Magnetic effects of electric current

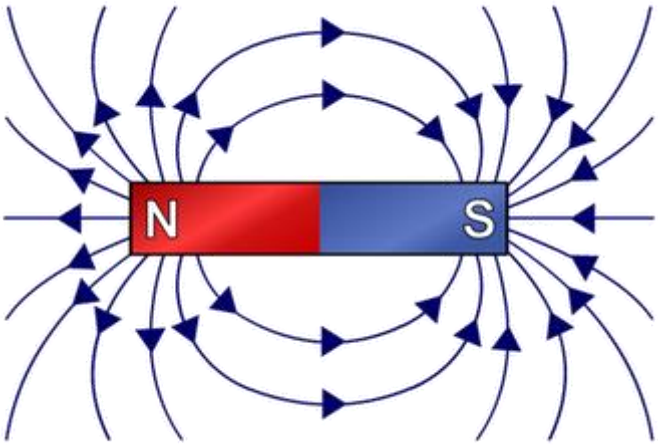
12 Chapter

Intext Exercise 1

1. Why does a compass needle get deflected when brought near a bar magnet?
Ans: A compass needle is basically a small bar magnet. When it is brought closer to a bar magnet, its magnetic field lines would interact with the bar magnet. Therefore, a compass needle shows a deflection on being brought near the bar magnet.

Intext Exercise 2

1. Draw magnetic field lines around a bar magnet.
Ans: We know that magnetic field lines of a bar magnet emerge from the north pole and will terminate at the south pole. And the field lines would emerge from the south pole inside the magnet and would terminate at the north pole, which can be seen in the below figure.

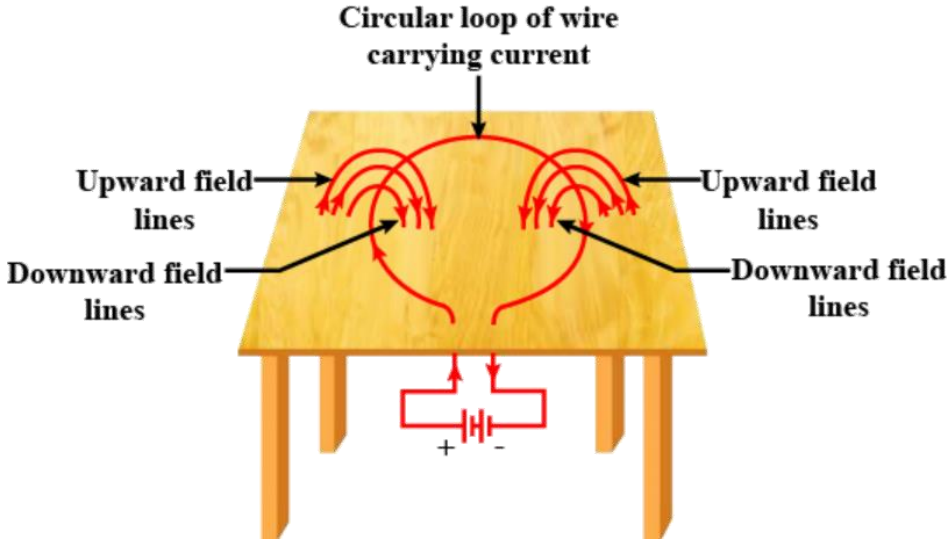


2. List the properties of magnetic lines of force.
Ans: The properties of magnetic lines of force are known to be as follows.
1. Magnetic field lines are known to arise from the north pole.
2. Magnetic field lines will always terminate at the south pole.
3. The direction of field lines inside the magnet is known to be from the south pole to the north pole.
4. Magnetic lines do not intersect each other.

3. Why don't two magnetic lines of force intersect each other?
Ans: When two field lines of a magnet intersect, the compass needle would point in two different directions at the point of intersection, which we know is impossible. Therefore, we could conclude that two field lines do not intersect each other.

Intext Exercise 3

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.



Ans: We can see that, 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 can be seen to be as if they are emerging from the table outside the loop and merging in the table inside the loop. Similarly, for the upward direction of the current flowing through the circular loop, the direction of magnetic field lines can be seen to 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.
Ans: Uniform magnetic field could be represented by the parallel straight lines.

Uniform Magnetic Field 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
Ans: The correct option is (d). The magnetic field inside a long, straight, current-carrying solenoid is found to be uniform. Inside the solenoid it would be the same at all points.

Intext Exercise 4

1.Which of the following properties 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: The correct options are (c) and (d).
When a proton enters a magnetic field area, it would experience a magnetic force. As a result of this force, the path of the proton would become circular. Therefore, its velocity and momentum would also change.

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?
Ans: We know that in a magnetic field, a current-carrying conductor would experience a force. The magnitude of this force would increase with the amount of current, the magnetic field strength and the length of the conductor. So, the magnetic force exerted on rod AB and its deflection would increase if:
i. current in rod AB is increased

ii. a stronger horse-shoe magnet is used
iii. length of 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
Ans: The correct option is (d). Using the Fleming's left-hand rule, the direction of the magnetic field could be easily determined. As per this rule, stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If the first finger points in the direction of magnetic field and the second finger in the direction of current, then the thumb would point in the direction of motion, that is, the direction of the force acting on the conductor.
Since, the direction of positively charged alpha particles is given to be towards west, the direction of current will be the same i.e., towards west. And, the direction of magnetic force is towards the north. Therefore, according to Fleming's left-hand rule, the magnetic field will be directed upwards.

Intext Exercise 8

1. Name two safety measures commonly used in electric circuits and appliances.
Ans: Two safety measures commonly used in electric circuits and appliances are listed as follows:
i. An electric fuse must necessarily be connected to each circuit. This would prevent the flow of excessive current through the circuit. When the current passing through the wire exceeds the maximum limit of the fuse element, the fuse would melt to stop the excess flow of current through that circuit, thus protecting the appliances connected to the circuit.
ii. In order to prevent shocks, earthing is considered as an important safety measure. Any leakage of current in an electric appliance could be 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.

Ans: Current drawn by the electric oven could be obtained by the expression,

$P = V \times I$

Where, I is the Current.

We are given: Power of the oven, $P = 2\ kW = 2000W$

Voltage supplied, $V = 220\ V$

$\Rightarrow I = \frac{P}{V} = \frac{2000}{220}$

$\Rightarrow I = 9.09\ A$

Hence, the current drawn by the electric oven is found to be 9.09 A, which exceeds the safety limit of the circuit. So, the fuse element of the electric fuse would melt and hence break the circuit.

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

Ans: Following precautions should be taken in order to avoid the overloading of domestic circuits:

i. Too many appliances shouldn't be connected to a single socket.
ii. Too many appliances shouldn't be used simultaneously.
iii. Fuse must be connected in the circuit.
iv. Faulty appliances shouldn't be connected into the circuit.

NCERT 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

Ans: The correct option is (d). The magnetic field lines, produced around a straight current-carrying conductor, are always in concentric circles. Their centres would lie on the wire.

2. 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: The correct option is (c). When two naked wires of an electric circuit touch each other, the amount of current flowing through the circuit would increase abruptly. This would in turn cause a short-circuit.

3. State whether the following statements are true or false.
a) The field at the centre of a long circular coil carrying current will be parallel straight lines.

Ans: True; A long circular coil is a long solenoid. The magnetic field lines inside the solenoid are known to be parallel lines.

b) A wire with a green insulation is usually the live wire of an electric supply.
Ans: False; Live wire has red insulation cover, whereas earth wire has green insulation colour in the domestic circuits.

4. List two methods of producing magnetic fields.
Ans: There are following method to produce the magnetic field.
i. Moving charge
ii. Permanent magnets,
iii. Electromagnets
iv. Current-carrying conductors.

5. When is the force experienced by a current-carrying conductor placed in a magnetic field largest?
Ans: The force experienced is found to be maximum when the direction of the current is perpendicular to the direction of the magnetic field.

6. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from the back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of the magnetic field?
Ans: The direction of the magnetic field could be given by Fleming's left-hand rule. Magnetic field inside the chamber would be perpendicular to the direction of current (opposite to the direction of electron) and direction of deflection/force i.e., either upward or downward. The direction of current is from the front wall to the back wall as the negatively charged electrons are moving from the back wall to the front wall. Also, the direction of magnetic force is rightward.
Now, by using Fleming's left-hand rule, it could be concluded that the direction of magnetic field inside the chamber is downward.

7. State the rule to determine the direction of a

a) magnetic field produced around a straight conductor-carrying current.

Ans: Maxwell's right-hand thumb rule.

b) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it.

Ans: Fleming's left-hand rule.

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

Ans: Fleming's right-hand rule.

8. When does an electric short circuit occur?

Ans: An electric short circuit is known to occur when:

a) When the resistance of an electric circuit becomes very low and the current that is flowing through the circuit becomes very high. This is caused by connecting too many devices to a single socket or connecting high power rating appliances to the light circuits.

b) When the insulation of live and neutral wires undergoes wear and tear and then they touch each other, the current flowing in the circuit would increase abruptly.

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

Ans: Using an earth wire, the metallic body of electric appliances could be connected to the earth so that any electric current leakage is transferred to the ground. This would prevent any electric shock to the user. Therefore, earthing of electrical appliances is very necessary.