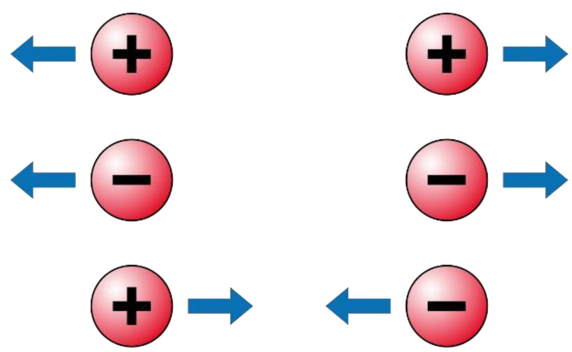
Charge:

There are two types of Charges

1) Positive Charge
2) Negative Charge

- Same charges repel each other and different charges attract each other



- SI unit of charge is Coulomb (C)

- 1 Coulomb means 6.24×10^{18} electrons

- An electron has negative charge of 1.6×10^{-19} C

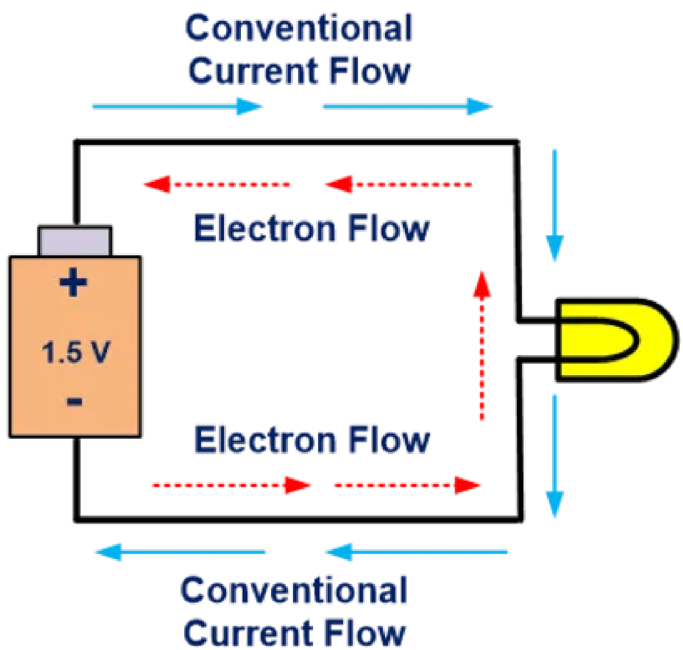
Electric Current:

- The rate of flow of charge is called Current

- Movement of Electrons makes Current

- In an electric circuit the direction of electric current is taken as opposite to the direction of the flow of electrons.

- Means if electrons are moving in Left then current is moving in Right direction

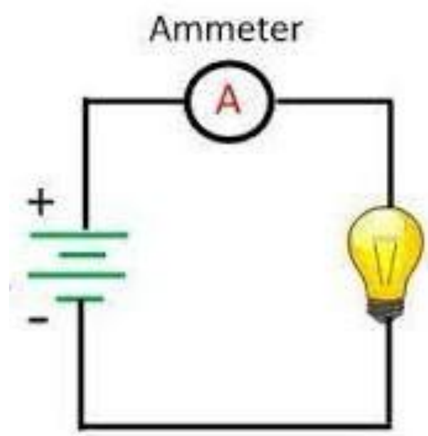


- The unit of electric current is Ampere

- $I = \frac{Q}{t}$ where I = Current, Q = Charge and t = time

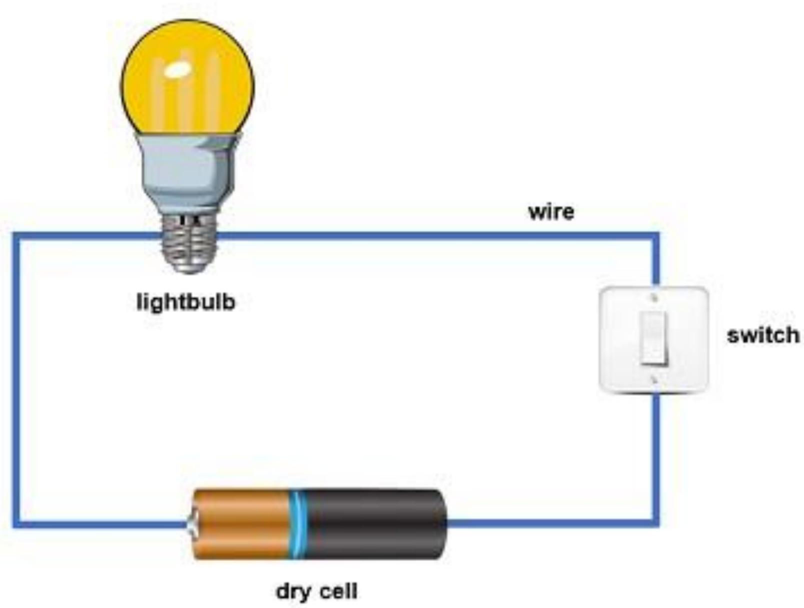
- 1 Ampere current may be defined as the flow of one coulomb of charge per second.

- Current is measured by <u>Ammeter</u> and Ammeter is always connected in Series.



Electric Circuit:

- Closed path of an electric current is called Electric circuit.
- If the Circuit is broken anywhere the current stops flowing.
- Electricity flows in the circuit from the Positive Terminal of the cell to the negative terminal of the cell.



Electric Potential:

- The amount of work done in bringing a unit positive charge from infinity to that point is called Electric Potential.
- The unit of electric potential is Voltage.
- Positive Charge move from Higher Potential to Lower Potential
  Whereas Electrons moves from Lower to Higher Potential.

Potential Difference:

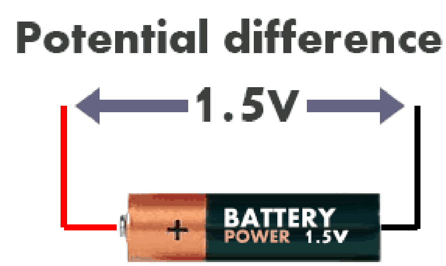
The power of a cell/battery is called its potential difference. For example, the cell of a TV remote gets exhausted after a few days of use, meaning its potential difference has decreased. A new cell/battery has a higher potential difference, and when used, the potential difference decreases with time.

- The amount of work done in bringing a unit positive charge from one point to another point is called Potential difference.

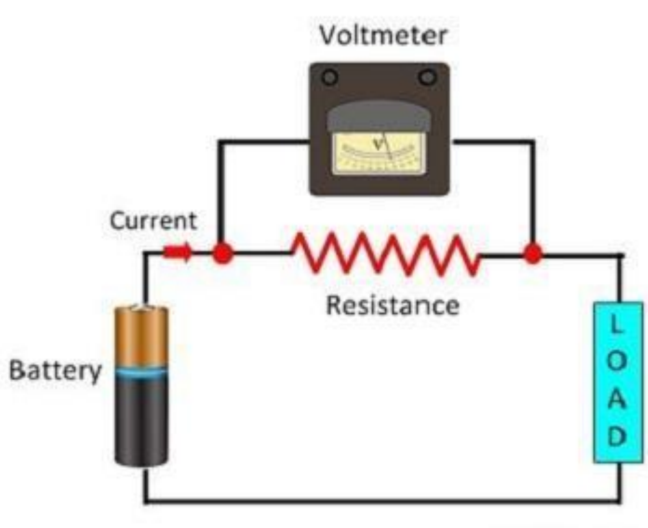
- Potential difference is created by cell or a Battery.

- $V = \frac{W}{Q}$ where V = Potential Difference, W = Workdone, Charge = Q

- SI unit of Potential difference is Volt (V)

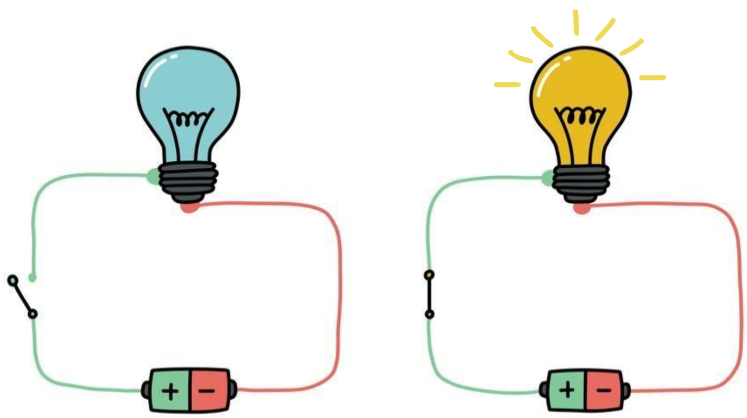


- Potential difference is measured by Voltameter and Voltmeter is always connected in Parallel.



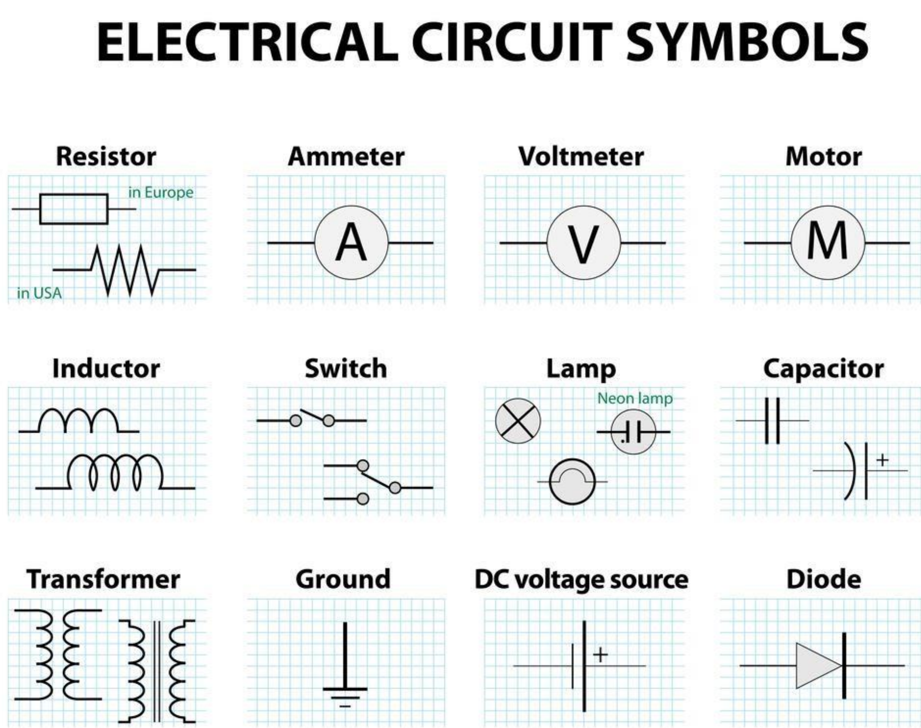
Circuit Diagram:

- An electric circuit contains a cell (or a battery), connecting wires, Plug key and electrical components.



SWITCH OFF SWITCH ON

- Symbols used in Circuit Diagram



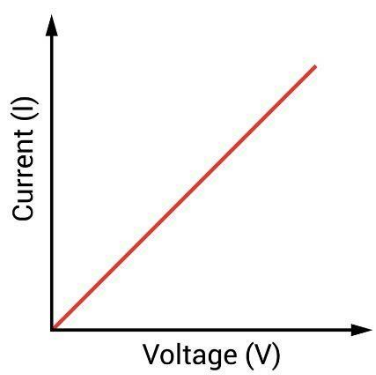
Ohm's Law:

- The current passing through a circuit is directly proportional to the potential difference (Voltage)
- Potential Difference $\propto$ Electric Current

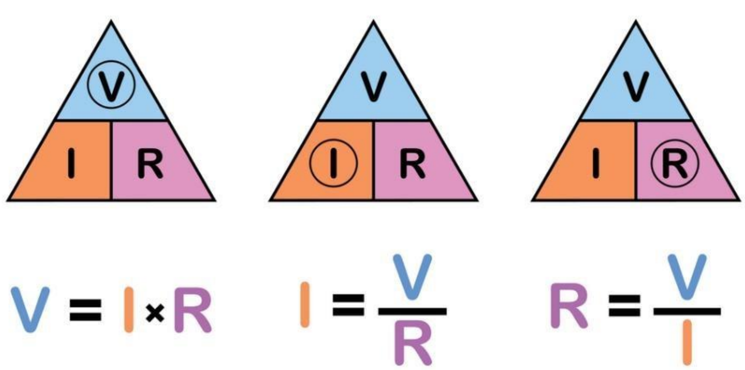
$$V \propto I$$

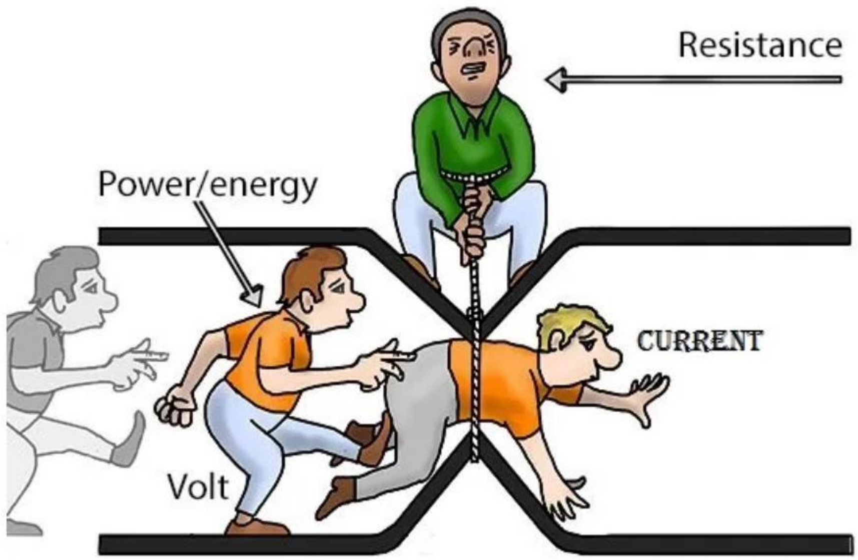
$$V = IR$$

Here R is constant for the given conductor and is called Resistance.



- Ohm's Law is valid only when temperature is constant. If temperature changes resistance also changes दजसकी वजह से Ohm's Law भी change हो जाता है





Resistance:

- Something that opposes the flow of current that is called Resistance.

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

- The SI unit of Resistance is ohm (Ω)

- The electrical appliance which is used to oppose the current is called Resistor.

- Variable resistance (Rheostat) is the component used to increase or decrease current without changing the Voltage.

Factors affecting Resistance

1) Length of conductor –

If the wire is long then the resistance will be high and if the wire is short then the resistance will be low.

→ Low Resistance

→ High Resistance

2) Area of Cross- Section –

If the wire is thick, the resistance will be low.

And if the wire is thin, the resistance will be high.

→ Low Resistance

→ High Resistance

3) Nature of Material -

This depends on what the wire is made of.

For example, silver and copper have low resistance, while tungsten has high resistance.

Silver has the lowest resistance among all elements

4) Temperature -

Resistance also increases as the temperature increases.

Resistivity

- Electrical resistance of a conductor of unit cross-sectional area and unit length is called Resistivity

$$R = \rho \frac{L}{A}$$

- Here, ρ (rho) is a constant of proportionality and is called the electrical resistivity.
- The SI unit of resistivity is Ωm
- Resistivity also increases if temperature increases.
- Insulators have high Resistance and Resistivity
- Conductors have low Resistance and Resistivity.

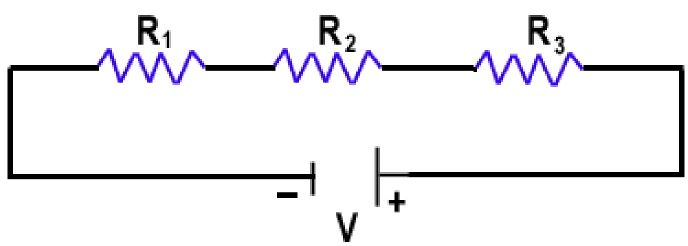
Combination of Resistors:

- There are two types of Combinations of Resistors.

  1) Series Combination

  2) Parallel Combination

Resistance in Series



- Same Current flows through the circuit means Same current flows through each resistor.

- Voltage will be sum of all Voltages across each resistor.

- Ohm's Law can be applied to this combination to find Equivalent Resistance.

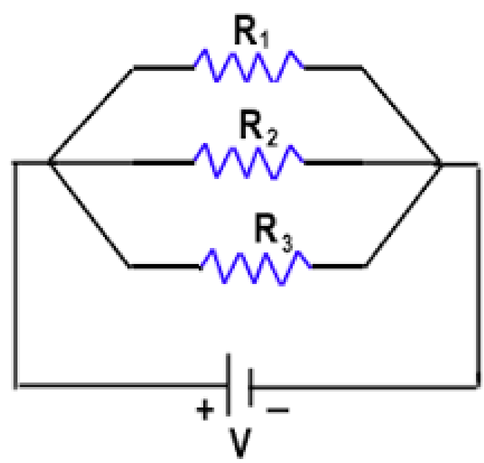
Equivalent Resistance (R_s) in series combination –

$$R_s = R_1 + R_2 + R_3$$

- Equivalent Resistance (R_s) is always greater than each individual resistance in series combination.

$R_s > R_1$
$R_s > R_2$
$R_s > R_3$

Resistance in Parallel



- Potential difference between the two points across resistors are same.

- There will be different current flowing through each resistor.

Equivalent Resistance (Rp) in series combination –

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

- Equivalent resistance of resistors in parallel combination is always less than the individual resistances.

$R_p < R_1$
$R_p < R_2$
$R_p < R_3$

Advantage of Parallel Combination –

- In parallel combination each appliance gets the full voltage.
- If one appliance is switched on, others are not affected.

Heating Effect of Electric Current:

- When an electric current is passed through a conductor, it generates heat due to the Resistance.
- Workdone = VQ

Power:

- The rate of consumption of energy in an electric circuit is called Electric Power.
- $\text{Power} = \frac{\text{Workdone}}{\text{time}} = \frac{VQ}{t} = V\frac{Q}{t} = VI$
- Heat = Power x time

$$= VI \times t$$
$$= IR \times I \times t \quad \text{[Because } V = IR\text{]}$$
$$= I^2Rt$$

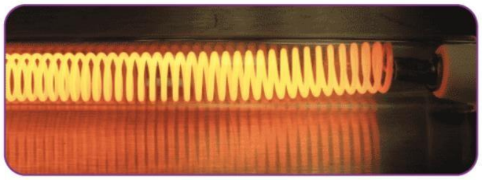
Joule's law of heating:

Factors affecting Heat produced –

1) Current in Conductor –

As the current increases, the heat will also increase, for example, there is more current in the wires of a transformer, hence those wires become more hot.
Because Heat is directly proportional to the square of current.
$H \propto I^2$

2) Resistance –
Heat increases as resistance increases, for example, the wires of a bulb and a press have high resistance, so they heat up quickly.
Because Heat is directly proportional to the Resistance.
$H \propto R$



Electric Coil

3) Time –
If current continues to flow in a wire for a long time, then that wire gets heated, just like the phone gets heated if you use it for a long time
Because Heat is directly proportional to the Time.
$H \propto T$

Electric Bulb:

- The filament of Bulb is made of Tungsten.
- Tungsten has very high melting point (3380° C)
- Nitrogen and Argon gas are filled inside the bulb which does not allow the bulb wire to burn.

Electric Power:

- The rate at which electrical energy is consumed is called Electric Power.
- $P = VI = I^2R = \frac{V^2}{R}$
- The SI unit of Electric Power is Watt (W).
- On large scale we measure electricity or electric power as Kilowatt (1000 Watt).
- Energy is counted in ($P \times t$) so the unit we use to measure energy consumption commercially in KWh.

1 kWh = 1000 watt × 1 hour = 1 unit = 1000 W × 3600 s

1 kWh = 3.6×10^6 watt second = 3.6×10^6 J