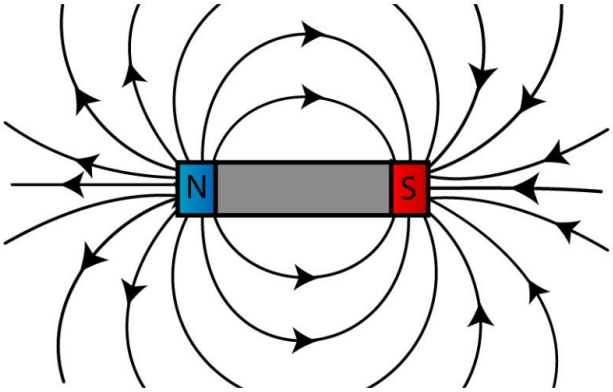
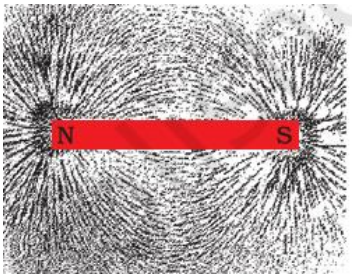
Magnetic field: The area around a magnet where a magnetic force is experienced is called the magnetic field. It is a quantity that has both direction and magnitude, (i.e., Vector quantity).



Magnetic field and field lines: The influence of force surrounding a magnet is called magnetic field. In the magnetic field, the force exerted by a magnet can be detected using a compass or any other magnet.



The magnetic field is represented by magnetic field lines. The imaginary lines of magnetic field around a magnet are called field line or field line of magnet. When iron fillings are allowed to settle around a bar magnet, they get arranged in a pattern which mimics the magnetic field lines. Field line of a magnet can also be detected using a compass. **Magnetic field is a vector quantity**, i.e. it has both direction and magnitude.

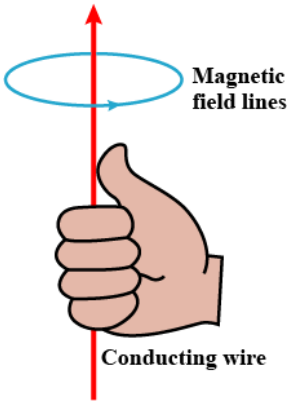
Direction of field line:

Outside the magnet, the direction of magnetic field line is taken from North Pole to South Pole.
Inside the magnet, the direction of magnetic field line is taken from South Pole to North pole.

Strength of magnetic field: The closeness of field lines shows the relative strength of magnetic field, i.e. closer lines show stronger magnetic field and vice – versa. Crowded field lines near the poles of magnet show more strength.

Properties of magnetic field lines

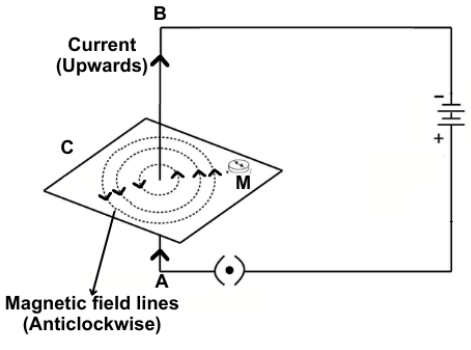
(i) They do not intersect each other.
(ii) It is taken by convention that magnetic field lines emerge from North pole and merge at the South pole. Inside the magnet, their direction is from South pole to North pole. Therefore, magnetic field lines are closed curves.



Right-Hand Thumb Rule: If a current carrying conductor is held by right hand, keeping the thumb straight and if the direction of electric current is in the direction of thumb, then the direction of wrapping of other fingers will show the direction of magnetic field.

Magnetic field lines due to current a current carrying straight conductor

Electric current through a straight Conductor generates magnetic field around it.
a)Magnetic Field intensity increases on the increasing the current in the conductor
b) Magnetic field decrease as the distance increase from the conductor



Magnetic field pattern due to a straight current-carrying wire.

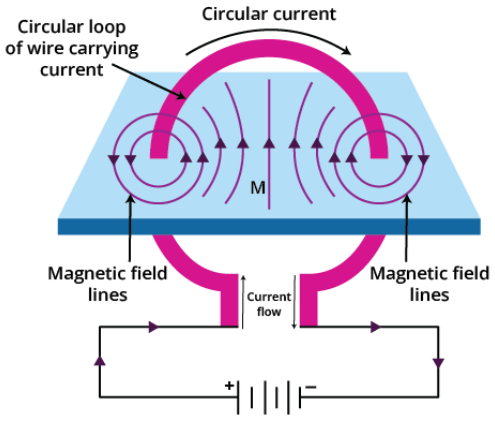
c) Magnetic Field direction can be find using Right Hand Thumb Rule.

Magnetic Field due to a Current through a Circular Loop

a) As with straight conductor, the magnetic field lines would be in the form of concentric circles around every part of the periphery of the conductor.

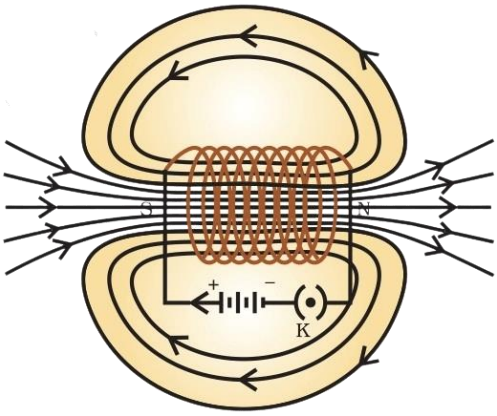
b) The magnetic field would be stronger near the periphery of the loop as magnetic field lines tend to remain closer when near the conductor.

c) The magnetic field lines would be distant from each other when we move towards the centre of the current carrying loop. At the centre, the arcs of big circles would appear as straight lines



Magnetic Field due to current through a coil having number of turns

We know that the magnetic field produced by a current-carrying wire at a given point depends directly on the current passing through it and the current in each circular turn has the same direction Therefore, Magnitude of magnetic field gets summed up with increase in the number of turns of coil. **If there are 'n' turns of coil, magnitude of magnetic field will be 'n' times of magnetic field** in case of a single turn of coil.

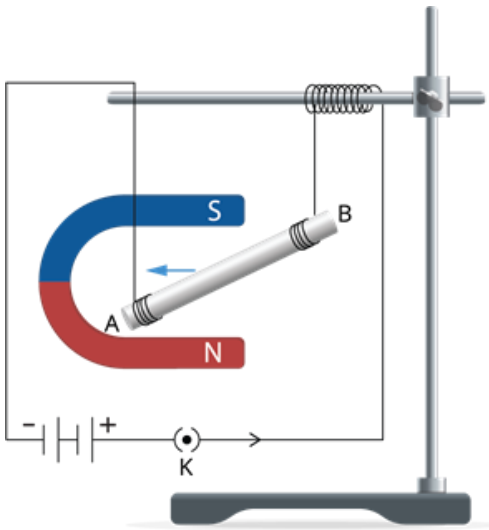


Solenoid

A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called a solenoid Magnetic Effect of Current carrying Solenoid A current carrying solenoid produces similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole. Magnetic field lines are parallel inside the solenoid; like a bar magnet; which shows that magnetic field is same at all points inside the solenoid

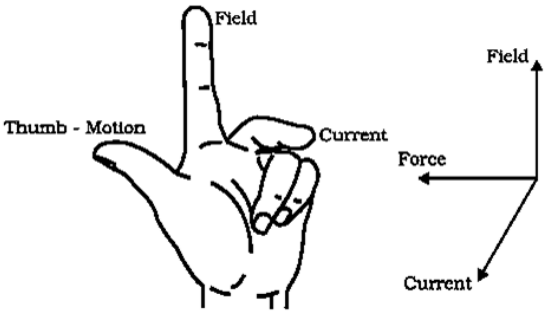
Electromagnet

When a piece of magnetic material, like soft iron is placed inside a solenoid, the strong magnetic field produced inside a solenoid magnetise the soft iron and it behaves like strong magnet. The magnetism in the soft iron is temporary and it becomes null when the current is switched off. This type of magnet is called Electromagnets. So, electromagnets are temporary magnets



FORCE ON A CURRENT CARRYING CONDUCTOR IN A MAGNETIC FIELD

When a current carrying, conductor is placed in a magnetic field, it experienced a force. The direction of force depends on the direction of the current and direction of the Magnetic Field. The direction of the force can be found using Fleming Left hand rule

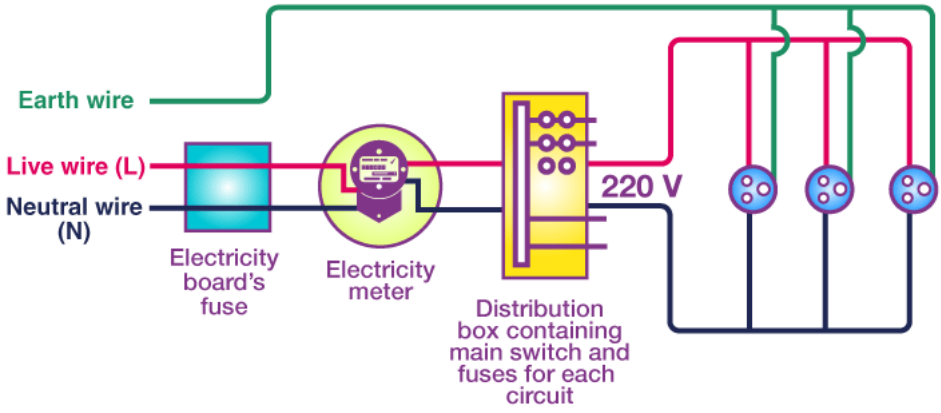


Fleming Left hand rule

Stretch **the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular**.
If **Fore finger** points in the **direction of magnetic field Central finger** in the direction of current,
then the **thumb will point in the direction of motion or the force acting on the conductor**

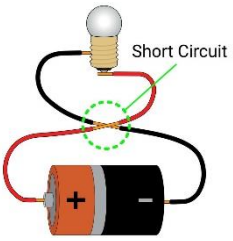
DOMESTIC ELECTRIC CIRCUITS

Domestic Electric Circuits: We receive electric supply through mains supported through the poles or cables. In our houses, we receive AC electric power of 220 V with a frequency of 50 Hz. The 3 wires are as follows



Domestic Electric Circuit

- **Live wire** – (Red insulated, Positive)
- **Neutral wire** – (Black insulated, Negative)
- **Earth wire** – (Green insulated) for safety measure to ensure that any leakage of current to a metallic body does not give any serious shock to a user.



Short Circuit: Short-circuiting is caused by the touching of live wires and neutral wire and sudden a large current flow. It happens due to

- **Damage of insulation in power lines.**
- **a fault in an electrical appliance.**

Overloading of an Electric Circuit: The overheating of electrical wire in any circuit due to the flow of a large current through it is called overloading of the electrical circuit. A sudden large number of current flows through the wire, which causes overheating of wire and may cause fire also.

Electric Fuse:

It is a protective device used for protecting the circuit from short-circuiting and overloading. It is a piece of thin wire of material having a low melting point and high resistance.

- Fuse is always connected to live wire.
- Fuse is always connected in series to the electric circuit.
- Fuse is always connected to the beginning of an electric circuit.
- Fuse works on the heating effect of current.