CHAPTER 12 ELECTRICITY

Charge

Charge is a fundamental particle in an atom. It may be positive or negative.

Like charges repel each other.

Unlike charges attract each other.

S.I.unit of charge is coulomb (C)

1 Coulomb charge = Charge present on approx. 6×10^{18} electrons

Charge on 1 electron = -1.6×10^{-19}C

$$\boxed{Q = ne}$$

$$Where\ Q = Charge(total)$$

$$n = No.of electrons$$

$$e = Charge\ on\ 1\ electron$$

Current (I)

The rate of flow of charge is called current.

$$\text{current} = \frac{\text{charge}}{\text{time}}$$

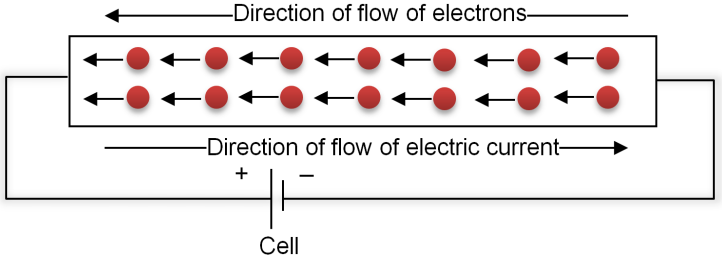
$$\boxed{I = \frac{Q}{t}}$$

S.I.unit of current is Ampere (A)

$$1mA = 10^{-3}A \qquad (mA = miliampere)$$

$$1\mu A = 10^{-6}A \qquad (\mu A = microampere)$$

- There are two different types of current in use today. They are **direct current** (DC) and **alternating current** (AC). In a direct current, the electrons flow in one direction.
- In an electric circuit, when the electric charge is flowing in one direction, the current will flow in the opposite direction.



Electric circuit

The electric circuits are closed-loop or path which forms a network of electrical components, where electrons are able to flow. This path is made using electrical wires and is powered by a source, like a battery.

Potential Difference (V)

Work done to move a unit charge from one point to another point is called the potential difference. S. I. unit of Potential difference is Volt (V)

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

1 Volt

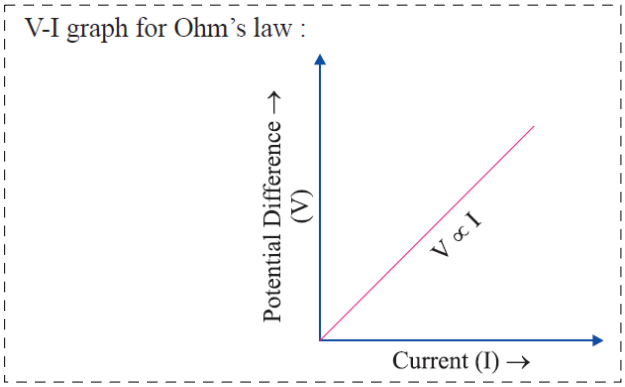
When 1-joule work is done in carrying one Coulomb charge then the potential difference is called 1 volt.

$$When \quad W = 1, Q = 1,$$
$$Then \quad V = 1$$

Ohm's Law

At constant temperature Potential difference across the two points of a metallic conductor is directly proportional to current.

$$V \propto I$$
$$\boxed{V = IR}$$



Resistance (R)

It is the property of a conductor to resist the flow of charges through it.

• Ohm (Ω) is the S. I. unit of resistance.

1 ohm

When the potential difference is 1V and current through the circuit is 1A, then resistance is 1 ohm.

Factors on which the resistance of a conductor depends

The resistance of a uniform metallic conductor is directly proportional to its length (l) and inversely proportional to the area of cross-section (A).

$$R \propto l \quad \text{.....(1)}$$

$$R \propto \frac{1}{A} \quad \text{.....(2)}$$

$$R \propto \frac{l}{A} \qquad \text{where } \boxed{A = \pi r^2}$$

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

Where ρ (rho) is a constant of proportionality and is called the **electrical resistivity** or **specific resistance** of the material of the conductor. The SI unit of resistivity is **Ωm**.

The resistance of a conductor depends on the nature of the material of which it is made. Some materials have low resistance, whereas other have high resistance.

Resistivity

- The resistivity of a material does not depend on its length or thickness but depends on the nature of the substance and temperature.
- Insulators such as glass, rubber, etc., have a very high resistivity (10^{12} to 10^{17} Ωm), while conductors have a very low resistivity (10^{-8} to 10^{-6} Ωm).
- Alloys have higher resistivity than that of their constituent metal. They do not oxidize easily at high temperatures, this is why they are used to make heating element of devices such as electric iron, heaters, etc.,
- Tungsten is almost used exclusively for filaments of electric bulbs, whereas copper and aluminum are generally used for electrical transmission lines.

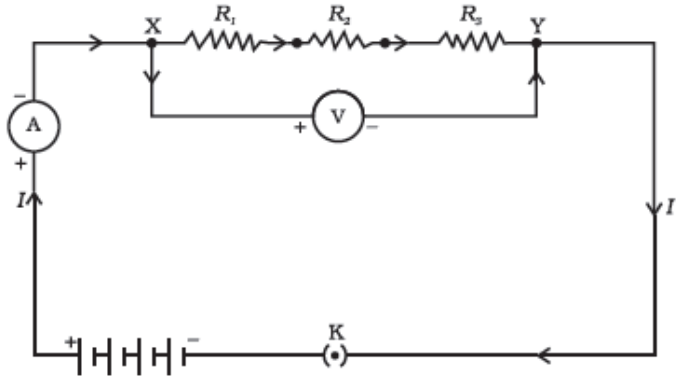
Resistor

An electrical component with two terminals that are used for either limiting or regulating the flow of electric current in electrical circuits.

- The main purpose of a resistor is to reduce the current flow and to lower the voltage in any particular portion of the circuit.

Resistors in series

When two or more resistors are connected end to end, the arrangement is called a series combination.



Total/resultant/overall/effective resistance in series

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