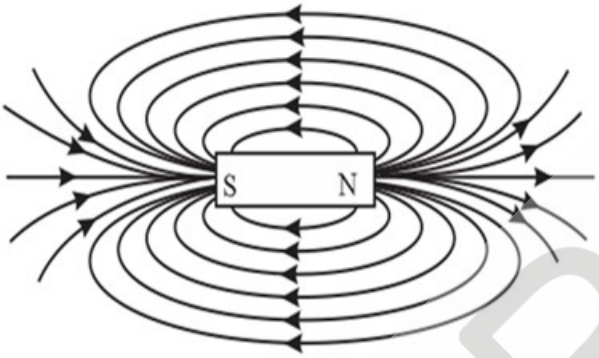
# NCERT CBSE Solutions for Class 10 Science Chapter 13

## Magnetic Effects of Electric Current

*In Chapter Questions: (Page:228)*

**1.** Draw magnetic field lines around a bar magnet.

**Solution:**




Field lines around a bar magnet

**2.** List the properties of magnetic lines of force

**Solution:**

- Magnetic field lines are parallel to each other in the uniform magnetic field.
- Magnetic field lines do not cross each other.
- Magnetic field lines always form closed loops.
- Outside the magnet, magnetic field lines are directed from the North Pole to the South Pole of the magnet, whereas inside the magnet they are directed from the South Pole to North Pole of the magnet.
- The relative strength of magnetic field is depicted by the degree of closeness of the field lines. Field lines are more crowded at a place where the field is stronger.

**3.** Why don't two magnetic lines of force intersect each other?

**Solution:**

None of the field lines crosses each other. This is because if they did, the compass needle will point in two directions, which is not possible in any case.

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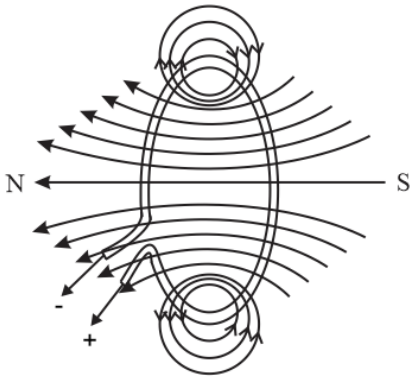
**1.** Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop:

**Solution:**




Magnetic field lines of the field produced by a current carrying circular loop

The magnetic field lines have been shown in figure. As per right-hand rule we find that inside the loop, magnetic field lines are directed perpendicular to the plane of the paper in the inward direction, outside the loop magnetic field lines directed out of the plane of the paper.

**2.** The magnetic field in a given region is uniform. Draw a diagram to represent it

**Solution:**

The uniform magnetic field lines are represented by parallel equidistant lines.

**3.** Choose the correct option.

The magnetic field inside a long straight solenoid-carrying current

(A) is zero.

(B) decreases as we move towards its end.

(C) increases as we move towards its end.

(D) is the same at all points.

**Solution:** (D)

The magnetic field inside a long straight solenoid- carrying current is the same at all points.

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*In Chapter Questions: (Page:231)*

**1.** Which of the following property of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer.)

(A) mass

(B) speed

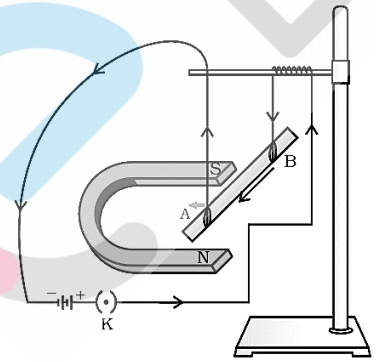
(C) velocity

(D) momentum

**Solution:**

When proton moves freely in a magnetic field its velocity and momentum will change.

**2.** In Activity 13.7, how do we think the displacement of rod AB will be affected if (i) current in rod AB is increased; (ii) a stronger horse-shoe magnet is used; and (iii) length of the rod AB is increased




**Solution:**

i) If current in the rod increased, force exerted on the current carrying rod increases and hence the displacement of the rod increase.

ii) If a strong horse-shoe magnet is used, magnetic field strength increases and hence force on the current carrying rod also increases. This increases the displacement of the rod.

iii) If the length of the rod is increased, force on the rod increases. Displacement of the rod depends on mass of the rod as well. Therefore, data is insufficient to judge.

**3.** A positively-charged particle (alpha-particle) projected towards the west is deflected towards the north by a magnetic field. The direction of the magnetic field is

(A) towards the south

(B) towards the east

(C) downward

(D) upward

**Solution:** (D)

Here alpha particle is moving towards the west, so the direction of current is towards the west. The deflection is towards the north, so the force is towards the north. And in accordance with Fleming left-hand rule, the direction of the magnetic field is upward.

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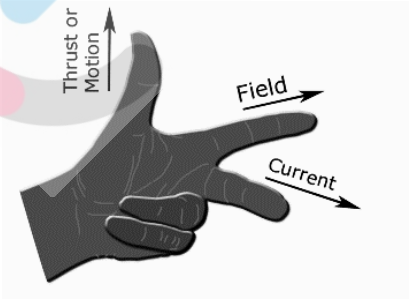
*In Chapter Questions: (Page:233)*

**1.** State Fleming's left-hand rule

**Solution:**

Fleming's left-hand rule:




It states that if we stretch the thumb, forefinger and the middle finger (of the left hand) such that they are mutually perpendicular and if the forefinger and the middle

finger points in the direction of magnetic field and direction of current respectively, then the thumb will be in the direction of motion or the force acting on the conductor.

**2.** What is the principle of an electric motor?

**Solution:**

Electric motor works on the principle of the magnetic effect of current. When a current carrying conductor is placed in a magnetic field it experiences magnetic force on it. The direction of force can be find using Flemings left hand rule

**3.** What is the role of the split ring in an electric motor?

**Solution:**

A split ring acts just like a commutator in the electric motor. A commutator is a device that reverses the direction of flow of current through a circuit. The reversing of this current also reverses the direction of force acting on the two arms.

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*In Chapter Questions: (Page:236)*

**1.** Explain different ways to induce current in a coil

**Solution:**

Either by moving the coil in a magnetic field or by changing the magnetic field around it, current can be induced in a coil.

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*In Chapter Questions: (Page:237)*

**1.** State the principle of an electric generator

**Solution:**

A generator, also known as a dynamo, is a device used to convert mechanical energy into electrical energy. It works based on the principle of electromagnetic induction. When a closed coil is rotated in a uniform magnetic field with its axis of rotation perpendicular to the direction of magnetic field, the magnetic field lines passing through the coil changes and this induces current in the loop.

**2.** Name some sources of direct current.

**Solution:**

some of the sources of direct current are dry cells, button cells and lead accumulator

**3.** Which sources produce alternating current?

**Solution:**

Alternating current is produced by AC generators of the nuclear power plant, thermal power plants, hydroelectric power stations.

**4.** Choose the correct option.

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each

(A) two revolutions

(B) one revolution

(C) half revolution

(D) one-fourth revolution

**Solution:** (C)

When a rectangular coil of copper wires is rotated in a magnetic field, the direction of the induced current changes once in each half revolution.

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*In Chapter Questions: (Page:238)*

**1.** Name two safety measures commonly used in electric circuits and appliances.

**Solution:**

Two safety measurements commonly used in electric circuits are,

i) Electric fuse: Electric fuse is connected in series to prevent overloading or short circuiting. In the case of overloading or short-circuiting current in the circuit become very high. Large amount of heat produced due to this high current and fuse gets melted first at this temperature.

ii) Proper earthing prevents damage due to leakage of current. Metal parts of electric appliances are directly connected to earth wire. If live wire comes in contact with metal part, current flows through the earth wire to the earth and prevents damage to the appliance as well as user.

**2.** An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain

**Solution:**

Power of the oven $P = 2\ \text{kW} = 2000\ \text{W}$

Potential difference applied $V = 220\ \text{V}$

Power consumed can be written as $P = V \times I$

$$\Rightarrow I = \frac{P}{V}$$

$$= \frac{2000\ \text{W}}{220\ \text{V}} = 9.09\ \text{A}$$

This exceeds the safe limit value of the domestic circuit i.e. 5 A. Thus, electric fuse in the circuit will melt and breaks the circuit.

**3.** What precaution should be taken to avoid the overloading of domestic electric circuits?

**Solution:**

Following precautions should be taken to avoid the overloading of domestic circuits.

i) Electric fuse must be connected in series with the circuit to prevent overloading or short-circuiting

ii) Do not use too many high-power appliances like air-conditioner, electric motor, water heater, etc. simultaneously.

iii) Do not connect too many appliances to a single socket.

iv) Use the appliance within the safe limit of electric circuit.

♦ ♦ ♦

*Back of the chapter Questions:*

# NCERT CBSE Solutions for Class 10 Science Chapter 13

**1.** Which of the following correctly describes the magnetic field near a long straight wire?

(A) The field consists of straight lines perpendicular to the wire.

(B) The field consists of straight lines parallel to the wire.

(C) The field consists of radial lines originating from the wire.

(D) The field consists of concentric circles centred on the wire.

**Solution:** (D)

Magnetic field lines due to long strait current carrying wire form concentric circles with centre on the wire.

**2.** The phenomenon of electromagnetic induction is

(A) the process of charging a body.

(B) the process of generating magnetic field due to a current passing through a coil.

(C) producing induced current in a coil due to relative motion between a magnet and the coil.

(D) the process of rotating a coil of an electric motor.

**Solution:** (C)

The phenomenon in which electric current is induced in a coil due to relative motion between a magnet and the coil is called electromagnetic induction.

**3.** The device used for producing electric current is called a

(A) generator.

(B) galvanometer.

(C) ammeter.

(D) motor.

**Solution:** (A)

The device used for producing electric current is called a electric generator.

**4.** The essential difference between an AC generator and a DC generator is that

(A) AC generator has an electromagnet while a DC generator has permanent magnet.

(B) DC generator will generate a higher voltage.

(C) AC generator will generate a higher voltage.

(D) AC generator has slip rings while the DC generator has a commutator.

**Solution:** (D)

The essential difference between an AC generator and a DC generator is that, AC generator has slip rings while the DC generator has a commutator

**5.** At the time of short circuit, the current in the circuit

(A) reduces substantially.

(B) does not change.

(C) increases heavily.

(D) vary continuously.

**Solution:** (C)

At the time of short circuit, the current in the circuit increases heavily.

**6.** State whether the following statements are true or false.

(A) An electric motor converts mechanical energy into electrical energy.

(B) An electric generator works on the principle of electromagnetic induction.

(C) The field at the centre of a long circular coil carrying current will be parallel straight lines.

(D) A wire with a green insulation is usually the live wire of an electric supply.

**Solution:**

(A) False

Electric motor converts electrical energy to mechanical energy, not other way around.

(B) True

When copper coils are rotated in magnetic field of a generator, electric current is induced in the coil. This phenomenon is called electromagnetic induction.

(C) True

Inside a long circular current carrying coil or in a solenoid, magnetic field lines are parallel to its axis and uniformly distributed.

(D) False

In the domestic power supply, the wire with green insulating cover is called earth wire

**7.** List two methods of producing magnetic fields.

**Solution:**

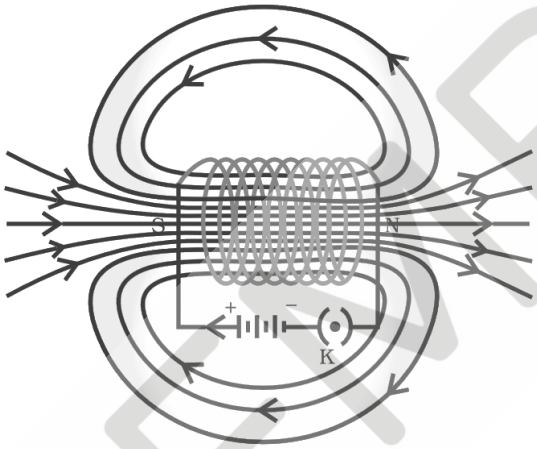
(i) Current carrying wire produces magnetic field.

(ii) Permanent magnets produce magnetic fields around them.

**8.** How does a solenoid behave like a magnet? Can you determine the north and south poles of a current–carrying solenoid with the help of a bar magnet? Explain.

**Solution:**

Solenoid consists coil of many circular turns of insulated copped coils wrapped closely in the shape of a cylinder. When current flows through the coils of solenoid, magnetic field will be produced around the coils as shown in figure. These field lines are similar to magnetic field lines due to permanent magnet. Current circulating solenoid behaves similar to a bar magnet.




We can identify north or south poles of solenoid with the help of bar magnet. The end of solenoid which repels the south pole of bar magnet behaves as south pole. Similarly, the end which repels the north pole of a bar magnet behaves as north pole.

**9.** When is the force experienced by a current–carrying conductor placed in a magnetic field largest?

**Solution:**

From experiments force acting on current carrying conductor is maximum when current in the conductor is perpendicular to the magnetic field direction.

**10.** Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

**Solution:**

Direction of magnetic field can be identified from Fleming's left-hand rule. As current direction is opposite to the direction of electron flow, the central finger points towards me. Also, the direction of force is towards right so the thumb points right-side. This gives the direction of fore-finger as downwards, or the direction of magnetic field is downwards.

**11.** Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

**Solution:**

An electric motor is a device which converts electrical energy into mechanical energy.

***Principle:***

It works on the principle that when a current-carrying coil is placed normally in a magnetic field, it experiences a torque which tends to rotate it.

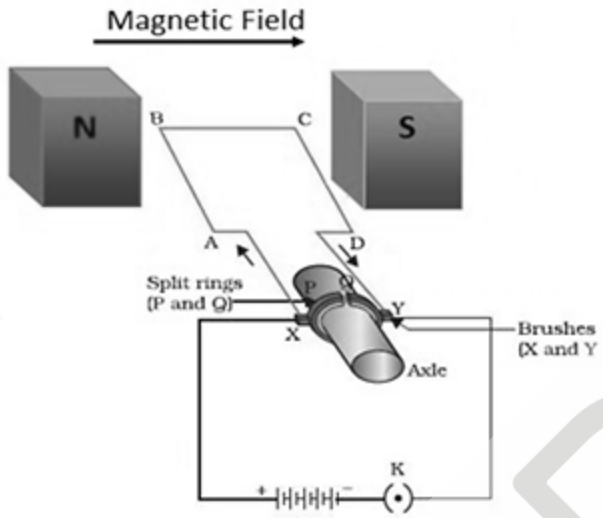
***Working:***

(i) When a current flow through the coil, arms AB and CD experience a force. According to Fleming's left-hand rule, arm AB of the coil experiences a force in the downward direction. Similarly, arm CD of the coil experiences a force in the upward direction. Two equal and opposite forces constitute a couple and hence the coil will rotate in anticlockwise direction.

(ii) When the coil reaches the vertical position, no current flows in the coil and no force acts on the coil in this position.

(iii) (Now coil rotates further and side AB is moved on the right, with its commutator segment touching the right-hand brush so it has downward force acting it. Similarly, side CD has an upward force on it. Thus, the couple always acts in the same direction (clockwise) and the coil spins

(iv) The split rings or commutators help to reverse the direction of current in the circuit.




**12.** Name some devices in which electric motors are used.

**Solution:**

Few devices in which electric motors are used,

(i) Electric fans

(ii) Electric mixer grinders

(iii) Washing machines

(iv) Water pumps

**13.** A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is

(i) pushed into the coil,

(ii) withdrawn from inside the coil,

(iii) held stationary inside the coil?

**Solution:**

(i) When bar magnet is pushed into the coil, magnetic field through the coil changes. Hence electric current is induced in the coil momentarily. As a result, galvanometer deflects momentarily in a particular direction.

(ii) When bar magnet is withdrawn from inside the coil again magnetic field though the coil changes. Hence current is induced in the circuit momentarily in the opposite direction as compared to first case. As a result, galvanometer deflects again momentarily, in opposite direction.

(iii) When bar magnet is held stationary inside the coil, magnetic field though the coil does not change. Hence, there will be no induced current in the coil and no deflection in the galvanometer.

**14.** Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

**Solution:**

Current in A produces magnetic field around it and if B is close to A, part of magnetic field passes though B. If current in A is changed, magnetic field though B also changes and hence current will be generated in B.

**15.** State the rule to determine the direction of a

(i) magnetic field produced around a straight conductor-carrying current,

(ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and

(iii) current induced in a coil due to its rotation in a magnetic field.

**Solution:**

(i) Rule that used to determine the magnetic field produced around a straight conductor is right-hand thumb rule or Maxwell's corkscrew rule

(ii) Flemings left hand rule is used to determine the direction of force on a current carrying straight conductor placed in a magnetic field.

(iii) Fleming's right hand rule is used to determine the direction of induced current in a coil due to its rotation in a magnetic field.

**16.** Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

**Solution:**

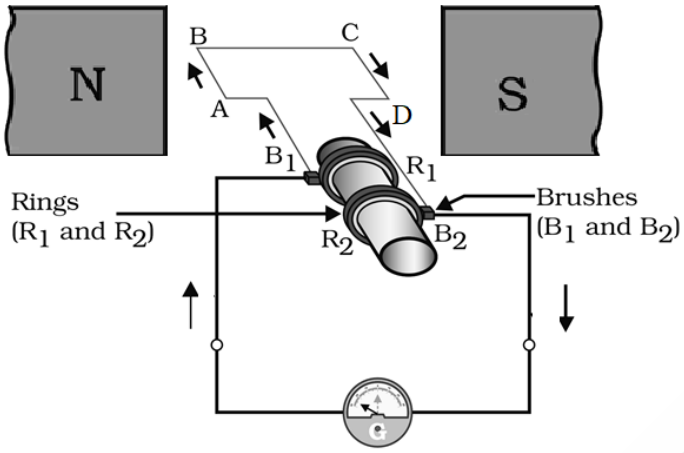
An electric generator is a device used to convert mechanical energy into electrical energy.

***Principle:***

An electric generator is based on the principle of electromagnetic induction according to which if a closed coil is rotated about an axis perpendicular to a uniform magnetic field, an induced current is produced whose direction is governed by Fleming's right-hand rule.

***Construction:***

An electric generator consists of a rectangular coil called armature, fixed magnet, slip rings and carbon brushes.




***Working:***

(i) When the armature is rotated in clockwise direction inside the magnetic field produced by the magnets, it cuts magnetic lines of force. This changing field produces induced current in the coil whose direction is given by Fleming's right-hand rule.

(ii) When the axle attached to two slip rings is rotated such that the arm AB moves up and CD downwards, induced current starts to flow from A to B and C to D. Thus, an induced current flow in the direction ABCD and in the external circuit, it flows from $B_2$ to $B_1$

(iii) After half a rotation, arm CD starts moving up and AB moves down. As a result, the direction of induced current will be DCBA and begin to flow from $B_1$ to $B_2$ in the external circuit. Thus, after every half rotation, the polarity of the current in the respective arms changes. Such a current, which changes the direction after equal intervals of time is called an alternating current.

***Function of carbon brushes:***

Carbon brushes $B_1$ and $B_2$, are pressed against slip rings to maintain continuous contact with rings. External circuit is connected to generator through brushes.

**17.** When does an electric short circuit occur?

**Solution:**

When the resistance of the circuit is very low current flows through is very high. This situation is known as short circuit. Short circuit may occur when too many electric appliances are connected to a single socket or a high-power rated appliance is connected to light circuit. In household electric circuits, if the insulation of wires is damaged or there is a fault in the appliance live wire and the neutral wire come into direct contact short circuit occurs. In such a situation, the current in the circuit abruptly increases.

**18.** What is the function of an earth wire? Why is it necessary to earth metallic appliances?

**Solution:**

The green coloured insulation wire in domestic circuits is earth wire. It is connected to a metal plate deep in the earth near the house. It is connected to metal parts of electric appliances like electric press, toaster, table fan, refrigerator, etc. if the live wire gets damaged and touches the metal part current flows to the earth tough the earth wire preventing damage to appliance as well as user.

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