

Magnetic Effects of Electric Currents

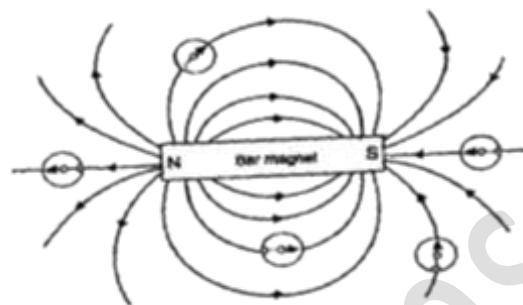
Solved Intext Exercises

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

Ans. Compass needle is a small bar magnet and when it is brought near a bar magnet than compass needle is either attracted or repelled from the bar magnet. This makes the compass needle deflect.

Q2. Draw a magnetic field line around a bar magnet.

Ans.



Q.3 List the properties of magnetic lines of force.

Ans.

Magnetic lines of Force originate from the north pole of a magnet and end at a south pole.

The magnetic lines of force come to one another near the poles of magnet but they are widely separated at another place.

Magnetic lines of Force do not intersect one another.

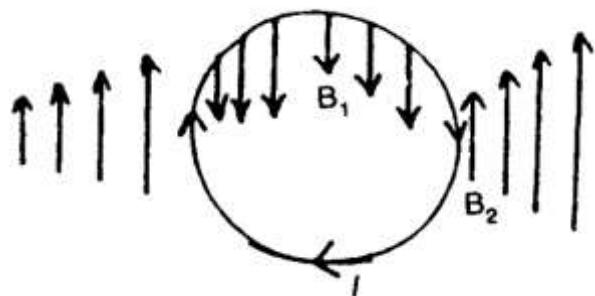
Explanation: Suppose two magnetic lines of forces intersect each other at a point P, if we place a compass needle at point P, then north pole of compass needle must show two directions but this is not possible at a point at a time, the north pole of compass needle shows only one direction.

Q4. Why don't two magnetic lines of force intersect each other?

Ans. Two lines of force never intersect each other because if they intersect, it means that at the point of intersection, the needle should point towards two directions, which is not possible.

Q5. 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.

Ans. The magnetic field inside the loop is inside the plane of the table and perpendicular to it. The magnetic field outside the loop is above the plane of the table and perpendicular to it.



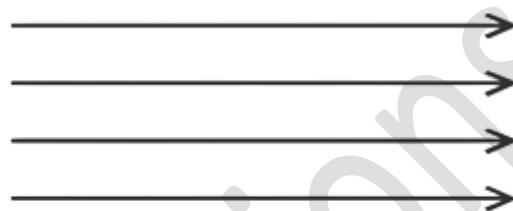
B₁ - Magnetic field inside the loop

B₂ - Magnetic field outside the loop

I - Current

Q6. The magnetic field in a given region is uniform. Draw a diagram to represent it.

Ans.



Q7. The magnetic field inside a long straight solenoid carrying current is :

- (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.

Ans. (d) is the same at all points.

Q8. 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

Ans. (c) velocity and (d) momentum

Q9. In activity 13.7 (of text book) 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) The length of Rod AB increases

Ans.

- i. displacement of rod AB will increase.

- ii. displacement of rod AB will increase.
- iii. displacement of rod AB will increase.

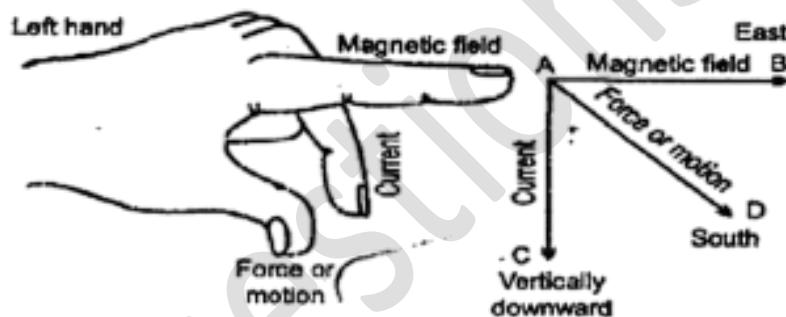
Q10. A positively - charged particle (alpha particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is

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

Ans. (c) upward (according Flemings left hand rule).

Q11. State Fleming's left - hand rule.

Ans. Hold the fore finger, the central finger and thumb of your left hand at right angles to each other adjust your hand in such a way that the forefinger points in the direction of magnetic field and the central finger points in the direction of current then the direction in which thumb the give the direction of force acting on the conductor.



Q12. What is the principle of an electric motor?

Ans. When a current carrying coil is placed in a strong magnetic field, it experience a torque and rotates continuously.

Q13. What is the role of the split ring in an electric motor?

Ans. The role of the split ring in an electric motor is to reverse the direction of the current flowing through the coil every time the coil just passes the vertical position during a revolution.

Q14. State the principle of an electric generator.

Ans. Electric generators are based upon the principle of electromagnetic induction i.e., when a conductor or coil is moved in a magnetic field, current is induced in the conductor of the coil.

Q15. Name some sources of direct current.

Ans. Cell, battery, bicycle, dynamo, car dynamo, dry cell, electric battery, electrical inverter.

Q16. Which source produce alternating current?

Ans.

Hydro electric generator.

Thermal Power generator.

Nuclear Power generator.

Q17. 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.

- (i) two revolution
- (ii) one revolution
- (iii) half revolution
- (iv) two revolution

Ans. (iii) half revolution

Q18. Name two safety measures commonly used in electric circuits and appliances.

Ans.

- Use of earth wire.
- Use of electric fuse.

Q19. An electric oven of 2kW power rating is operated in a domestic electric circuit (220V) that has a current rating of 5A. What do you expect?

Ans. The power rating is 2kW. When operated at 220V, it will draw a current

$$I = \frac{2kW}{220V} = \frac{2 \times 1000}{220} = 9 \text{ Amp.}$$

Since this is above the current rating, so either. (i) the fuse will blow. (ii) the wire may melt due to overheating.

Q20. What precaution should be taken to avoid overloading of domestic circuits?

Ans. Too many appliances drawing a large current should not be connected in a single electric circuit. Also using fuses of proper ratings may avoid the chance of overloading of the circuit.

Solved NCERT Exercises

Q.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 centered on the wire.

Ans. (d) The field consists of concentric circles on the wire.

Q.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.

Ans. (c) Producing induced current in a coil due to relative motion between a magnet and the coil.

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

(a) Generator

(b) Galvanometer

(c) Ammeter

(d) Motor

Ans. (a) Generator

Q.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.

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

Q.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

Ans. (c) increases heavily

Q.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 center of a long circular coil carrying current will be parallel straight lines.

(d) A wire with a green insulator is usually the live wire.

Ans.

(a) False

(b) True

(c) True

(d) False

Q7. List three sources of magnetic fields.

Ans.

current - carrying straight conductor.

current - carrying circular wire.

current flowing in a solenoid.

Q8. 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.

Ans. Solenoid behaves like a magnet in the following ways:

The magnetic field produced by a current carrying solenoid is similar to the magnetic field produced by a bar magnet.

If a current - carrying solenoid is suspended freely, it comes to rest pointing north and south like a suspended magnet.

Yes, we can determine the north and south poles of a current carrying solenoid with a help of bar magnet. We suspend both current carrying solenoid and bar magnet freely. Bar magnet and current carrying solenoid both come to rest. The end of solenoid pointing same as the south pole of bar magnet is south pole.

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

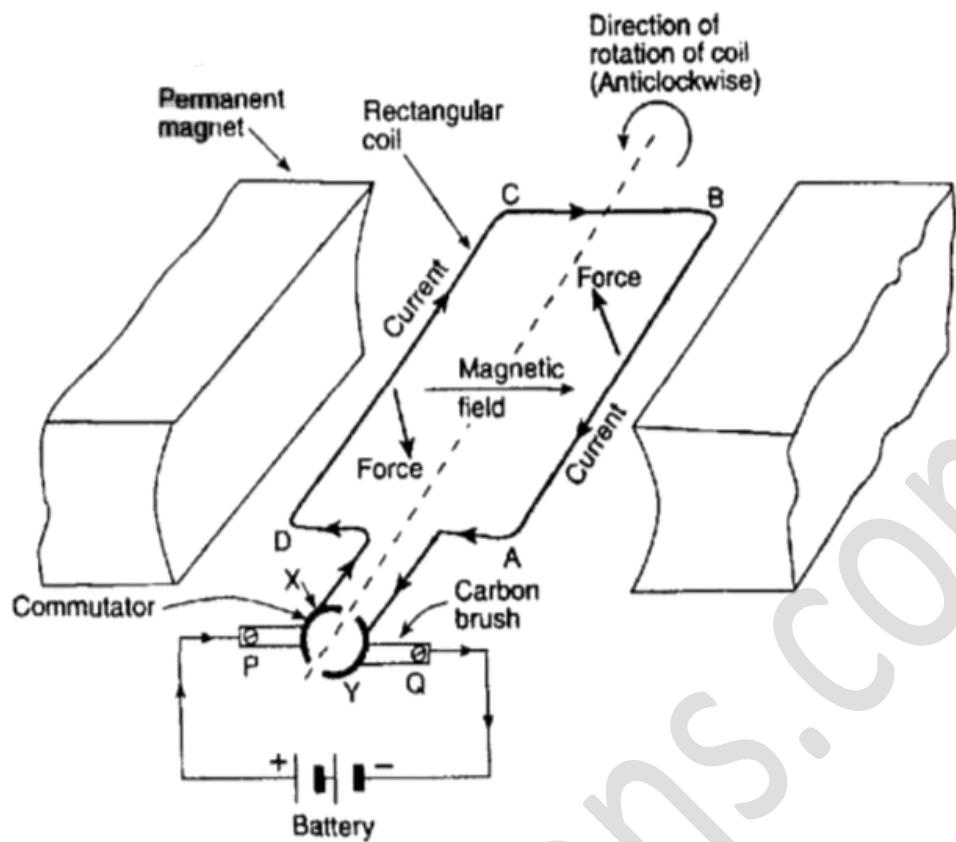
Ans. The force experienced by a current carrying conductor is the largest when it is perpendicular to the direction of magnetic field.

Q.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?

Ans. The direction of magnetic field is vertically downwards.

Q.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?

Ans. Principal: It is based on the magnetic effect of electric current. When a current carrying coil is placed in a strong magnetic field, it experience a torque according Fleming's Left Hand Rule and rotates continuously between strong magnetic field.



Working: Suppose initially the coil ABCD is in the horizontal position. When current passes through the side AB of the coil from B to A then AB part of the coil experience an upward mechanical force. (According to Fleming's Left Hand Rule) when current passes through the side CD of the coil from D to C, then CD part of the coil experience a downward mechanical force (According to Fleming's Left Hand Rule). These two equal, opposite and parallel forces acting on the two sides of the coil form a couple and rotate the coil in the anticlockwise direction.

After half revolution the two commutator half rings automatically change their contact from one brush to the other. This reverses the direction of current through the coil now the side AB of the coil moves downward and side DC moves upward according to Fleming's Left Hand Rule. This process is repeated again and again and the coil continues to rotate as long as the current is passing.

Q.12 Name the devices in which electric motors are used.

Ans. Electric fans, washing machines, refrigerators, mixers, blenders, computers, MP3 Players.

Q.13 A coil of insulated copper wire is connected to a galvanometer. What happens if a bar magnet is (i) pushed into the coil, (ii) withdrawn from inside the coil, (iii) held stationary inside the coil?

Ans.

- The galvanometer needle deflects indicating the presence of a current in the circuit.
- The galvanometer again shows deflection but in opposite direction.
- The galvanometer does not show any deflection.

Q.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 reasons?

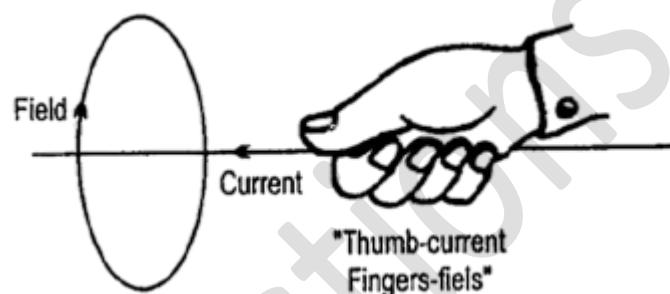
Ans. Current will be induced in the coil B if the current in coil A is changed because when the current in first coil changes, the magnetic field associated with it also changes. This induces a change of magnetic flux in the secondary coil (coil B) which in turn produces a potential drop.

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

- magnetic field produced around a straight conductor carrying current.**
- force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it and**
- current induced in a coil due to its rotation in a magnetic field**

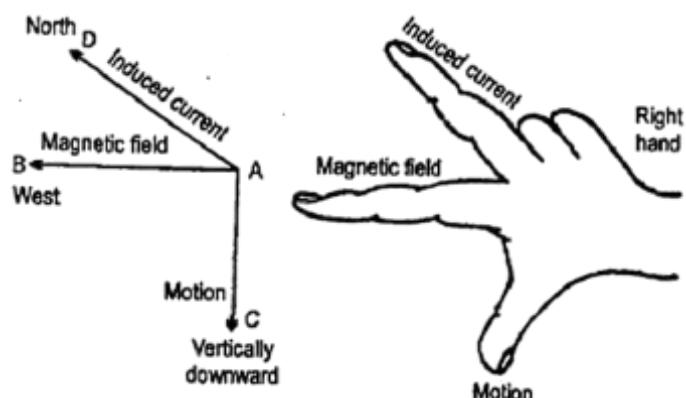
Ans.

(i) Right Hand Thumb Rule: According to Maxwell's right hand thumb rule imagine that you are holding the current - carrying wire in your right hand so that your thumb points in the direction of current, then the direction in which your fingers encircle the wire will give the direction of magnetic field lines around the wire.



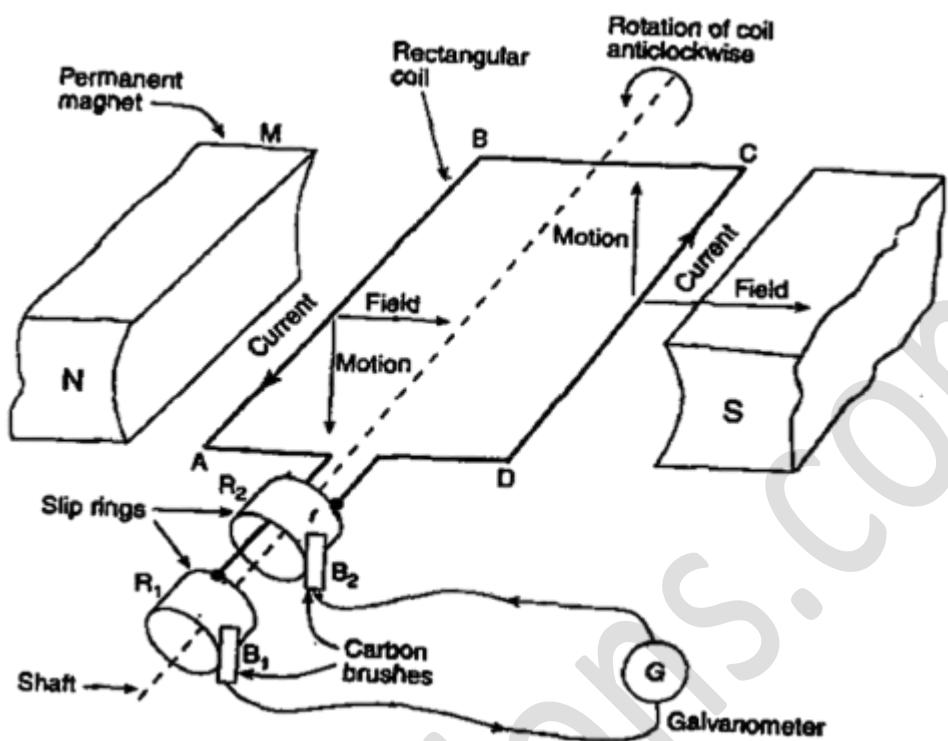
(ii) Fleming's Left Hand Rule: According to Fleming's Left Hand Rule hold the forefinger, the central finger and thumb of your left hand at right angles to each other adjust your hand in such a way that the forefinger points in the direction of magnetic field and the central finger points in the direction of current then the direction in which thumb the give the direction of force acting on the conductor.

(iii) Fleming's Right Hand Rule: Hold the thumb, the forefinger and the central finger of your right hand at right angle to one another adjust your hand in such a way that forefinger points in the direction of magnetic field and thumb points in the direction of motion of conductor then the direction in which central finger points given the direction of current. Fleming right hand rule also known dynamo rule.



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

Ans. Principle: It is based on the phenomenon of electromagnetic Induction. When a coil is moved in a magnetic field and induced current is produced in a coil. The direction of induced current can be identified by Fleming's Right Hand Rule.



Working: Suppose the coil ABCD is initially in the horizontal position and starts rotates anticlockwise direction, the side AB of coil moves downward and side CD moves up cutting the lines of forces. Due to this, induced current is produced. In the sides AB and DC, from B to A and D to C respectively according Fleming's Right Hand Rule and effective induced current flow in the direction.

After half revolution the side of coil ABCD interchange their position. As a result of this, the direction of induced current in each side of the coil reversed after half a revolution. The end of coil which was +ve in the first half of rotation becomes -ve in the second half. Thus in one revolution of the coil, the current changes its direction two times.

Q.17 When does an electric short circuit occur?

Ans. An electric short circuit occurs when due to damaged or defective wiring, live wire comes in the contact of neutral wire directly.

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

Ans. Earth wire is used as a safety measure to ensure that any leakage of current to the metallic body of an appliance does not give any severe shock to the user. It is necessary to earth metallic appliances to save ourselves from electric shocks and save the appliances from damage due to excessive current.