Electrostatic Potential: When electric charges move through a conductor, an electric field interacts with the moving charges and hence some energy is spent in moving the charges in forward direction. The measure of the energy spent is called the electrostatic potential. Thus, the electrostatic potential at any point may be defined as the work done in bringing a unit positive charge from infinity to that point. It is denoted by the letter "V" and is measured in Volt. Thus a potential is said to be 1 Volt if 1 joules of work is done in bringing a charge of 1 coulomb from infinity to that point.

Potential difference: The Potential difference between two points is defined as the amount of work done in moving a unit positive charge from one point to another in an electric circuit. If "W" be the amount of work done in moving "Q" coulomb of charge from one point to another , then potential difference "V" between two points is given as;

$$\text{Pot. Difference} = \frac{\text{Work done}}{\text{Quantity of charge transferred}} \Longrightarrow V = \frac{W}{Q}$$

Measurement of potential difference: The potential difference is measured by an instrument called as voltmeter. It is connected in parallel with the circuit. An ideal voltmeter should have a high resistance so that it takes a negligible current from the circuit.

Units of potential difference:- The S.I. unit of potential difference is Volt. The potential difference between any two charges is said to be one volt if work of 1 joule is done in moving 1 coulomb of charge from one point to another i.e.

$$1\ \text{Volt} = \frac{1\ \text{joule}}{1\ \text{coulomb}} \Longrightarrow 1V = \frac{1J}{1C}$$

Electric current: The flow of electric charge through a conductor is called as electric current and the magnitude of electric current is the amount of electric charge passing through a given point of conductor in one second .

Consider a charge of "Q" coulombs flowing though a conductor in time "t" seconds, then the magnitude of electric current flowing through the conductor "I" can be given as under,

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

The S.I. unit of electric current is Ampere denoted by letter "A". Current is said to be one ampere if a charge of 1 coulomb flows through any conductor in one second, i.e

$$1\ \text{ampere} = \frac{1\ \text{Coulomb}}{1\ \text{second.}}$$

Measurement of Current: Current flowing through a circuit is measured by an instrument called as ammeter. It is connected in series with the circuit in which the current is to be measured. An ideal ammeter should have a very low Resistance (shunt) so that it may not change the value of electric current flowing in the circuit.

Relationship between Potential difference and Current Or Ohm's Law:

According to ohm's Law , "At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends". If "I" be the current flowing through a conductor and "V" the Potential difference across its ends, then according to the Ohm's law,

$$I \propto V$$

Or $$V \propto I$$

Or $$V = R.I$$

Where "R" is constant of Proportionality and is called as resistance of a conductor.

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

Or $V = IR$

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

Thus from above equation it is quite clear that the current flowing through a conductor "I" is directly proportional to its Potential difference "V" and inversely proportional to the resistance "R".

<u>Experimental Verification Of Ohm's Law:</u>

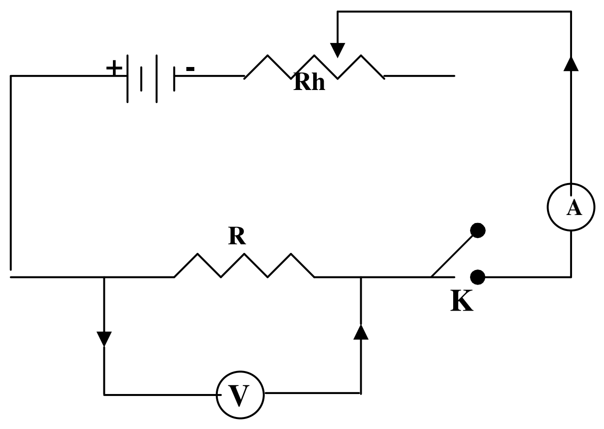
The circuit diagram for the verification of Ohm's Law is as shown as under:

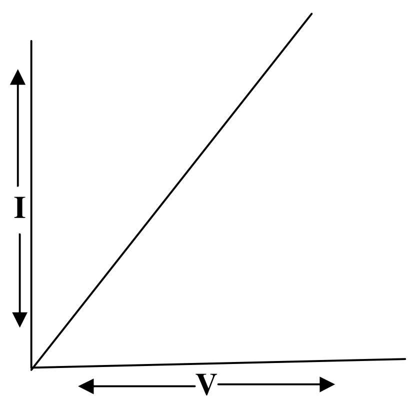
In this circuit a conductor having resistance "R" is connected in series with an ammeter "A", battery "B", key "K" and a rheostat "Rh". The voltmeter "V" is connected across the conductor to measure the voltage .The Ammeter measures the current through the resistance "R". The purpose of rheostat is to change the circuit resistance and hence current .The key "K" is to make or break the circuit.

To start the experiment, close the key "K" and set the rheostat "Rh" at some value .Take the reading of voltmeter "V" and ammeter "A". Let it be V_1 and I_1 respectively. Find the ratio of V_1/I_1.Now change the setting of rheostat so that current in the circuit changes. Note down the readings again. Let it be V_2 and I_2 respectively. Find the ratio of $V_2$and I_2.It will be found that

$$\frac{V_1}{I_1} = \frac{V_2}{I_2}$$

On taking a number of readings , it is observed that the ratio of potential difference to current in each case is constant and is equal to the resistance of the conductor .If we plot a graph between the voltage and current ,a straight line is obtained, which also proves the Ohm's law.





<u>Resistance of a Conductor:</u> Resistance of a conductor is defined as the property due to which it opposes the flow of current through it . It is defined by letter "R" and is equal to the ratio of potential difference across its ends to the current flowing through it.

Thus,

$$\text{Resistance} = \frac{\text{Potential Difference}}{\text{Current}}$$

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

The S.I. Unit of resistance is Ohm denoted by Greek symbol Omega(Ω).The Resistance of a conductor is said to be 1 Ohm if a potential difference of 1 volt is applied across its ends and a current of 1 ampere is flowing through it, i.e

$$1 \text{ Ohm} = \frac{1 \text{ Volt}}{1 \text{ Ampere}}$$

Factors on which Resistance of a conductor depends:

Resistance of a conductor depends upon:

a) Length:- If the length of a conductor increases, the electrons have to travel a longer distance and as a result fo this, its resistance increases. If ‘l’ is the length of the conductor then

Thus, $\mathcal{R} \alpha \ell$ …………………… (1)

b) Cross-Sectional area:- If the cross-sectional area of the conductor decreases, the electrons find it more difficult to pass through it and as such its resistance increases. Thus.

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

Combining 1 and 2, we get

$$R \propto \frac{l}{A}$$

$$R \propto \frac{Pl}{A}$$

Where $\mathcal{P}$ is a constant of proportionality and is called the specific resistance or resistivity of the conductor. The resistivity of conductor depends on the nature of its material.

Resistivity:- Resistivity of a material is defined as the resistance offered by a cube of the material of side one metre when the current flows perpendicular to the opposite faces of the cube. It is defined as the resistance of the conductor of length 1m having area of cross-section $1m^2$.

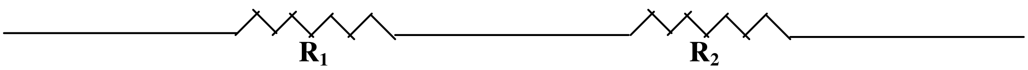
Unit of Resistivity:-

We know that $R = \frac{Pl}{A}$, $\mathcal{P} = \frac{RA}{l}$

Unit of P is $\frac{ohm \times m^2}{m} = ohm - m$

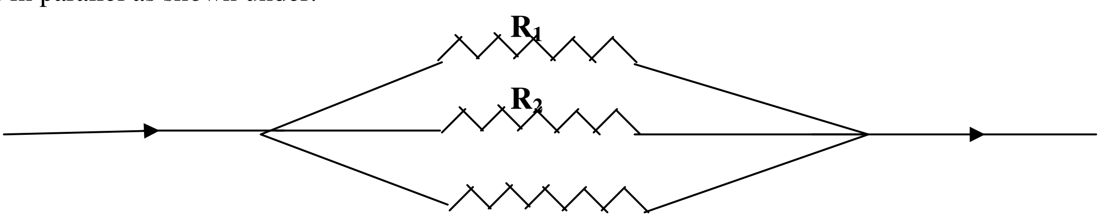
Combination of Resistance: The Resistance can be combined in two ways in electrical circuit viz.

I) In Series: When two or more resistance are connected end to end consecutively, they are said to be connected in series as shown under:



The current flowing through each resistances placed in series remains same.

II) In Parallel: When two or more resistances are connected between the same two points, they are said to be connected in parallel as shown under:



A **R_3** **B**

The potential difference across the ends of each resistance remains same.

Law of Combination of Resistances:

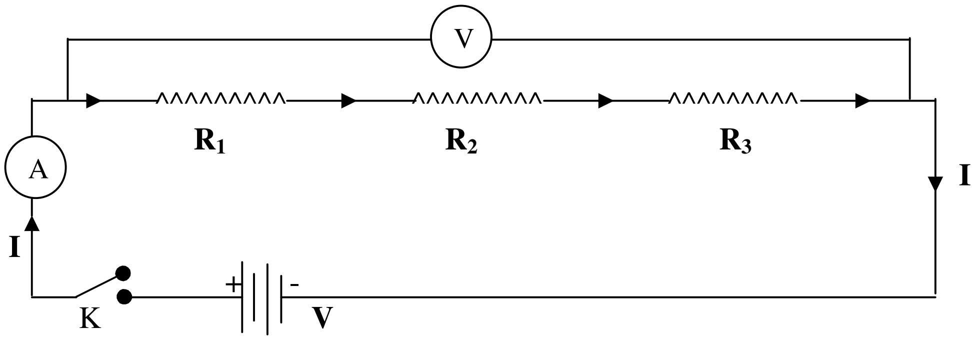
1) Law of combination of resistances in series:

According to this law, "The combined resistance of any number of resistances connected in series in a circuit is equal to the sum of their individual resistances". For example if a number of resistances $\mathbf{R_1, R_2, R_3, R_4}$**--------**$\mathbf{R_n}$ are connected in series, then their resultant resistance is given by.

$$\mathbf{Rs = R_1 + R_2 + R_3 + R_4 \text{--------------} R_n}$$

Expression for total resistance of a number of resistances connected in series:

Consider three resistances R_1, R_2 and R_3 connected in series as shown under in the figure.



Let "V" be the total voltage applied across the ends and "I" be the total current flowing through the circuit. Then, according to the Ohm's law, we have:

$$V = I \cdot R_s \quad \left[\text{because } R = \frac{V}{I}\right]$$

Therefore, Voltage drop across resistance R_1, can be given as:

$$V_1 = I \cdot R_1 \quad \text{--------------------} \ (i)$$

And Voltage drop across resistance R_2, can be given as:

$$V_2 = I \cdot R_2 \quad \text{------------------} \ (ii)$$

And Voltage drop across resistance R_3, can be given as:

$$V_3 = I \cdot R_3 \quad \text{------------------} \ (iii)$$

Since total voltage applied on the circuit is V, then:

$$V = V_1 + V_2 + V_3$$

$$\Rightarrow \quad V = I R_1 + I R_2 + I R_3 \quad (\text{Using Eq.s i, ii and iii})$$

$$\Rightarrow \quad V = I (R_1 + R_2 + R_3)$$

$$\Rightarrow \quad V / I = R_1 + R_2 + R_3$$

But, from Ohm's law, we have:

$$V / I = R$$

Then

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

Hence, the total resistance of a no. of resistances connected in series in a circuit is given by the algebraic sum of their individual resistances.

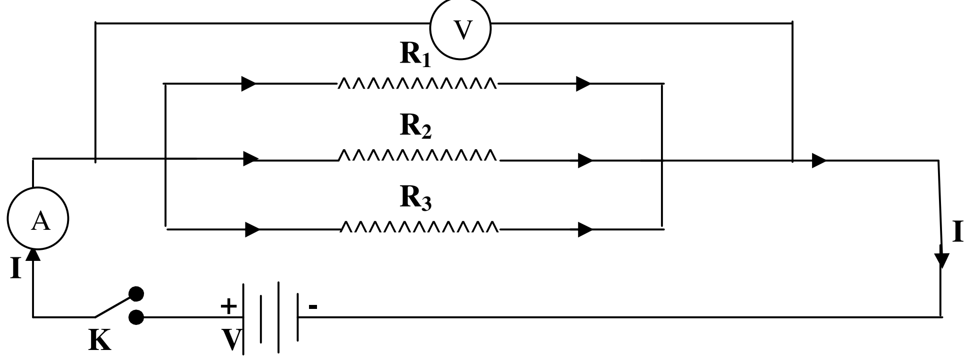
2) Law of Combination of resistances in Parallel:

According to this, "The Reciprocal of the combined resistances of a number of resistances of a number of resistances connected in parallel is equal to the sum of the reciprocal of all the individual resistances". If a number of resistances **R_1, R_2, R_3, R_4--------R_n are** connected in parallel, then their combined resistance **R** is given as under:

$$\overrightarrow{1/R} = 1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 \text{------------------------} 1/R_n$$

Expression for total resistance of a number of resistances connected in parallel:

Consider three resistances R_1, R_2 and R_3 connected in parallel as shown under in the figure:



Let "V" be the total voltage applied across the ends and "I" be the total current flowing through the circuit. Then according to Ohm's Law, we have:

$$V = I \,.\, R \quad \Rightarrow \quad I = V / R$$

Therefore, current across resistance R_1 can be given as: $I_1 = V / R_1$ ....(I)

Similarly, current across resistance R2 can be given as: $I_2 = V / R_2$ ....(II)

And, current across resistance R_3 can be given as: $I_3 = V / R_3$ ....(III)

Since total current flowing current flowing through the circuit is I, then:

$$I = I_1 + I_2 + I_3$$

$$\Rightarrow \quad I = V/R_1 + V/R_2 + V/R_3 \quad \text{[Using equations (I), (II) \& (III)]}$$

$$\Rightarrow \quad I = V\ (1/R_1 + 1/R_2 + 1/R_3)$$

$$\Rightarrow \quad I/V = 1/R_1 + 1/R_2 + 1/R_3$$

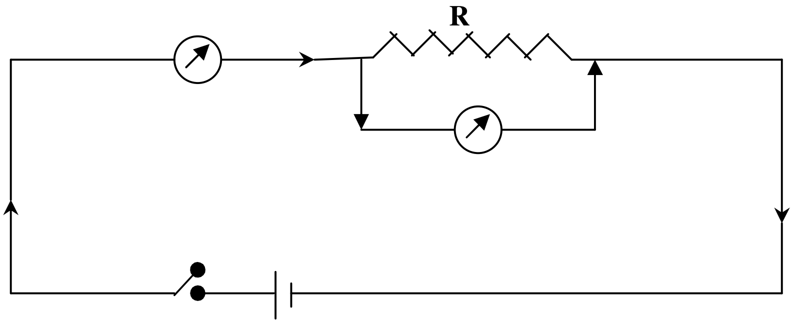
But from Ohm's Law, we have:

$$V/I = R_p \quad \Rightarrow \quad I/V = 1/R$$

Then $$1/R_p = 1/R_1 + 1/R_2 + 1/R_3$$

Hence the reciprocal of the total resistance of a number of resistances connected in parallels in a circuit is given by the algebraic sum of the reciprocals of the individual resistances.

Electrical Circuits: A circuit may be defined as a continuous path of conducting wires and other resistances between the terminals of a battery along which an electric current is flowing .Drawing circuit diagrams, showing the connectivity of the different components of a circuit by using their electrical symbols, represents these. A circuit containing resistance "R", Voltmeter "V", ammeter "A", key "K" and cell connected together is shown under:



A

V

\+ -

K

Cell

<u>Electric Power:</u> When an electric current flow through a conductor, electrical energy is used up and it is said that current is doing work. The rate of doing work is called as power. In other words, electric power is the work done by electrical current in unit time. Thus.

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$$

If "W" be the work done by the electrical current in time "t" seconds then the power "P" can be given as under:

P = W/t------------------------------ (I)

But W = V x I x t [because W = Vq and q = It]

Where V = Potential difference
I = Current flowing
t = Time taken

Thus $P = \frac{V \times I \times t}{t}$

Or P = V x I -------------------------- (II)

Thus,

Electric power = Potential difference x current

Also from Ohm's law, we have;

V/I =R

Or V = I.R

∴ From equation and we have

P = I x R x I

P $= I^2R$ **------------------------- (III)**

But from Ohm's law

I = V/R

Then from equation II we have

P =V x I

Or P = V x V/R

Or P $= V^2/R$**---------------------- (IV)**

Thus, from equation (I) (II) (III) and (IV) are four equation for explaining and calculating electrical power.

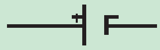
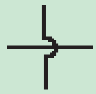
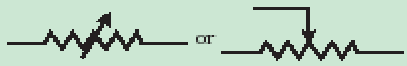
Thus S. I. unit of electrical power is watt denoted by letter "W" and power is said to be 1 watt if a work of 1 joule is done in one second.

$$1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{second}}$$

However, power can also be expressed in bigger units like kilowatts and Megawatts;

When, I Kilowatt $=10^3$ watts.

And 1 Megawatt $= 10^6$ watts

Sl. No.	Components	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	

Electric Energy: When an electrical current flow through a conductor, work is being done by the electrical current and the electrical energy consumed is given by the product of electric power and the time for which it is consumed i.e.

Electric energy = Power x time

E = P x t

But **P = Vx I**

Thus **E = V x I x t**

Or **E = VI t**

Thus, the product of voltage, current and time, can give electrical energy consumed. The S.I unit of energy is Joule. When a joule is the amount of electrical energy consumed when an appliance of 1 Watt power is use for one second. However a bigger unit of electrical energy is Kilowatt-hour also known as Board of trade unit (B.T.U).

Joule's Law of Heating:-

Consider a current 'I' flowing through a resistor of resistance R. Let the potential difference across it be V. Let the time during which a charge Q flows across. The work done is moving the charge Q through a potential difference V is VQ. Therefore, the source must supply energy equal to VQ in time t. Hence, the power input to the circuit by the source is

$$P = \frac{VQ}{t} = VI$$

Or the energy supplied to the circuit by the source in time t is P x t, i.e. VIt

Thus for a steady current I, the amount of heat H produced in time t is

$$H = VIt$$

Applying Ohm's law, we get

$$H = I^2Rt$$

This is known as Joule's law of heating.

This law implies that, heat produced in a resistor is:

1. Directly proportional to the square of current for a given resistance.
2. Directly proportional to resistance for a given current and
3. Directly proportional to the time for which the current flows through the resistor.

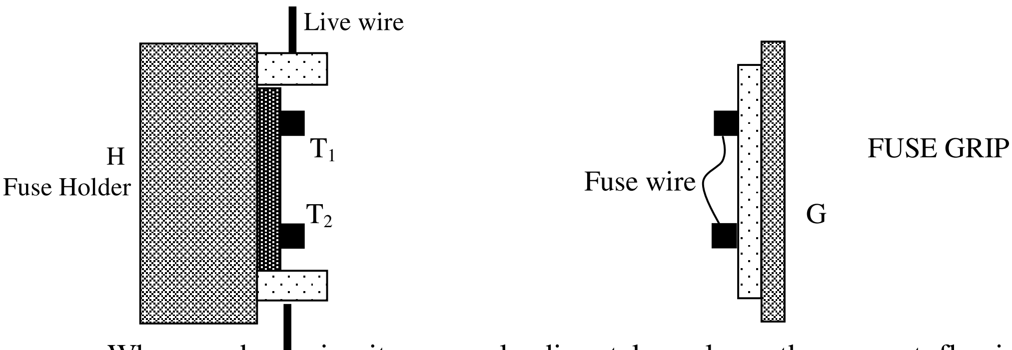
Heating effect Electric Current:-

Whenever a current is passed through a conductor, it becomes hot. This means that electric energy is being converted into heat energy. This is called the heating effect of current.

We know that conductors have free electrons. When a potential difference is applied across the ends of a conductor, these electros begin to drift from lower potential to higher potential. The motion of these electrons is not smooth because they experience a resistance on account of their collisions with other electrons and also with the ions in the conductor. As a result of this, some work is done to overcome this resistance. It is this work done that is converted into heat.

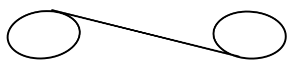
Electric Fuse: It is a safety device having a short length of a thin wire made up of tin or tin lead alloy having low melting point, which melts and breaks the circuit, if the current exceeds a safety value. Fuse is connected in series in the circuit and works on the heating effect of the current.

An electric fuse consists of a porcelain fuse holder "H" having two brass terminals T_1 and T_2 in it, which is connected to the live wire. The second part of the fuse is a removable fuse grip "G" made up of porcelain having a fuse grip fixed in it. When the fuse grip is inserted in the fuse holder, the current of domestic wire is completed, and the electric current is available in the domestic wires.

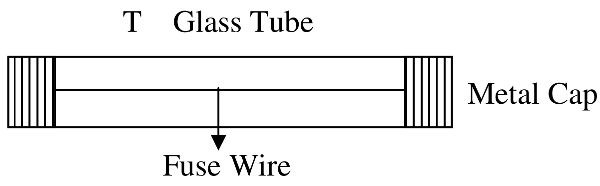


When a short circuit or overloading takes place, the current flowing through the circuit becomes large which heats up the fuse wire, ultimately leading into its blowing. This happens because the fuse wire has a low melting point, thus breaks electric supply without any serious damage to the rest wirings of the circuit.

However, the in the electrical appliances consists of a glass tube "T" having a thin fuse wire inside it. The glass tube has two metal caps at its ends to which the fuse wire is connected. The metallic caps are to connect the fuse suitably in circuit as shown under:



Symbol of Electric Fuse

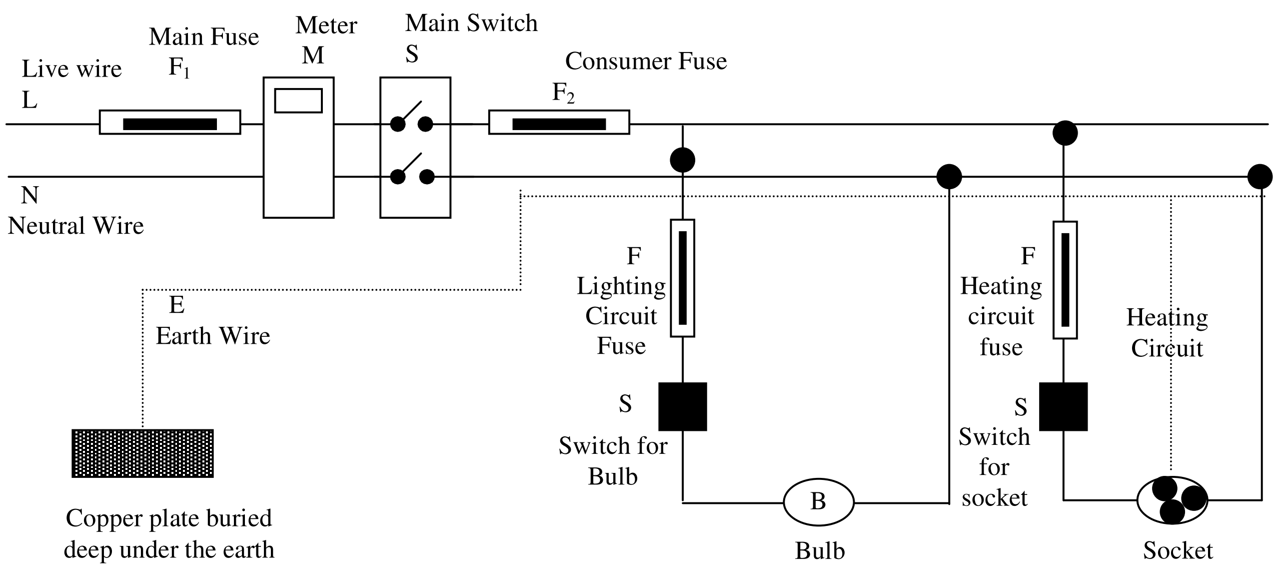


Characteristics of an Ideal Safety Fuse:

1. It should have a low melting point, so that it melts and breaks a circuit easily.
2. It should be made up of a thin wire of tin or tin lead alloy and fixed supports of a fireproof material.
3. It should be of a correct value so that it can function properly in an electric circuit.

Domestic wiring or House hold electric circuits: The electric current is transmitted from PowerStation to houses through copper wires fixed over electric poles. From electric poles every house brings two insulated wires, one called live wire "L" having high potential of 220 Volts and the other Neutral wire "N" having a ground potential of zero Volts. Thus, the potential difference between two wires is 220 volts. The two insulated wires then enter a box having a fuse of high rating about 50 amperes called the main fuse "F_1" and a watt-hour meter "M". Which records the consumption of electrical energy in the units of Kilowatt hours? The two wires coming out from the meter are connected to a main switch "S". After the main switch there is another fuse in the live wire called as consumers fuse "F_2". The circuit is then divided into two separate circuits *lighting circuit* with a 5 ampere fuse and *power circuit* with a 15 ampere fuse. These fuses are provided separately, so as to detect any fault occurring in the circuit. However, a third wire, called as earth wire "E" is introduced into the heating or power circuit along with the live and neutral wires. The earth is an uncovered wire, whose one end is connected to a copper plate buried deep under deep under the earth. In each room, all the electrical appliances like bulbs, fans, sockets etc. are provided with separate switches connected in parallel across the live wire and the neutral wires as shown under:

Usually, a red coloured wire is used as a live wire, a black wire as a neutral wire and a green wire as the earth wire. The separate coloured wires are used so as to make easy differentiation of live, neutral and earth wires.



Hazards or Dangers of Electricity:

1. It gives a severe electric shock to a person touching it, which may prove fatal to the person.
2. Short circuiting due to damaged wiring or overloading can lead to over heating of the wires or even electrical fires causing great loss to property and life.
3. Fluctuations produced due to over loading may cause damage to various electrical appliances used in houses.
4. Defective switches, loose connections and wiring in circuits may cause sparking and lead to electrical fires.

Precautions in using electricity:

1. The electrical supply should be switched off or cut off incase of electric fires, short circuiting or any other electrical accident.
2. The electrical supply should be switched off incase a person receive an electric shock and should be ensured an insulated support of wood, plastic, rubber, cloth etc.
3. The wires of the circuits should be of good quality having a proper insulation, and the connections should be tight and properly covered with an insulating material.
4. While working with live circuits, rubber gloves and shoes should be used.
5. The electrical appliances should be properly connected to earth wire, so as to avoid electric shocks.

Electricity in the body: The nerve cells or neurons present in our sensory organs are capable to produce electric potential or electricity called as **Action Potential** by the conversion of some signals. This electricity is produced as a result of concentration difference of sodium (Na^+) and potassium (K^+) ions present inside and outside of a neuron. In normal or resting state, the sodium ion concentration outside a nerve cell is higher than inside. But the concentration of potassium ion is low inside than outside. This conc. gradient creates a potential difference of about -70 millivolts. Thus in resting phase, a neuron has a potential of -70 mv.

Outside neuron

Resting phase of neuron	Exciting phase of neuron
Na^+ high K^+ low	Na^+ low K^+ high
++++++++++++++++++++++++	------------------------------
(membrane)	(membrane)
------------------------------	++++++++++++++++++++++++

Inside neuron

Resting phase of neuron	Exciting phase of neuron
Na^+ low K^+ high	Na^+ high K^+ low
------------------------------	++++++++++++++++++++++++
(membrane)	(membrane)
++++++++++++++++++++++++	------------------------------

Resting phase of neuron **Exciting phase of neuron**

However, when a signal acts on it, the nerve cell becomes excited and permeable to Na^+ ions. This increases concentration of sodium ions inside the cell. At the same time, potassium ions start to go outside causing a decrease in the potassium ion concentration within the cell. As a result of these concentration changes, nerve potential changes from -70 mv to +40 mv. Thus a total change of 110 mv occurs in a cell. In other words, an action potential of 110 mv is produced in a nerve cell when a signal is applied to it. The action potential produces an electric impulse which travels from one neuron to another, finally reaching to the brain, which reacts to these impulses and produces the necessary action.

Electromagnetism: In 1820, Oersted performed an experiment to show that a current flowing through a wire produces a magnetic field around it. In this experiment, he found that when a magnetic needle was placed under a wire having no current flowing through it, the needle remained parallel to the wire as shown in the figure. But when electric current was allowed to flow through it by connecting it with a battery, a deflection was observed in the magnetic needle showing that a current carrying wire produces a magnetic field around it, which lasts as long as the current is flowing through the wire. This phenomenon is referred to as electromagnetism.

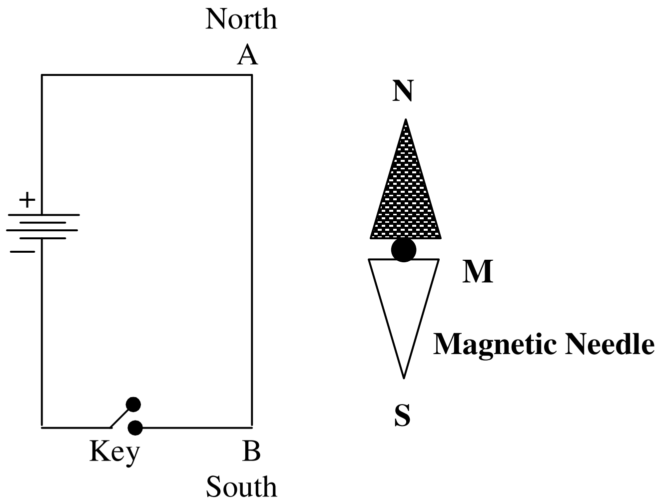


Diagram showing that magnetic needle is parallel

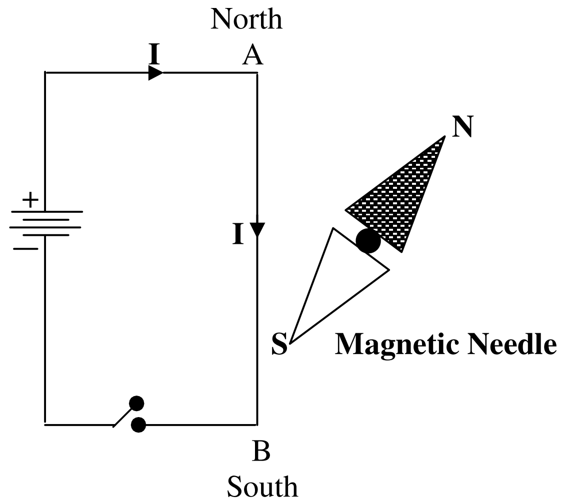
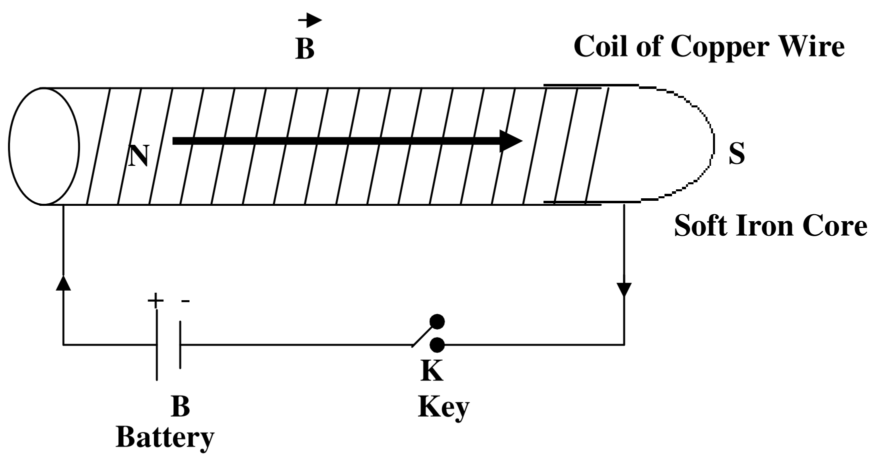


Diagram showing deflection in magnetic needle

Electromagnet: An electromagnet consists of a long coil of insulated copper wire wound around a soft iron core. It works on the magnetic effect of current. It acts as a temporary magnet as long as electric current flows through the coil, the moment an electric current is stopped; the coil looses its magnetism. An electromagnet has various shapes and sizes and its strength depends upon the number of turns in the coil, magnitude of current and length of air gaps between its poles.



Factors effecting strength of an electromagnet: The various factors which effect the strength of an electromagnet are:

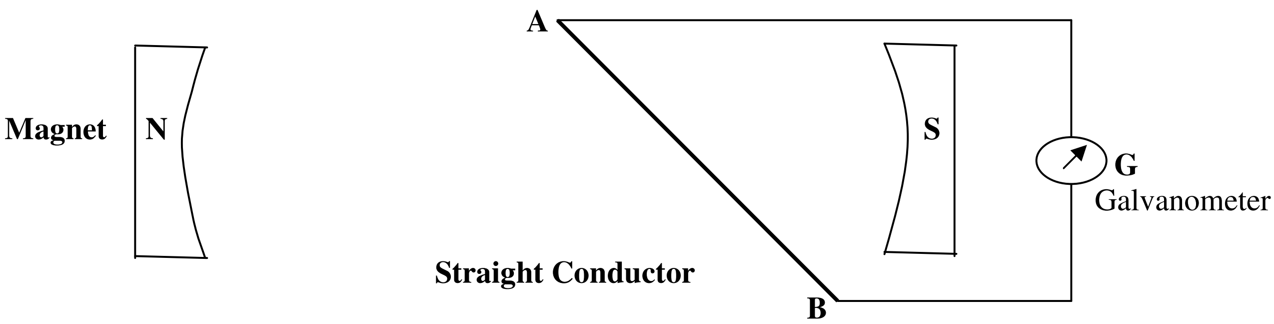
i) The increase in the no. of turns in the coil of an electromagnet increases its strength.

ii) Increasing the current flowing through the coil, increase the strength of an electromagnet.

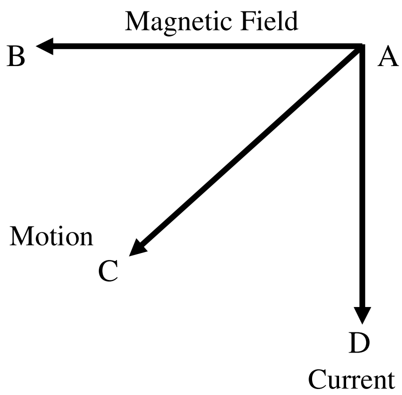
iii) Decreasing the length of air gaps between the poles increases the strength of an electromagnet.

Electromagnetic Induction: In 1921, Michael Faraday found that when a straight metal wire is moved up and down in a magnetic field between the poles of a horse-shoe magnet, an electric current is produced in the wire. This process of production of electric current by moving a straight wire in a magnetic field is called as **electromagnetic induction** and the current produced as **induced current**. The production of induced current continues as long the relative motion between the wire and the magnetic field continues. The moment the relative motion is stopped, the production of magnetic current also stops.

Experimental demonstration: Consider a metal wire "AB" held between the N and S of a permanent horse-shoe type magnet "M". The two ends of the wire are connected to a galvanometer "G". When the wire is held stationary i.e there is no relative motion between the wire and the magnet, no deflection is observed in the galvanometer indicating that no current is produced. But when the wire is moved downwards, there is a deflection in the galvanometer, pointer showing presence of current in the wire and when the wire is moved upwards, the galvanometer again shows deflection but in the opposite direction. This shows that when the direction of motion of the wire in the magnetic field is reversed, the direction of induced current also gets reversed.



Fleming's Right Hand Rule: Fleming enunciated a law to show the direction of induced current produced in a straight conductor moving in a magnetic field. According to this law, "Hold the thumb, the fore finger and the middle finger of your right hand at right angles to one another. Adjust your hand in such a way, that the fore finger points in the direction of magnetic field, and the thumb points in the direction of motion of the conductor, then the direction in which the middle finger points, gives the direction of the induced current in the conductor", as shown under. Suppose "AB" is the direction of the magnetic field and "AC" the direction of motion of conductor vertically downwards, then the direction of the induced current will be given by "AD" as per Fleming's right hand rule, as shown below;



Motor Principle or **Force exerted on a current carrying conductor placed in a magnetic field:**

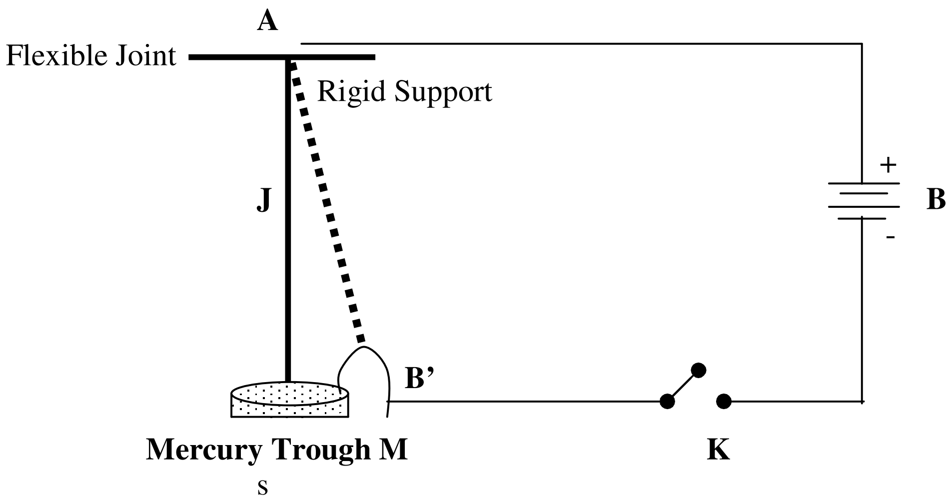
Michael Faraday in 1821, performed an experiment to show that when an electric current carrying conductor is placed in a magnetic field, a mechanical forced is exerted on the conductor, which can make the conductor move. Thus, experimental observation was referred to as **motor principle** as it forms the working principle of the modern motor. It is also known as **Faraday's Kicking Wire Experiment.**

Experimental demonstration of motor principle:

Faraday suspended a thick copper wire "AB" vertically from a support "T" by means of a flexible joint "J". The lower end of the wire is placed just touching the surfaces of mercury kept in shallow vessel "V" placed between the poles of a U-shaped magnet "M", so that it can move when a force acts on it. The wire is then connected to a battery "B" such that its positive terminal is linked to the end "A" of the wire and its negative terminal is dipped into the mercury vessel so as to complete the circuit as shown under in the diagram:

On passing electric current through the wire "AB", the wire is kicked forward towards the south such that its lower end reaches to position "B" as shown by the dotted line. But at this position, its connection with the mercury vessel is cut off due to which circuit is broken and current stops flowing in the wire "AB". Since no current flows in the wire, no force acts on the wire and it falls back to its original position. But as soon as the wire "AB" comes to its original position and touches the mercury surface, current begins to flow in the wire and the wire is kicked again due to the force exerted by the magnetic field.

Thus, from this experiment, it is clear that when a current carrying conductor is placed in a magnetic field, a mechanical force is exerted on it by the magnetic field. However, reversing the direction of the current flowing in the conductor can reverse the direction of the force exerted.



Electric Power Plants: India has developed three types of electric power plants to generate electricity on a large scale, viz;

1. **Hydroelectricity Power Plants** or **Hydel Power Plants:**

In a hydel power plant, water from a high rise dam or reservoir falls down and rotates the blades of a turbine which in turn rotates the generator coils to its shaft and produce electricity. Some of the important hydroelectric power plants are:

1. Bakra Nangal Hydroelectric Power Plant in Punjab.
2. Rihand Hydel Power House in U.P.
3. Periyar Hydel Power Station in T.N
4. Iddiki Hydroelectric Power House in Kerala.
5. Umaim Hydroelectric Power Station in Assam.

2. **Thermal Power Plants:**

In a Thermal Power Plant, the heat energy obtained by burning coal or natural gas is used to heat water and produce steam, which rotates the turbine and the coils attached to its shaft to generate electricity. Some of the important Thermal Power Plants of India include:

1. Badarpur Thermal Power Station in Delhi.
2. Talcher Thermal Power House in Orissa.
3. Barauni Thermal Power Station in Bihar.
4. Neyveli Thermal Power Station in T.N.
5. Namrup Thermal Power Station in Assam.

3. Atomic Power Plants:

In an Atomic Power Station, the heat energy released in the fission of heavy and unstable nuclei is used to heat water and produce steam. The high pressure steam drives the steam turbines and its connected generator coil fixed on its shaft to generate electricity. Some the important Atomic Power Stations of India are:

1. Tarapur Atomic Power Station in Maharashtra.
2. Rajasthan Atomic Power Station in Kota.
3. Madras Atomic Power Station in T.N.
4. Narora Atomic Power Station in U.P.

SHORT TERMS:

1. **Resistance:** The opposition or obstruction offered by a conductor to the flow of electrons is called the **electric resistance.**
2. **Conductor:** The materials which offer a way small electric resistance to the passage of electric current are called the **conductors**. Silver is the best conductor.
3. **Resistors:** The materials which offer very high resistance as compared to the conductors are called the **resistors.** The resistors are used in converting electric energy into heat energy.
4. **Insulators:** The materials which have infinitely high resistance are called the **insulators.** The insulators don't allow the electric current to flow through them. Vacuum is the best insulator.

EARTHING: Electric appliances such as ovens, table fans, toasters etc. are frequently touched by us with bare hands. If by chance the insulation of any such appliances melts or is damaged somehow, such that its bare wire touches its metal casing, then the person will receive a severe electric shock. It is because the electric potential of the metal casing will be the same as that of the applied potential. Thus, the electric current will rush through our body to earth and in doing so, will affect our nervous system which in turn may cause death. To avoid such a situation, metal casing of all such appliances are **earthed**. It means that the metal body of the appliance is connected to a thick copper wire, which is buried deep in the earth and its end is a copper plate surrounded by a mixture of charcoal and common salt.

The earth can be regarded as an **electric sink** i.e. it can receive any amount of electrons, but **potential remains zero**. Thus when an earthed appliance gets short circuited, then the current from its metal body flows into the earth. Since earth doesn't offer any resistance, therefore, the **magnitude of the current in a short-circuited appliance suddenly rises to a very high value.** This rise in magnitude of the current in turn **overloads the circuit and hence the fuse in that circuit melts.** On melting of fuse, the short-circuited appliance will not receive any current and hence user is protected from receiving an electric shock. Moreover, the appliance itself is protected from burn out.

COLOUR CODING OF ELECTRIC WIRES: An electric appliance is provided with three core flexible cable. In order to distinguish, which wire is live or neutral or of earth, the insulation of each wire is given a specific colour.

The old convention of colour is **red** for **live wire, black** for **neutral wire** and **green** for **earth wire.**
However, according to the new international convention, **brown** is for **live wire, light blue** for the **neutral wire** and **green or yellow** for **earth wire.**
The three core flexible wires can withstand current of some specific value it can tolerate, then the plastic insulation on them melts. This in turn brings the wires in contact and hence an electric short circuit results.

OBJECTIVE TYPE QUESTIONS

1. A magnetic line of force is used to find the direction of
a) South-north b) a bar magnetic
c) a compass needle d) magnetic field

2. The magnetic lines of force inside a solenoid due to electric current in it are nearly
a) Straight lines b) Circular lines
c) Parabolic lines d) Elliptic lines

3. If the No. of turns per unit length in a solenoid is increased, the strength of the electromagnet so formed will
a) increase b) decrease
c) remain constant d) become zero

4. An electric motor
a) supplies a constant Pot. Difference b) measures electric current
c) measures a pot. Difference d) converts electric energy into rotational. Kinetic energy

5. Electric motors can be operated
a) on AC but not on DC b) on DC but not on AC
c) on AC as well as on DC d) neither on AC nor on DC

6. If the power supply to your house is cut off, you can operate
a) a motor but not a dynamo b) a dynamo but not a motor
c) a motor as well a dynamo d) neither a motor nor a dynamo

7. An electric fuse is based on
a) the heating effect of the current b) the chemical effect of the current
c) the magnetic effect of the current d) none

8. The direction of the included current can be found by
a) Fleming’s left hand rule b) Fleming’s right hand rule
c) Galvanometer d) none

9. The function of the commutator is
a) to supply continuous current b) to stop back flow of current
c) to change the direction of the current d)none

10. A voltmeter is used to measure
a) potential difference b) electric current
c) electric power d) resistance

11 A battery is used to
a) maintain a potential difference b) measure current
c) measure electric potential d) saving short circuits

12. Joule/Coulomb is the same as

a) Watt b) Volt
c) Ampere d) Ohm

13. On which of the following no “plus” or “minus” sign is marked

a) a battery b) an ammeter
c) a voltameter d) a resistor