Class - X | 2023-24 | Board: CBSE

Magnetic Effect of Electric Current

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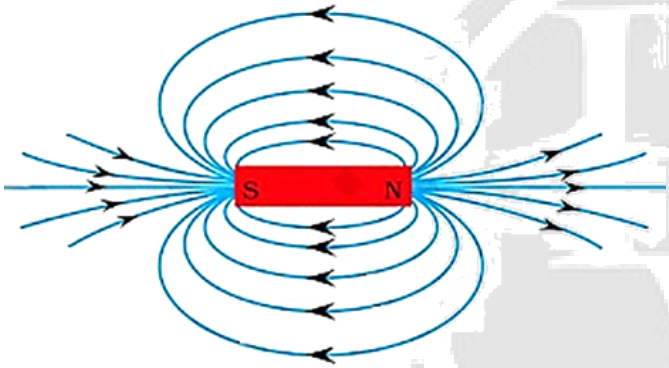
Magnetic effect of electric current :

Magnet is an object that attracts objects made of iron, cobalt and nickle. Magnet comes to rest in the North – South direction, when suspended freely.

Properties of Magnet-

- A free suspended magnet always points towards the north and south direction.
- The pole of a magnet which points toward north direction is called north pole or north-seeking.
- The pole of a magnet which points toward south direction is called south pole or south seeking.
- Like poles of magnets repel each other while unlike poles of magnets attract each other.

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).

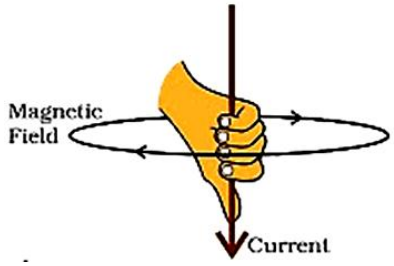


The imaginary lines of magnetic field around a magnet are called field line or field line of magnet. When iron fillings are allowed to settle around a bar magnet, they get arranged in a pattern which mimicks the magnetic field lines.

Properties of magnetic field:

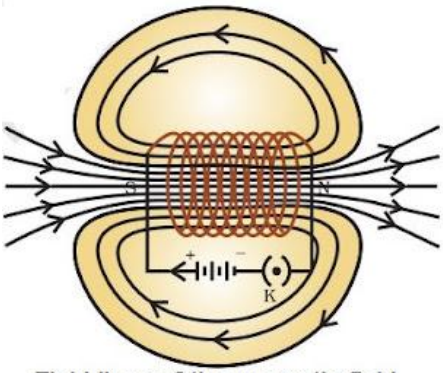
- The magnitude of magnetic field increases with increase in electric current and decreases with decrease in electric current.
- The magnitude of magnetic field produced by electric current decreases with increase in distance and vice – versa. The size of concentric circles of magnetic field lines increases with distance from the conductor, which shows that magnetic field decreases with distance.
- Magnetic field lines are always parallel to each other.
- No two field lines cross each other.

Right-Hand Thumb Rule: If a current carrying conductor is held by the 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 the magnetic field.



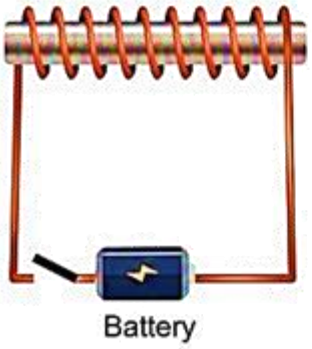
Force on a current carrying conductor in a magnetic field: A current carrying conductor exerts a force when a magnet is placed in its vicinity. Similarly, a magnet also exerts equal and opposite force on the current carrying conductor.

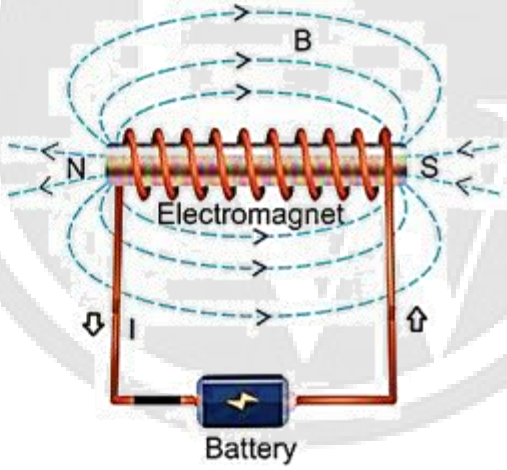
Magnetic field due to a current in a Solenoid: Solenoid is the coil with many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. A current carrying solenoid produces a similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole.



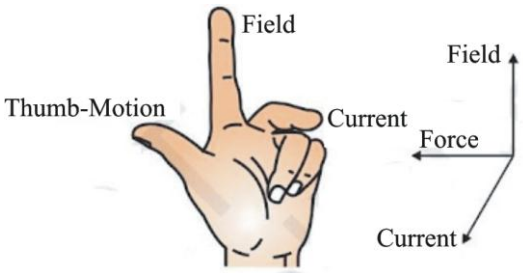
Field lines of the magnetic field through and around a current carrying solenoid.

Electromagnet: An electromagnet consists of a long coil of insulated copper wire wrapped on a soft iron. Magnet formed by producing a magnetic field inside a solenoid is called an electromagnet.

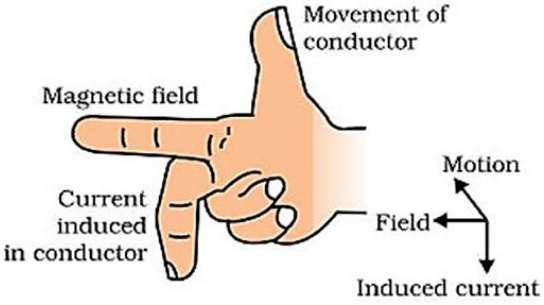




Fleming's left hand rule: According to this rule, "if the thumb, forefinger and middle finger of the left hand are stretched perpendicular to each other and if the fore-finger gives the direction of magnetic field, middle finger gives the direction of current, then the thumb will give the direction of motion or the force acting on the current-carrying conductor."

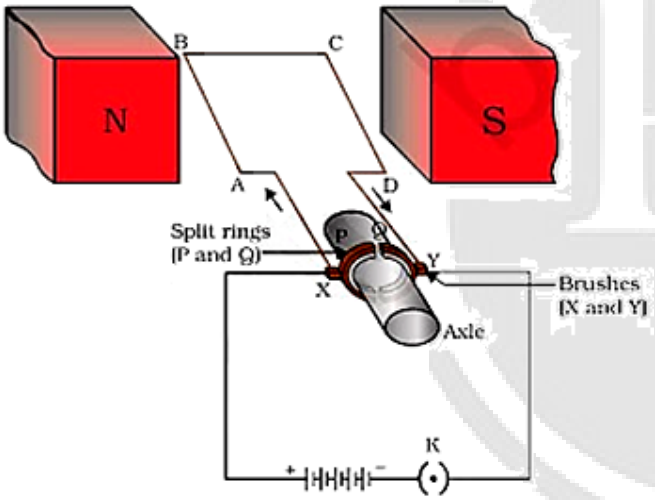


Fleming's right-hand rule: The direction of the induced current is given by Fleming's right-hand rule. According to this rule if the thumb, forefinger and middle finger of the right hand are stretched perpendicular to each other and if the fore-finger gives the direction of the magnetic field and the thumb gives the direction of motion, then the middle finger will give the direction of the induced current in the conductor.

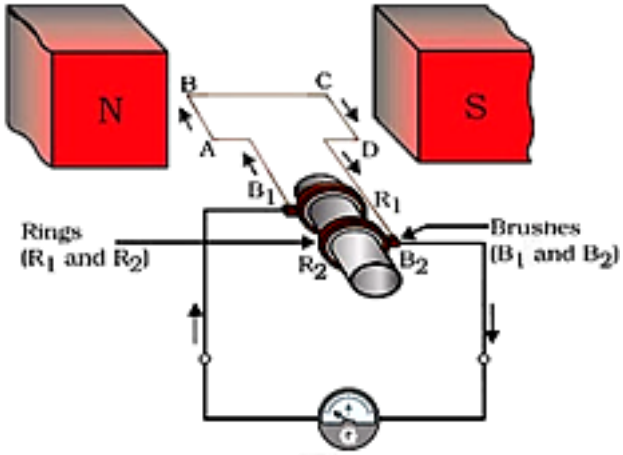


Principle of an electric motor: A motor works on the principle that when a rectangular coil is placed in a magnetic field and current passes through it, a force acts on the coil which rotates it continuously.

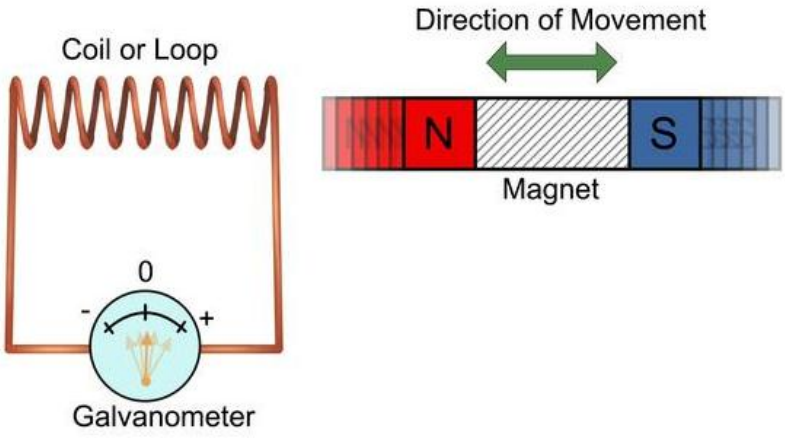
When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.



Principle of an electric generator: It is based on the principle of electromagnetic induction. It states that "an induced current is produced in a coil placed in a region where the magnetic field changes with time." The direction of induced current is given by Fleming's right-hand rule. An electric generator converts mechanical energy into electrical energy.



Electromagnetic induction: The phenomenon of setting up of an electric current or an induced e.mi. by changing the magnetic lines of force by a moving conductor is called electromagnetic induction.



A.C – Alternate Current: Current in which direction is changed periodically is called Alternate Current. In India, most of the power stations generate alternate current. The direction of current changes after every 1/100 second in India, i.e. the frequency of A.C in India is 50 Hz. A.C is transmitted upto a long distance without much loss of energy is advantage of A.C over D.C.

D.C – Direct Current: Current that flows in one direction only is called Direct current. Electrochemical cells produce direct current.