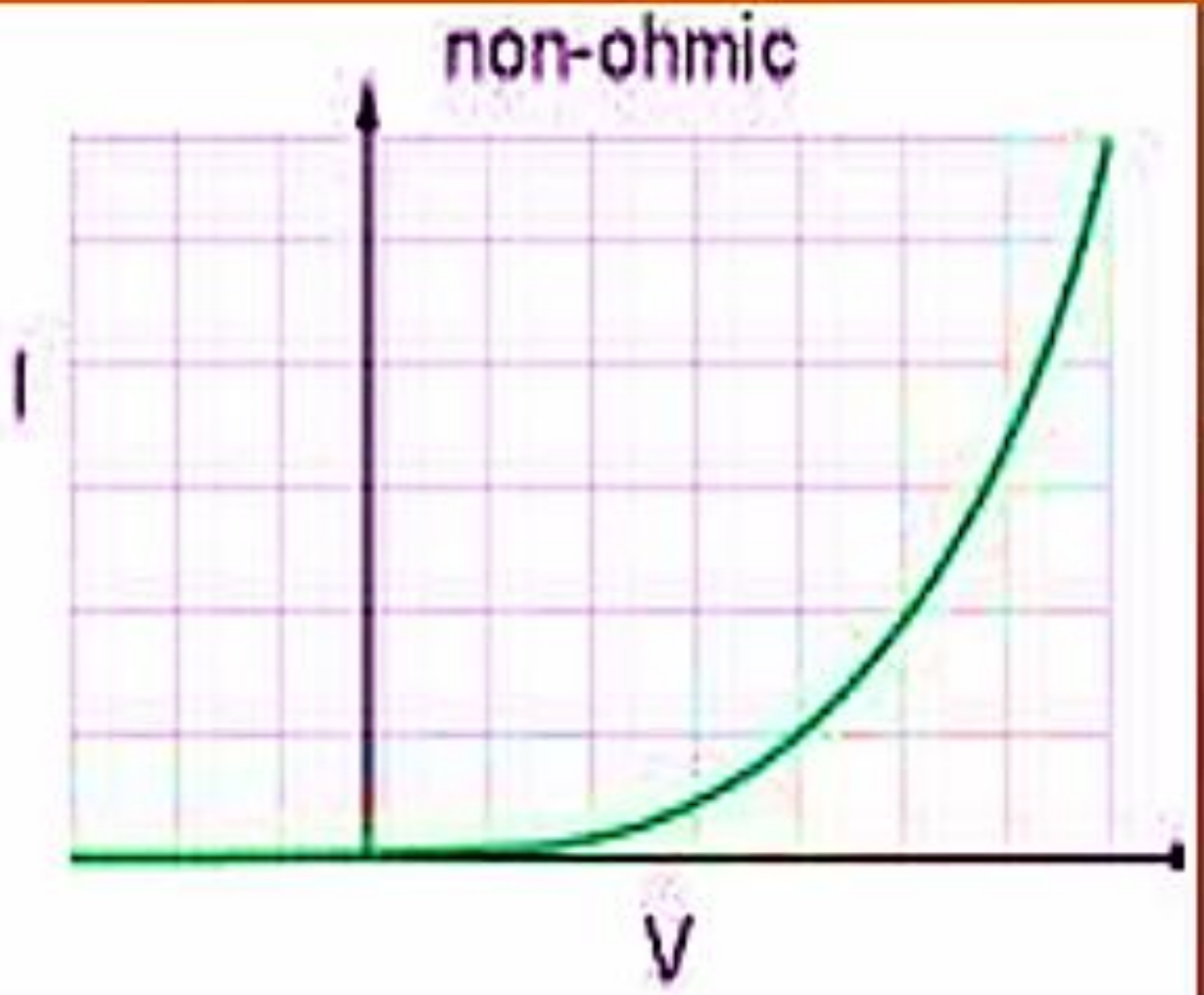
  $I \alpha V$

  $V = IR$ where R is constant called Resistance
- According to this law conductors are divide into -

1. Ohmic conductors (follow ohm's law)
2. Non- ohmic conductors (do not follow ohm's law)

I-V Graphs for Conductors

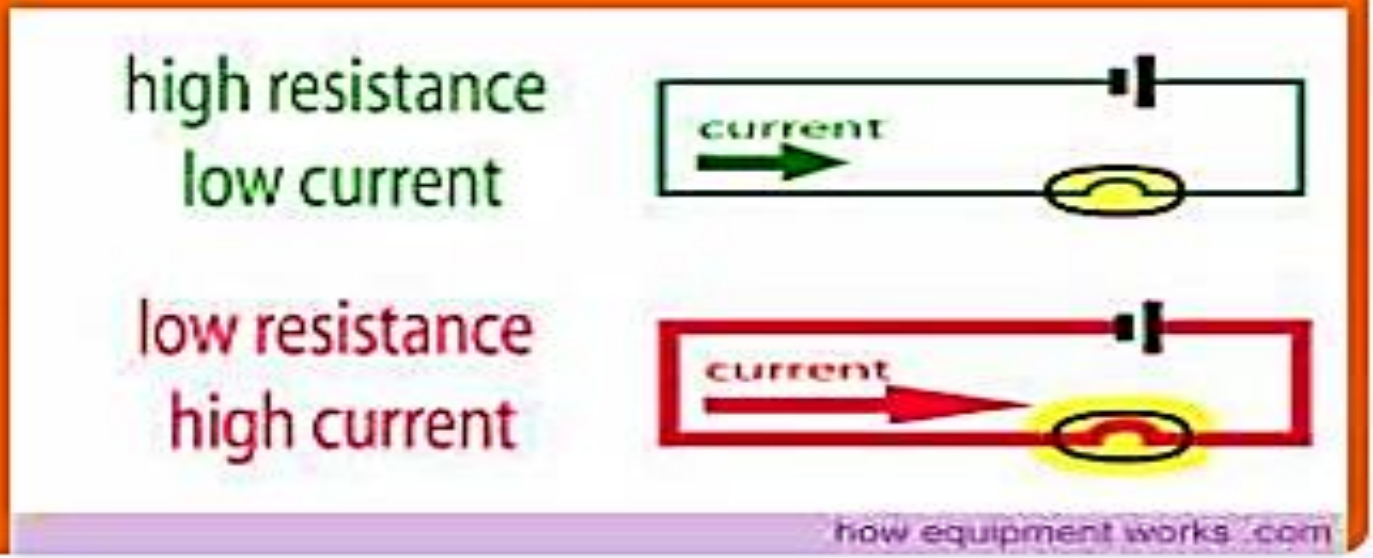




Resistance and Resistivity

Resistance

- It is defined as the hindrance to the flow of current
- It is the ratio of potential difference to current i.e.
  $R = V/I$
- Its S.I. unit is volts per ampere or Ohm (denoted by Ω)
- Reciprocal or resistance is called Conductance (C) . S.I. unit Ohm^{-1} i.e. Ω^{-1}

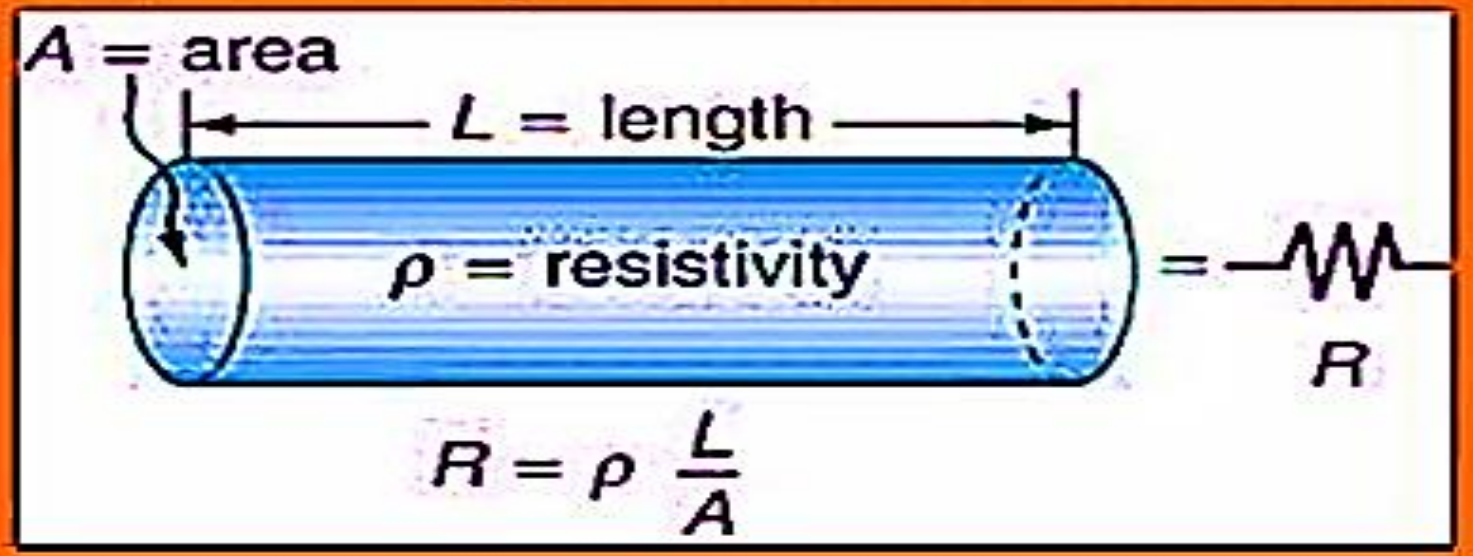


Factors affecting Resistance

- R α Length (l) .....(i)
- R α 1/Area of cross section of conductor (A) .....(ii)
- R α Resistivity (ρ) .....(iii)

From (i), (ii) and (iii) we get

➢ R = ρl/A where constant "ρ" is the specific resistance of the conductor



Types of Resistances

- **Fixed Resistances:** Their value does not change under constant physical conditions. They are set at a particular value
- **Variable Resistances:** Their resistance can be easily changed by changing area of cross section and length

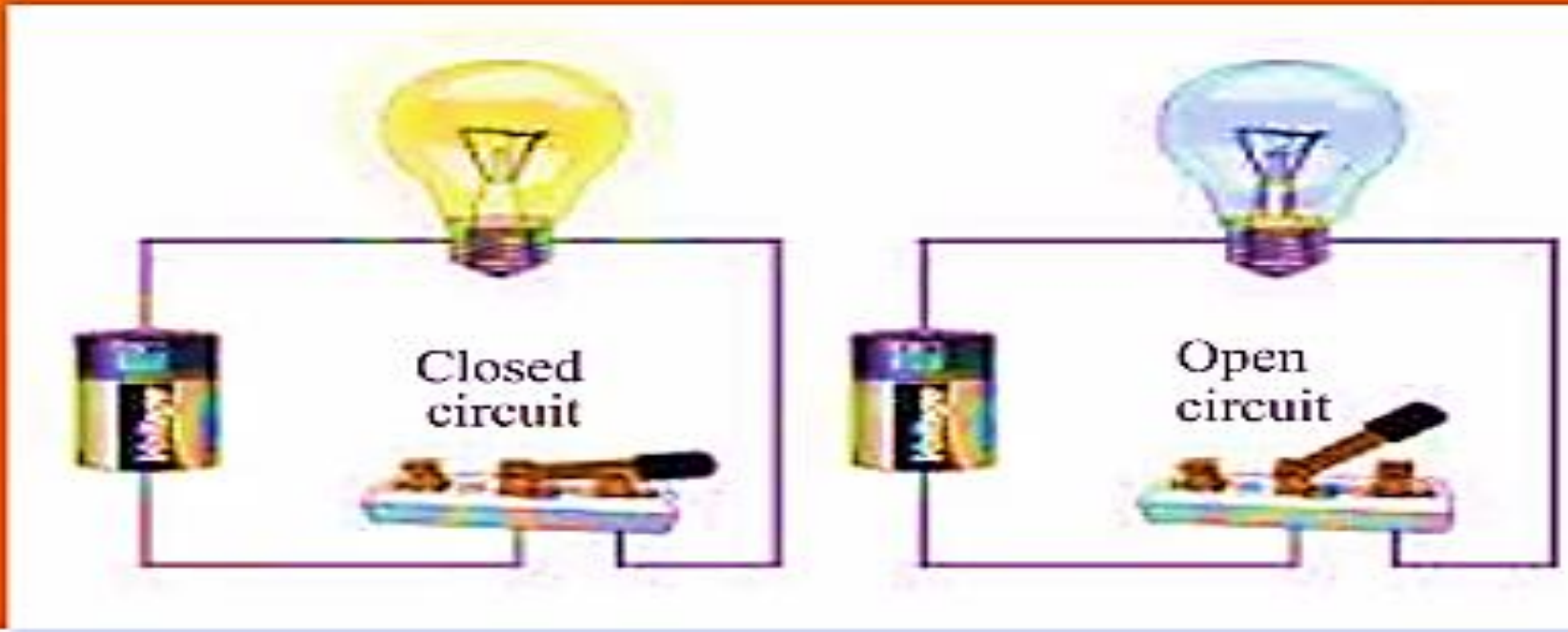
Fixed Resistors

Variable resistance or Rheostat

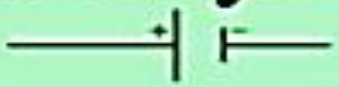
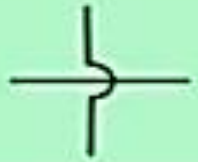
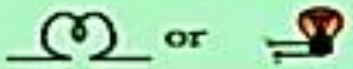
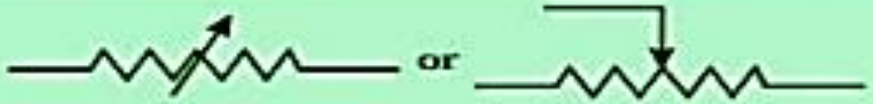
Electric Circuit and Its Components

Electric Circuit

- A closed path in which electric current can flow is called an electric circuit
- There are 2 types of circuits –
  1. Open Circuit: No current flows
  2. Closed Circuit: Current flows continuously



Electric Circuit Symbols

1	An electric cell	
2	A battery or a combination of cells	
3	Plug key or switch (open)	
4	Plug key or switch (closed)	
5	A wire joint	
6	Wires crossing without joining	
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or rheostat	
10	Ammeter	
11	Voltmeter	

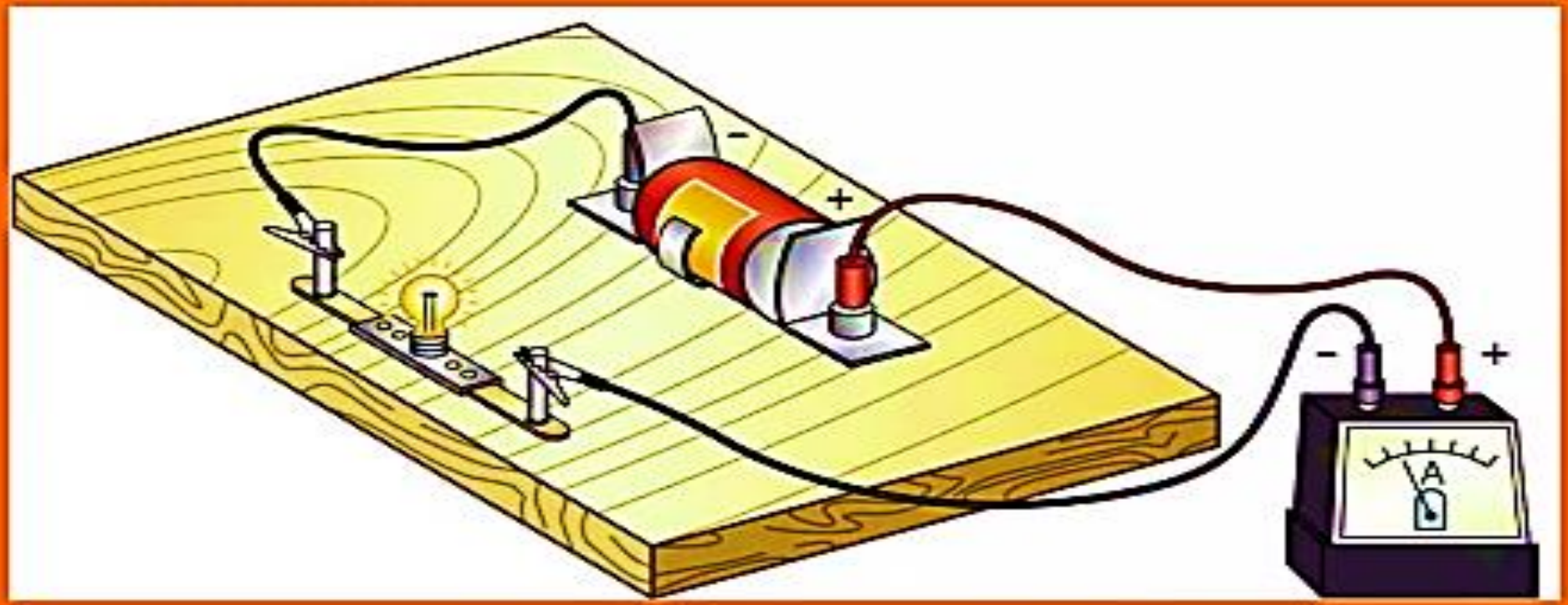
11.

Measuring Devices

Ammeter

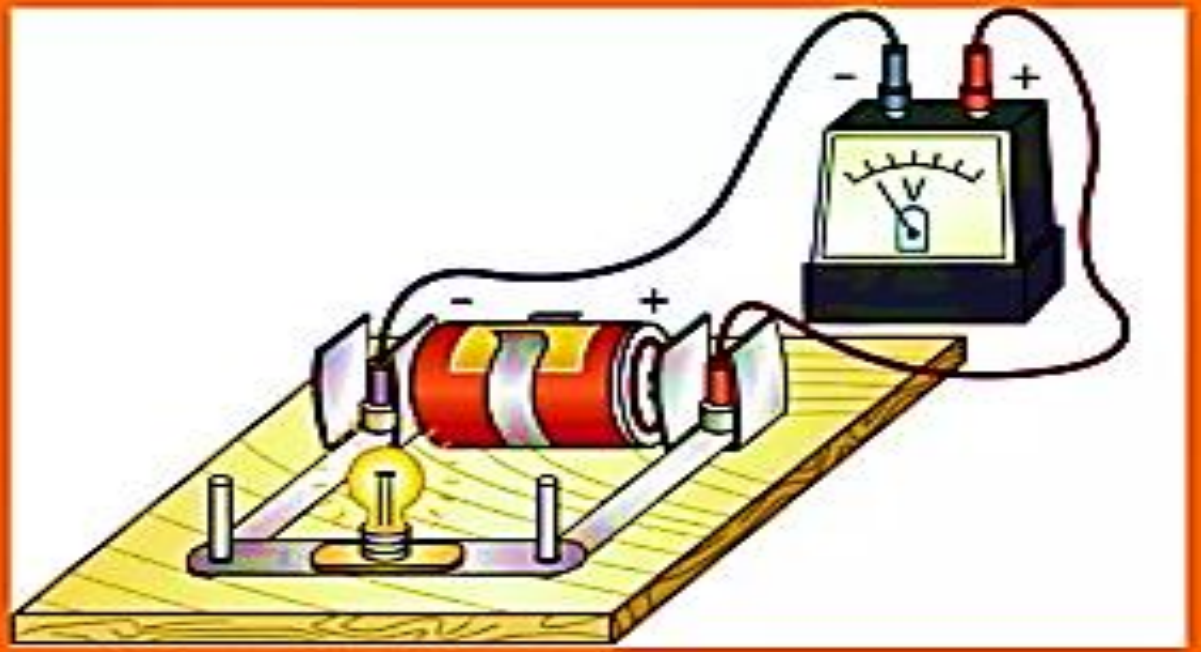
- It must be connected in series in the circuit.

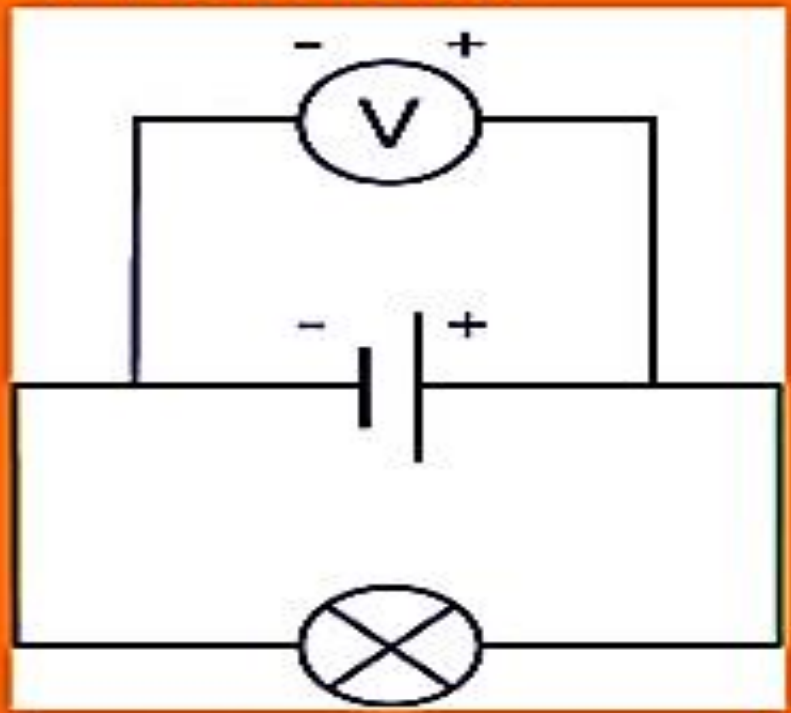
- Positive side of ammeter must be connected nearest to the positive terminal of the battery (electric cell), and vice versa.



Voltmeter

- Voltmeters must be connected in parallel to the circuit.
- The positive side of voltmeter is connected to the positive terminal of the cell, and vice versa.





Combination of Resistances

Combination of Resistances

There are 2 ways of joining resistors together

1. **Series Combination**
2. **Parallel Combination**

Resistance in Series

- The figure shows three resistances R_1, R_2, R_3 connected in series. Now suppose potential difference across resistance R_1 is V_1, R_2 is V_2 and R_3 is V_3. Let potential difference across battery be V, then :

$$V = V_1 + V_2 + V_3.$$

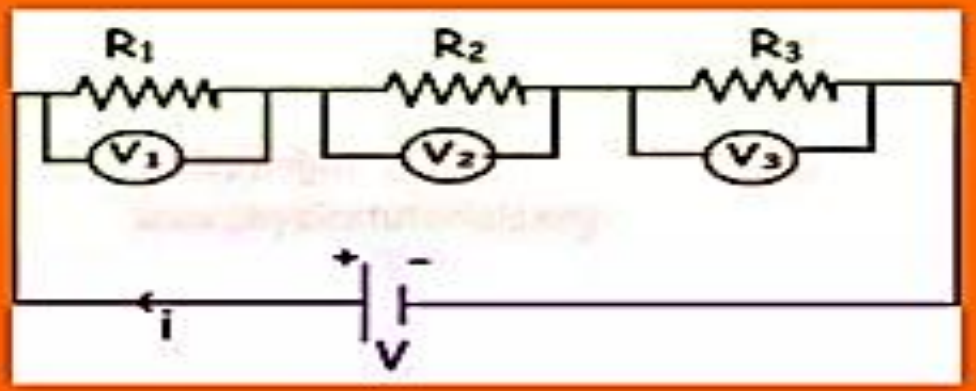
Applying Ohm's law to the whole circuit : $V = IR$. .....(1)

Applying Ohm's law to the three resistors separately, we get:

$V_1 = I \times R_1$. ..... (2)

$V_2 = I \times R_2$. ..... (3)

$V_3 = I \times R_3$. ..... (4)



Substituting (2), (3), (4) in (1)

$IR = IR_1 + IR_2 + IR_3$

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

Or, $R = R_1 + R_2 + R_3$.

Therefore we conclude that the sum total resistance in a series resistance connection is equal to the sum of all the resistances.

Resistance in Parallel

- The figure shows three resistances R_1, R_2, R_3 connected in series. Now suppose currant across resistance R_1 is I_1, R_2 is I_2 and R_3 is I_3. Let total current in the circuit be I, then:

$$I = I_1 + I_2 + I_3.$$

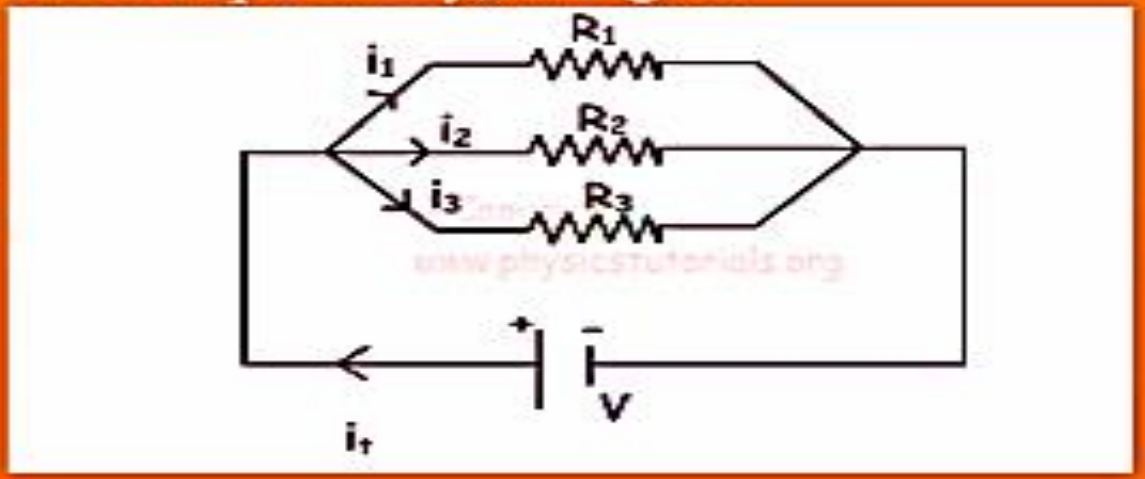
Applying Ohm's law to the whole circuit : $I = V/R$. .....(1)

Applying Ohm's law to the three resistors separately, we get:

$I_1 = V / R_1$. ..... (2)

$I_2 = V / R_2$. ..... (3)

$I_3 = V / R_3$. ..... (4)



Substituting (2), (3), (4) in (1)

$V/R = V/R_1 + V/R_2 + V/R_3$

OR, $V/R = V(1/R_1 + 1/R_2 + 1/R_3)$

Or, $1/R = 1/R_1 + 1/R_2 + 1/R_3$.

Therefore we conclude that the sum total resistance in a parallel resistance connection is equal to the sum of reciprocal of all the resistances.


THANK YOU