## Electric Current

**Electricity**

* **Electric current** is expressed as the amount of charge flowing through a particular area in unit time.
* Quantitatively, **electric current** is defined as the rate of flow of electric charge.

**Current, I  Charge flowing (Q)**

**Time taken (t)**

* The S.I. unit of current is **ampere (A)**, where 1 ampere = 1 coulomb/second.
* 1 mA = 10−3 A, 1 μ A = 10−6 A
* The conventional direction of electric current is the one in which positive charges move orderly.

## Electric Potential Different

* Electric potential difference (pd) between two points in an electric circuit, carrying some current, is the amount of work done to move a unit charge from one point to another.

**Potential difference, pd **

**Work done (W) Quanity of charge moved (Q)**

* The S.I. unit of pd is **volt (V)**, where 1 volt = 1 joule/coulomb.

## Electric Circuit

* A continuous conducting path between the terminals of a source of electricity is called an **electric circuit.**
* A drawing showing the way various electric devices are connected in a circuit is called a **circuit diagram**.
* Some commonly used circuit elements are given below:

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Element** | **Symbol** |
| 1 | An electric cell |  |
| 2 | A battery |  |
| 3 | Plug key or switch (open) |  |
| 4 | Plug key or switch (closed) |  |
| 5 | A wire joint |  |

|  |  |  |
| --- | --- | --- |
| 6 | Wires crossing without joining |  |
| 7 | Bulb |  |
| 8 | Resistor |  |
| 9 | Variable resistor or Rheostat |  |
| 10 | Ammeter |  |
| 11 | Voltmeter |  |

## Ohm’s law

* According to Ohm’s law, the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, provided its physical conditions remain the same.

**V**  **I**

#### V/ I = Constant V/ I = R

**V = IR**

where R is a constant of proportionality called **resistance** of the conductor.

* **Resistance** is the property of a conductor to resist the flow of charges through it.
* The S.I. unit of resistance is **ohm ( Ω ).**

From R  V , 1 ohm = 1 volt/ampere

I

## Resistivity

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

#### R  l/ A R = ρ l/A

where ρ is a constant of proportionality called **specific resistance** or **resistivity** of the material of the conductor.

* The S.I. unit of resistivity is **ohm metre ( Ω m).**

## Combination of Resistances

### Resistances in Series

* The current flowing through each resistance is the same.
* The potential difference across the ends of the series combination is distributed across the resistances.
* The equivalent resistance (Rs) of a series combination containing resistances R1, R2, R3... is

**Rs  R1  R2  R3  ...**

* The equivalent resistance is greater than the greatest resistance in the combination.

**Resistances in Parallel**

* The potential difference across each resistance is the same and is equal to the potential difference across the combination.
* The main current divides itself, and a different current flows through each resistance.
* The equivalent resistance (Rp) of a parallel combination containing resistances R1, R2, R3... is given by

**1  1  1**

**Rp R1 R2**

** 1  ... R3**

* The equivalent resistance is lesser than the least of all the resistances in the combination

### Heating Effect of Electric Current

* The effect of electric current due to which heat is produced in a conductor, when current passes through it, is called the heating effect of electric current.
* The total work (W) done by the current in an electric circuit is called **electric energy** and is given as

#### W = VIt = I²Rt W = V² t /R

This energy is exhibited as heat. Thus, we have H  VIt  I2Rt.

This is called **Joule’s Law of Heating**, which states that the heat produced in a resistor is directly proportional to the

* Square of the current in the resistor
* Resistance of the resistor
* Time for which the current flows through the resistance

### Practical Applications of the Heating Effects of Electric Current

* Electrical appliances like laundry iron, toaster, oven, kettle and heater are some devices based on Joule’s Law of Heating.
* The concept of electric heating is also used to produce light, as in an electric bulb.
* Another application of Joule’s Law of Heating is the fuse used in electric circuits.

### Electric Power

* Electric power is the rate at which electrical energy is produced or consumed in an electric circuit

#### P = VI = I²R

**P = V²/R**

* The **S.I. unit** of power is **watt (W).**
* One watt of power is consumed when 1 A of current flows at a potential difference of 1 V. The commercial unit of electric energy is **kilowatt hour (kWh)**, commonly known as a **unit**. **1 kWh = 3.6 MJ**