

Chapter 13: Magnetic Effects of Electric Current Science

In Text Questions

Page No: 224

1. Why does a compass needle get deflected when brought near a bar magnet?

Answer

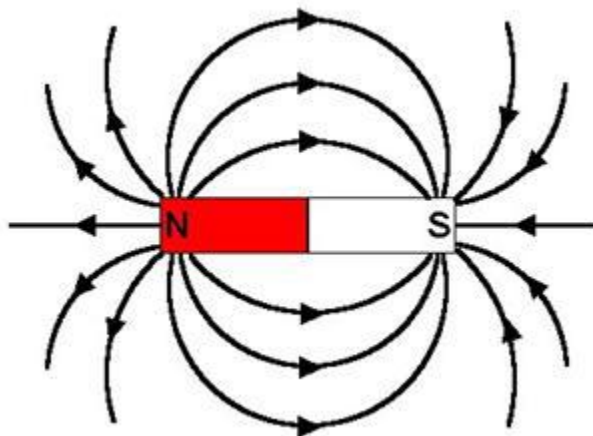
The needle of a compass is a small magnet. That's why when a compass needle is brought near a bar magnet, its magnetic field lines interact with that of the bar magnet. Hence, a compass needle gets deflected.

Page No: 228

1. Draw magnetic field lines around a bar magnet.

Answer

Magnetic field lines of a bar magnet emerge from the north pole and terminate at the south pole. Inside the magnet, the field lines emerge from the south pole and terminate at the north pole, as shown in the given figure.



2. List the properties of magnetic lines of force.

Answer

The properties of magnetic lines of force are as follows.

- Magnetic field lines emerge from the north pole.
- They merge at the south pole.
- The direction of field lines inside the magnet is from the south pole to the north pole.
- Magnetic lines do not intersect with each other.

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

Answer

The two magnetic field lines do not intersect each other because if they do it means at the point of intersect the compass needle is showing two different directions which is not possible.

Page No: 229

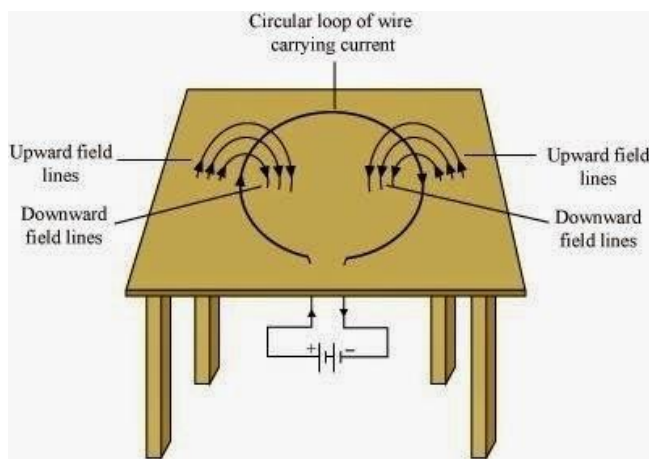
1. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

Answer

Inside the loop = Pierce inside the table

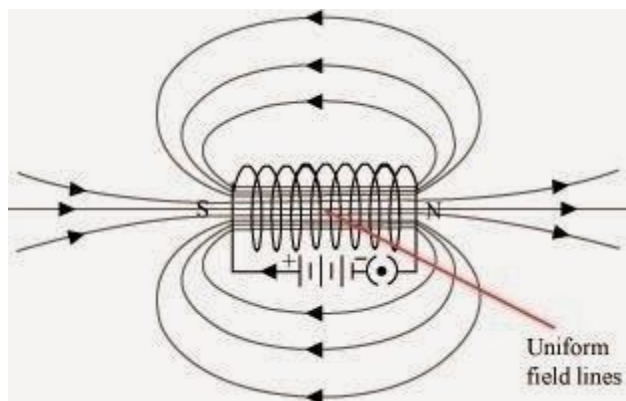
Outside the loop = Appear to emerge out from the table

For downward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop. Similarly, for upward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop, as shown in the given figure.



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

Answer



The magnetic field lines inside a current-carrying long straight solenoid are uniform.

Page No: 230

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

► (d) is the same at all points

Page No: 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

► (c) velocity and (d) momentum

Page No: 232

2. In Activity 13.7 (page: 230), 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?

Answer

(i) If the current in the rod is increased then rod will be deflected with greater force.

(ii) If a stronger horse-shoe magnet is used then also rod will be deflected with greater

force due to the increase in magnetic field.

(iii) If the length of the rod AB is increased.

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

- (a) towards south
- (b) towards east
- (c) downward
- (d) upward

► (d) upward

Page No: 233

1. State Fleming's left-hand rule.

Answer

Fleming's left hand rule states that if we arrange the thumb, the centre finger, and the forefinger of the left hand at right angles to each other, then the thumb points towards the direction of the magnetic force, the centre finger gives the direction of current, and the forefinger points in the direction of magnetic field.

2. What is the principle of an electric motor?

Answer

The principle of an electric motor is based on the magnetic effect of electric current. A current-carrying loop experiences a force and rotates when placed in a magnetic field. The direction of rotation of the loop is according to the Fleming's left-hand rule.

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

Answer

The split ring in the electric motor also known as a commutator reverses the direction of current flowing through the coil after every half rotation of the coil. Due to this the coil continues to rotate in the same direction.

Page No: 236

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

Answer

The different ways to induce current in a coil are as follows:

→ If a coil is moved rapidly between the two poles of a horse-shoe magnet, then an electric current is induced in the coil.

→ If a magnet is moved relative to a coil, then an electric current is induced in the coil.

Page No: 237

1. State the principle of an electric generator.

Answer

Electric generator works on the principle of electromagnetic induction. Electricity is generated by rotating a coil inside magnetic field.

2. Name some sources of direct current.

Answer

Some sources of direct current are cell, DC generator, etc.

3. Which sources produce alternating current?

Answer

AC generators, power plants, etc., produce alternating current.

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

► (c) half revolution

Page No: 238

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

Answer

Two safety measures commonly used in electric circuits and appliances are

→ Electric Fuse: An electric fuse is connected in series it protects the circuit from overloading and prevents it from short circuiting.

→ Proper earthing of all electric circuit in which any leakage of current in an electric appliance is transferred to the ground and people using the appliance do not get the shock.

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

Answer

Current drawn by the electric oven can be obtained by the expression,

$$P = VI$$

Where,

Current = I

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

Voltage supplied, $V = 220 \text{ V}$

$$I = 2000/220 \text{ V} = 9.09 \text{ A}$$

Hence, the current drawn by the electric oven is 9.09 A, which exceeds the safe limit of the circuit. Fuse element of the electric fuse will melt and break the circuit.

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

Answer

The precautions that should be taken to avoid the overloading of domestic circuits are as follows:

- Too many appliances should not be connected to a single socket.
- Too many appliances should not be used at the same time.
- Faulty appliances should not be connected in the circuit.
- Fuse should be connected in the circuit.

Page No: 240

Exercise

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
► (d) The field consists of concentric circles centred 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
► (c) producing induced current in a coil due to relative motion between a magnet and the coil
3. The device used for producing electric current is called a
(a) generator
(b) galvanometer
(c) ammeter
(d) motor
► (a) 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.
► (d) 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
► (c) increases heavily

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

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

► False

An electric motor converts electrical energy into mechanical energy.

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

► True

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

► True

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

► False

Live wire has red insulation cover, whereas earth wire has green insulation colour in the domestic circuits.

7. List three sources of magnetic fields.

Answer

Three sources of magnetic fields are as follows:

→ Current-carrying conductors

→ Permanent magnets

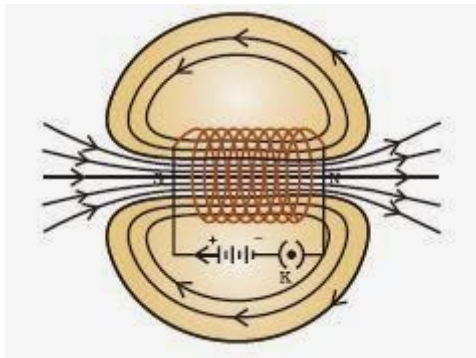
→ Electromagnets

Page No: 241

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.

Answer

A solenoid is a long coil of circular loops of insulated copper wire. Magnetic field lines are produced around the solenoid when a current is allowed to flow through it. The magnetic field produced by it is similar to the magnetic field of a bar magnet. The field lines produced in a current-carrying solenoid is shown in the following figure.



In the above figure, when the north pole of a bar magnet is brought near the end connected to the negative terminal of the battery, the solenoid repels the bar magnet. Since like poles repel each other, the end connected to the negative terminal of the battery behaves as the north pole of the solenoid and the other end behaves as a south pole. Hence, one end of the solenoid behaves as a north pole and the other end behaves as a south pole.

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

Answer

The force experienced by a current-carrying conductor is the maximum when the direction of current is perpendicular to the direction of the magnetic field.

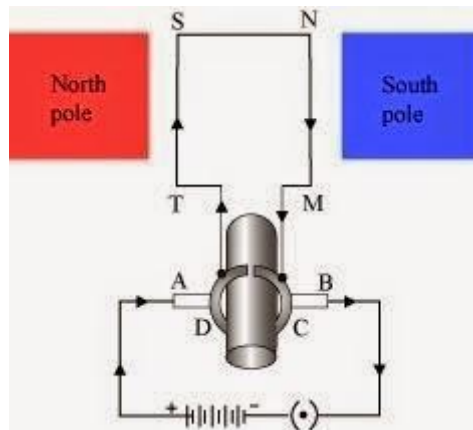
10. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

Answer

The direction of the magnetic field is vertically downwards. The direction of current is from the front wall to the back wall because negatively charged electrons are moving from back wall to the front wall. The direction of magnetic force is rightward. Hence, using Fleming's left hand rule, it can be concluded that the direction of magnetic field inside the chamber is downward.

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?

Answer



Principle: It works on the principle of the magnetic effect of current. A current-carrying coil rotates in a magnetic field.

Working: When a current is allowed to flow through the coil MNST by closing the switch, the coil starts rotating anti-clockwise. This happens because a downward force acts on length MN and at the same time, an upward force acts on length ST. As a result, the coil rotates anti-clockwise.

Current in the length MN flows from M to N and the magnetic field acts from left to right, normal to length MN. Therefore, according to Fleming's left hand rule, a downward force acts on the length MN. Similarly, current in the length ST flows from S to T and the magnetic field acts from left to right, normal to the flow of current. Therefore, an upward force acts on the length ST. These two forces cause the coil to rotate anti-clockwise. After half a rotation, the position of MN and ST interchange. The half-ring D comes in contact with brush A and half-ring C comes in contact with brush B. Hence, the direction of current in the coil MNST gets reversed.

The current flows through the coil in the direction TSNM. The reversal of current through the coil MNST repeats after each half rotation. As a result, the coil rotates unidirectional.

The split rings help to reverse the direction of current in the circuit. These are called the commutator.

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

Answer

Some devices in which electric motors are Water pumps, Electric fans, Electric mixers

and Washing machines.

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?

Answer

(i) The needle of the galvanometer shows a momentary deflection in a particular direction.

(ii) The needle of the galvanometer shows a momentarily in the opposite direction.

(iii) The needle of the galvanometer shows no deflection.

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.

Answer

Two circular coils A and B are placed close to each other. When the current in coil A is changed, the magnetic field associated with it also changes. As a result, the magnetic field around coil B also changes. This change in magnetic field lines around coil B induces an electric current in it. This is called electromagnetic induction.

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.

Answer

(i) Maxwell's right hand thumb rule

(ii) Fleming's left hand rule

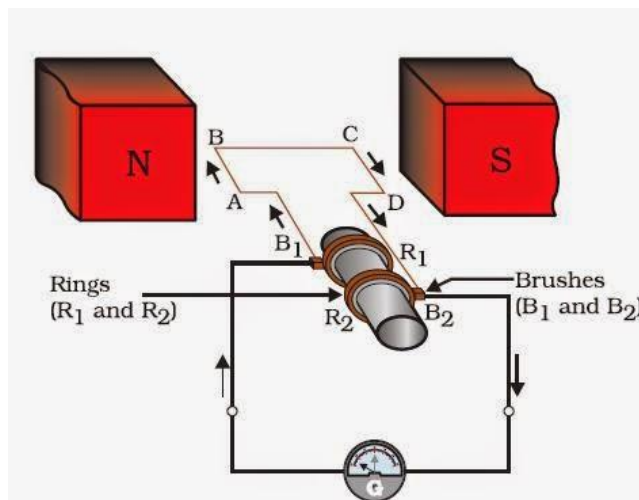
(iii) Fleming's right hand rule

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

Answer

Principle: An electric generator works on the principle of electromagnetic induction phenomenon. According to it, whenever a coil is rotated between the poles of a magnet,

an induced current is set up in the coil, whose direction is given by Fleming's right hand rule.



Working: Let in the beginning, as shown in Fig. brushes B_1 and B_2 are kept pressed separately on rings R_1 and R_2 respectively. Let the axle attached to the rings is rotated such that arm AB of the coil moves up and arm CD moves down in the magnetic field. Due to rotation of arms AB and CD induced currents are set up in them. As per Fleming's right hand rule induced currents in these arms are along the directions AB and CD. Thus an induced current flows along ABCD and current in the external circuit flows from B_2 to B_1 .

After half a rotation, arm AB starts moving down and the arm CD upward. Therefore, directions of induced currents in these arms change. Thus net induced current now becomes in the direction DCBA. In the external circuit now current flows from B_1 to B_2 . Thus after every half rotation current changes its direction and an alternating current is obtained from the generator.

Function of Brushes: Brushes are kept pressed on the two slip rings separately. Outer ends of the brushes are connected to the galvanometer (or the external load). Thus brushes help in transferring current from the coil ABCD to the external circuit.

17. When does an electric short circuit occur?

Answer

If the insulation of the wires used in the circuit is damaged or the appliance used is faulty due to which the live wire and the neutral wire comes in direct contact as a result current in the circuit rises and the short circuit occurs.

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

appliances?

Answer

The metallic body of electric appliances is connected to the earth by means of earth wire so that any leakage of electric current is transferred to the ground. This prevents any electric shock to the user. That is why earthing of the electrical appliances is necessary.