Class 10 Science Chapter 12: Magnetic Effects of Electric Current - Notes, Important Questions and MCQs (2026-27)

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These Class 10 Science Chapter 12 PDF Notes explain Magnetic Effects of Electric Current as per the 2026-27 NCERT book: magnetic field and field lines, the field due to a straight wire, a circular loop and a solenoid, the force on a current-carrying conductor, Fleming’s left-hand rule, and domestic electric circuits.

Questions on field-line properties, the right-hand thumb rule, solenoids and electromagnets, Fleming’s left-hand rule and the role of the earth wire, fuse, short-circuiting and overloading appear regularly in board papers.

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Chapter Overview

Hans Christian Oersted discovered that an electric current deflects a nearby compass needle, which showed that electricity and magnetism are linked. A current-carrying wire behaves like a magnet and produces a magnetic field around it.

The chapter maps magnetic fields using field lines, shows how the shape of a conductor changes its field, explains why a current-carrying conductor feels a force in a magnetic field, and ends with the safe wiring of houses.

Important Topics and Concepts

Magnetic field and field lines

The region around a magnet where its force can be felt is its magnetic field. It has both direction and magnitude. Field lines are drawn from the north pole to the south pole outside the magnet and from south to north inside, forming closed loops. Where lines are crowded, the field is stronger. Two field lines never cross, because a compass cannot point in two directions at once.

Field due to a straight current-carrying conductor

The field lines are concentric circles around the wire. The field is stronger closer to the wire and increases with current. Its direction reverses if the current reverses.

Right-hand thumb rule

Hold the current-carrying straight conductor in your right hand with the thumb pointing in the direction of current. The curled fingers show the direction of the magnetic field lines. This rule is also called Maxwell’s corkscrew rule.

Field due to a circular loop

Each small part of the loop has circular field lines around it. At the centre of the loop, these combine to appear as nearly straight lines. The field increases with the current and with the number of turns (n turns give about n times the field).

Solenoid and electromagnet

A solenoid is a coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. Its field is like that of a bar magnet, with one end behaving as a north pole and the other as a south pole. Inside the solenoid the field lines are parallel straight lines, so the field is uniform. A soft iron core placed inside makes a strong electromagnet, which works only while current flows.

Force on a current-carrying conductor in a magnetic field

André-Marie Ampère suggested that a magnet exerts an equal and opposite force on a current-carrying conductor. The force is largest when the current is perpendicular to the magnetic field. It reverses when either the current or the field reverses. Devices that use this include electric motors, generators, loudspeakers, microphones and measuring instruments.

Fleming’s left-hand rule

Stretch the thumb, forefinger and middle finger of your left hand so they are mutually perpendicular. If the forefinger points along the magnetic field and the middle finger along the current, the thumb gives the direction of the force (motion) on the conductor.

Domestic electric circuits

- Supply comes through main wires: live wire (red insulation), neutral wire (black) and earth wire (green). In India the potential difference between live and neutral is 220 V.
- At the meter board, a main fuse and an electricity meter are connected; then a main switch leads to separate circuits.
- Two circuits: 15 A for heavy appliances (geysers, air coolers) and 5 A for bulbs and fans.

- All appliances are connected in parallel so each gets equal voltage and can be switched on or off independently.
- Earth wire: connected to a metal plate deep in the ground; it is connected to the metal body of appliances and gives a low-resistance path to current if the body becomes live, protecting the user from shock.
- Short-circuiting: live and neutral wires touch directly (damaged insulation or faulty appliance), current increases sharply.
- Overloading: too many appliances on one socket or an accidental rise in supply voltage.
- The fuse melts and breaks the circuit when current exceeds a safe value, preventing damage and fire.

Rules You Must Remember

Rule	Used to find	How
Right-hand thumb rule	Direction of magnetic field around a straight conductor	Thumb = current; curled fingers = field
Fleming's left-hand rule	Direction of force on a conductor in a magnetic field	Forefinger = field; middle finger = current; thumb = force
Fleming's right-hand rule (for exercise Q7 iii)	Direction of induced current in a conductor moving in a field	Forefinger = field; thumb = motion; middle finger = induced current

Important Definitions and Terms

Term	Meaning
Magnetic field	Region around a magnet in which its force can be detected
Magnetic field lines	Imaginary lines showing the direction of the magnetic field
Solenoid	Coil of many turns of insulated wire in a cylindrical shape
Electromagnet	A temporary magnet made by passing current through a coil wound on soft iron
Live wire	Wire with red insulation carrying current at high potential
Neutral wire	Wire with black insulation at zero potential
Earth wire	Wire with green insulation connected to the ground for safety
Short-circuit	Direct contact of live and neutral wires causing a sudden large current
Overloading	Drawing more current than a circuit can safely carry
Fuse	Safety device that melts and breaks the circuit when current is too high

Short Answer Questions

Q1. Why does a compass needle get deflected when brought near a bar magnet?

A compass needle is a small magnet. The magnetic field of the bar magnet exerts a force on its poles, which turns the needle.

Q2. Why don't two magnetic field lines intersect?

At the point of intersection, the compass needle would have to point in two directions at once, which is impossible.

(i) Using a permanent magnet such as a bar magnet. (ii) Passing an electric current through a conductor, such as a straight wire or a solenoid.

Q4. When is the force on a current-carrying conductor in a magnetic field the largest?

When the direction of current is perpendicular to the direction of the magnetic field.

Q5. What is the difference between a solenoid and a bar magnet?

Both have similar field patterns, but a solenoid acts as a magnet only while current flows, and its strength and polarity can be changed. A bar magnet is permanent.

Q6. What precaution should be taken to avoid overloading?

Do not connect too many appliances to a single socket, and use the correct rating of fuse or MCB in the circuit.

Q7. What is the function of an earth wire? Why should metallic appliances be earthed?

The earth wire provides a low-resistance path to the ground for leakage current. If the metal body of an appliance becomes live, current flows to the earth instead of through the user, preventing an electric shock.

Q8. What happens to the current at the time of a short circuit?

The resistance of the circuit becomes very small, so the current increases heavily.

Long Answer Questions

Q1. Describe the magnetic field produced by a solenoid and explain how an electromagnet is made.

A solenoid is a long coil of many closely wound turns of insulated copper wire.

When current flows, field lines inside the solenoid are parallel straight lines, showing a uniform field. Outside, the lines go from one end to the other like those of a bar magnet; one end acts as the north pole and the other as the south pole.

To make an electromagnet, place a soft iron rod inside the solenoid. The strong field magnetises the rod, creating a powerful magnet that works only while current flows.

The strength of an electromagnet increases with the number of turns, the current and the use of a soft iron core.

Q2. Explain domestic electric wiring and the safety devices used.

Electricity reaches homes through live (red), neutral (black) and earth (green) wires. The potential difference between live and neutral is 220 V in India.

The supply passes through a main fuse and the electricity meter to the main switch, then into separate circuits: a 15 A circuit for high-power appliances and a 5 A circuit for lights and fans.

Appliances are connected in parallel so each gets 220 V and works independently.

Safety: (i) fuse in each circuit melts on excess current; (ii) earth wire on metal-bodied appliances prevents shocks; (iii) avoiding overloading and replacing damaged wires prevents short circuits.

Q3. A beam of electrons moves horizontally from the back wall towards the front wall of a

The current direction is opposite to the motion of electrons, so the current flows from the front wall towards the back wall.

The force on the beam is to the right.

Using Fleming’s left-hand rule (middle finger along current, thumb along force), the forefinger points vertically downward.

Answer: The magnetic field is directed vertically downward.

MCQs with Answers

1. Magnetic field lines around a straight current-carrying wire are(a) Straight and parallel (b) Concentric circles (c) Radial lines (d) EllipsesAnswer: (b) Concentric circles

2. The direction of the magnetic field around a straight conductor is found by(a) Fleming’s left-hand rule (b) Right-hand thumb rule (c) Ohm’s law (d) Joule’s lawAnswer: (b) Right-hand thumb rule

3. Inside a long solenoid, the magnetic field is(a) Zero (b) Uniform (c) Decreasing towards centre (d) CircularAnswer: (b) Uniform

4. The force on a conductor is largest when the current is(a) Parallel to the field (b) Perpendicular to the field (c) At 45° to the field (d) ZeroAnswer: (b) Perpendicular to the field

5. In Fleming’s left-hand rule, the thumb shows the direction of(a) Current (b) Field (c) Force/motion (d) Induced currentAnswer: (c) Force/motion

6. The colour of the earth wire insulation is(a) Red (b) Black (c) Green (d) BlueAnswer: (c) Green

7. The potential difference between live and neutral wires in India is(a) 110 V (b) 220 V (c) 240 V (d) 440 VAnswer: (b) 220 V

8. At the time of short circuit, the current(a) Reduces (b) Does not change (c) Increases heavily (d) Varies continuouslyAnswer: (c) Increases heavily

9. An electromagnet uses a core of(a) Steel (b) Copper (c) Soft iron (d) AluminiumAnswer: (c) Soft iron

10. Who discovered that current deflects a compass needle?(a) Faraday (b) Oersted (c) Ampère (d) OhmAnswer: (b) Oersted

Quick Revision Points

- Field lines: N to S outside, closed loops, never intersect; crowded = strong.
- Straight wire: concentric circles; right-hand thumb rule.
- Circular loop: field at centre nearly straight; more turns = stronger.
- Solenoid: uniform field inside; soft iron core makes an electromagnet.
- Force maximum when current perpendicular to field; Fleming’s left-hand rule.
- Live red, neutral black, earth green; 220 V in India.
- 15 A and 5 A circuits; appliances in parallel; fuse and earthing for safety.

Chapter Summary

An electric current produces a magnetic field. Field lines show its direction and strength. The field is circular around a straight wire, nearly straight at the centre of a circular loop, and uniform inside a solenoid, which behaves like a bar magnet and becomes an electromagnet with a soft iron core.

A current-carrying conductor placed in a magnetic field feels a force, largest when current and field are perpendicular, with its direction given by Fleming’s left-hand rule. Domestic circuits use live, neutral and earth wires, parallel connections, fuses and earthing to keep electricity safe.

Exam Tips and PYQ Pattern

- Draw field-line patterns for a bar magnet, straight wire and solenoid; diagram questions are common.
- Learn both hand rules and which hand goes with which rule.
- Domestic circuit questions often ask about earthing, fuses, short-circuiting and overloading.
- The electron-beam direction question from the NCERT exercise is a favourite application question.

Frequently Asked Questions

Are electric motor and generator in the 2026-27 syllabus?

In the 2026-27 NCERT book, motors and generators are mentioned only as devices that use the force on a current-carrying conductor; the chapter focuses on magnetic fields, solenoids, force on a conductor and domestic circuits.

Why is soft iron used in electromagnets?

Soft iron magnetises strongly when current flows and loses its magnetism quickly when the current stops.

Why are appliances connected in parallel at home?

So that each appliance gets the full 220 V and can be switched on or off without affecting the others.

Conclusion

Magnetic Effects of Electric Current is mainly about patterns and rules. Learn the field-line diagrams, practise the right-hand thumb rule and Fleming’s left-hand rule with examples, and revise domestic safety. These cover almost every question you will see from this chapter.

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Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE science educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 10 Science textbook (Reprint 2026-27)