

PRACTICE PAPER 01 (2026-27)
CHAPTER 12: MAGNETIC EFFECTS OF ELECTRIC CURRENT
(STEP-BY-STEP SOLUTIONS)

SUBJECT: SCIENCE

MAX. MARKS : 40

CLASS : X

DURATION : 1½ hrs

General Instructions:

- (i) All questions are compulsory.
- (ii) This question paper contains **20** questions divided into five Sections A, B, C, D and E.
- (iii) **Section A** comprises 10 MCQs and Assertion-Reason questions of **1 mark** each. **Section B** comprises 4 Very Short Answer questions of **2 marks** each. **Section C** comprises 3 Short Answer questions of **3 marks** each. **Section D** comprises 1 Long Answer question of **5 marks**. **Section E** comprises 2 Case Study Based questions of **4 marks** each.
- (iv) There is no overall choice. Internal choice is provided in Section E.
- (v) Use of calculators is not permitted.

SECTION - A

Questions 1 to 10 carry 1 mark each.

1. The scientist who discovered in 1820 that a compass needle is deflected when a current passes through a nearby wire was
- | | |
|------------------------|----------------------------|
| (a) Michael Faraday | (b) Hans Christian Oersted |
| (c) Andre-Marie Ampere | (d) John Fleming |

Solution:

Ans: (b) Hans Christian Oersted

2. Inside a bar magnet, the magnetic field lines are directed
- (a) from the north pole to the south pole
 - (b) from the south pole to the north pole
 - (c) from the centre towards both poles
 - (d) in no particular direction

Solution:

Ans: (b) from the south pole to the north pole

- Outside they go from N to S; inside from S to N – so field lines are closed curves.

3. The magnetic field lines around a long straight current-carrying conductor are
- | | |
|-----------------------------|------------------------|
| (a) parallel straight lines | (b) concentric circles |
| (c) ellipses | (d) radial lines |

Solution:

Ans: (b) concentric circles

- The circles are centred on the wire, in a plane perpendicular to it.

4. A circular coil of 50 turns carries a current. Compared to a single turn carrying the same current, the magnetic field at its centre is
- | | |
|-------------------------|-------------------------|
| (a) the same | (b) 50 times as large |
| (c) 1/50 times as large | (d) 2500 times as large |

Solution:

Ans: (b) 50 times as large

- The current in each turn is in the same direction, so the fields of the n turns add up.

5. A current flows in a horizontal wire from south to north. Using the right-hand thumb rule, the magnetic field at a point directly above the wire is directed towards the
- (a) north (b) south
(c) east (d) west

Solution:

Ans: (c) east

- Thumb northwards along the wire: fingers curl over the top of the wire from west to east, so the field above points east (and below, west).

6. In Fleming's left-hand rule, the middle (second) finger points in the direction of the
- (a) magnetic field (b) current
(c) force on the conductor (d) motion of electrons

Solution:

Ans: (b) current

- First finger – field; second finger – current; thumb – force (motion).

7. In domestic wiring, which of the following is correctly matched?
- (a) Live wire – black (b) Neutral wire – red
(c) Earth wire – green (d) Live wire – green

Solution:

Ans: (c) Earth wire – green

- Live – red; neutral – black; earth – green.

8. The magnetic field inside a long straight current-carrying solenoid
- (a) is zero (b) decreases towards its ends
(c) increases towards its ends (d) is uniform – the same at all points

Solution:

Ans: (d) is uniform – the same at all points

- The field lines inside are parallel straight lines.

In the following questions 9 and 10, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.

9. **Assertion (A):** Two magnetic field lines never intersect each other.

Reason (R): If they did, a compass needle placed at the point of intersection would point in two directions at once, which is not possible.

Solution:

Ans: (a)

10. **Assertion (A):** Appliances with a metallic body, like an electric iron, are connected to the earth wire.

Reason (R): The earth wire carries the current to the appliance during its normal working.

Solution:

Ans: (c)

- (A) is true – it is a safety measure. (R) is false – the earth wire provides a **low-resistance path** for any **leakage** current, keeping the body at earth's potential; normal current flows through live and neutral wires.

SECTION - B

Questions 11 to 14 carry 2 marks each.

- 11.** (a) Why does a compass needle get deflected when brought near a bar magnet?
(b) What is a magnetic field? Is it a quantity with magnitude only, or with magnitude and direction?

Solution:

(a) A compass needle is itself a **small bar magnet**. The magnetic field of the bar magnet exerts forces on the poles of the needle (like poles repel, unlike poles attract), so it gets deflected. [1]

(b) The region surrounding a magnet in which the force of the magnet can be detected. It has **both magnitude and direction**. [$\frac{1}{2} + \frac{1}{2}$]

- 12.** A straight copper wire is placed parallel to and over a compass needle. When current flows from north to south, the north pole of the needle moves east.

(a) What happens when the direction of current is reversed?

(b) What does this show?

Solution:

(a) The needle deflects in the **opposite direction** – its north pole moves towards the **west**. [1]

(b) The direction of the magnetic field produced by the current **depends on the direction of the current**; reversing the current reverses the field. [1]

- 13.** Iron filings are sprinkled uniformly around a bar magnet placed on a sheet of paper and the paper is tapped gently.

(a) What do you observe and why?

(b) Where is the magnetic field strongest, and how can you tell from the pattern?

Solution:

(a) The filings arrange themselves in a definite pattern of lines from one pole to the other. The magnet exerts a force on the filings in the region around it, and they align along the **magnetic field lines**. [1]

(b) Near the **poles**, where the field lines are **most crowded** (closest together). [1]

- 14.** What is short-circuiting and what is overloading in a domestic circuit? How does a fuse protect the circuit in such situations?

Solution:

Short-circuiting: the live wire and the neutral wire come into **direct contact** (damaged insulation or a fault), so the current increases abruptly. [$\frac{1}{2}$]

Overloading: an unduly high current due to short-circuiting, an accidental **hike in supply voltage**, or **too many appliances on one socket**. [$\frac{1}{2}$]

Fuse: connected in series; the high current causes **Joule heating** that **melts the fuse wire**, breaking the circuit and stopping the current. [1]

SECTION - C

Questions 15 to 17 carry 3 marks each.

15. A long straight copper wire passes vertically through a horizontal cardboard sheet. Iron filings are sprinkled on the sheet and a current is passed through the wire.

- (a) What pattern do the iron filings form, and what does it represent?
- (b) How can the direction of the magnetic field at a point on the sheet be found?
- (c) How does the magnetic field at a point change if (i) the current is increased, (ii) the point is moved farther from the wire?

Solution:

(a) A pattern of **concentric circles** around the wire, representing the **magnetic field lines**. [1]

(b) Place a **compass** at the point - the north pole of its needle gives the direction; or use the **right-hand thumb rule** (thumb along the current, curled fingers give the field). [1]

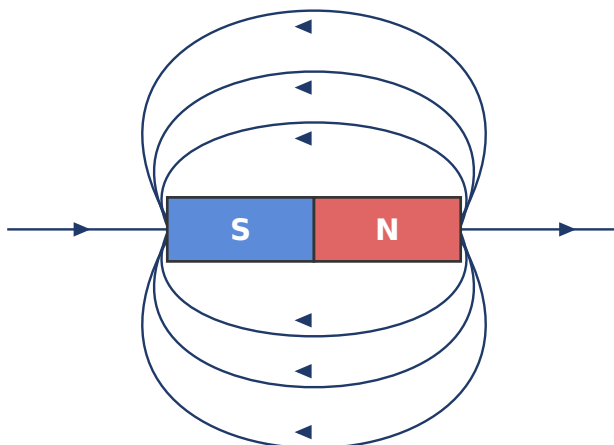
(c) (i) The field **increases** (larger compass deflection). (ii) The field **decreases** as the distance from the wire increases. [$\frac{1}{2}$ + $\frac{1}{2}$]

16. (a) Draw the magnetic field lines around a bar magnet.

(b) State three properties of magnetic field lines.

Solution:

(a)



Field lines around a bar magnet (outside: N $\rightarrow$ S; inside: S $\rightarrow$ N)

[1 mark for correct pattern with arrows]

(b) Any three [$\frac{2}{3}$ each]:

- They emerge from the **north pole** and merge at the **south pole** outside the magnet; inside, they go from S to N - they are **closed curves**.
- The **closeness** of the lines shows the relative strength of the field - crowded lines mean a stronger field.
- **No two field lines intersect.**
- The direction of the field at a point is the direction in which the north pole of a compass needle placed there points.

17. (a) What is a solenoid? Compare the pattern of its magnetic field with that of a bar magnet.
(b) What is an electromagnet? How is it made?

Solution:

(a) A coil of many circular turns of **insulated copper wire** wrapped closely in the shape of a cylinder. [$\frac{1}{2}$] Its field pattern is **similar to that of a bar magnet** – one end behaves as a north pole and the other as a south pole; inside, the field lines are **parallel straight lines**, so the field is **uniform**. [$1\frac{1}{2}$]

(b) A magnet made by placing a piece of magnetic material such as **soft iron** inside a current-carrying solenoid; the strong field inside the solenoid magnetises it. [1]

SECTION - D

Question 18 carries 5 marks.

18. (a) State the right-hand thumb rule.
(b) A current flows from east to west in a horizontal power line. What is the direction of the magnetic field at a point directly below it and at a point directly above it?
(c) Describe the pattern of the magnetic field lines of a current-carrying circular loop, especially near its centre.
(d) A circular loop lies in the plane of a table and carries a current in the clockwise direction (seen from above). Find the direction of the magnetic field inside and outside the loop.
(e) State two factors on which the magnetic field produced by a current-carrying circular coil depends.

Solution:

(a) Imagine holding a current-carrying straight conductor in your **right hand** with the **thumb pointing in the direction of the current**; then your **fingers wrap around** the conductor in the direction of the magnetic field lines. [1]

(b) Point the right thumb towards the **west**. The fingers curl so that the field just below the wire points **south** and just above the wire points **north**. [1]

(c) Near the wire, the field lines are concentric circles; they become larger as we move away from the wire, and at the **centre** of the loop the arcs appear as **straight lines**. Every section of the wire contributes field in the **same direction** inside the loop. [1]

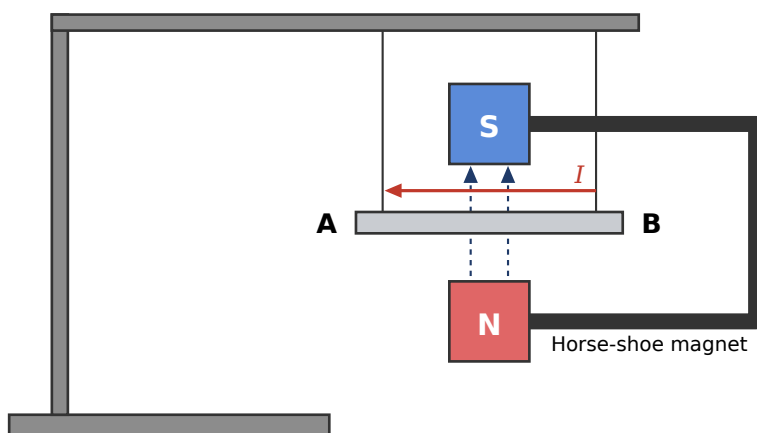
(d) Applying the right-hand rule to each part of the clockwise loop: inside the loop the field is directed **into the table (downwards)**; outside the loop it is **out of the table (upwards)**. [1]

(e) (i) The **current** through the coil (field increases with current). (ii) The **number of turns** n (field is n times that of one turn). [$\frac{1}{2} + \frac{1}{2}$]

SECTION - E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. A small aluminium rod AB is suspended horizontally between the poles of a strong horse-shoe magnet, with the north pole below and the south pole above it, as shown. When a current is passed from B to A, the rod is found to be displaced sideways.



Field vertically upward; current from B to A (battery, key and rheostat not shown)

- (a) Why is the rod displaced when current passes through it? **(1)**
(b) What happens to the displacement of the rod if (i) the current is reversed, (ii) the poles of the magnet are interchanged? **(1)**
(c) State Fleming's left-hand rule. How will the displacement change if a larger current or a stronger magnet is used? When is the force on the rod the greatest? **(2)**

OR

- (c) An electron moving towards the east enters a magnetic field directed vertically downward. Using Fleming's left-hand rule, find the direction of the force on it. Explain your reasoning. **(2)**

Solution:

(a) A current-carrying conductor placed in a magnetic field **experiences a force** (the magnet exerts an equal and opposite force on the current, as suggested by Ampere). [1]

(b) (i) The rod is displaced in the **opposite direction**. (ii) Again the rod is displaced in the **opposite direction**. The force depends on the directions of both current and field. [$\frac{1}{2} + \frac{1}{2}$]

(c) Stretch the thumb, forefinger and middle finger of the **left hand** mutually perpendicular. If the **first finger** points along the **field** and the **second finger** along the **current**, the **thumb** gives the direction of the **force (motion)**. [1]

A larger current or a stronger magnet gives a **larger displacement** (greater force). The force is greatest when the current is **at right angles** to the field. [$\frac{1}{2} + \frac{1}{2}$]

OR

(c) The direction of current is opposite to the motion of electrons, so the current is towards the **west**. [$\frac{1}{2}$]

Left hand: first finger downwards (field), second finger towards west (current) → thumb points towards the **south**. The force on the electron is towards the **south**. [$1\frac{1}{2}$]

20. Read the passage and answer the questions that follow.

Electric power reaches our homes through the mains. At the meter-board, the wires pass through the electricity meter and a main fuse to the main switch. Usually two separate circuits are used – one of 15 A rating for appliances with higher power such as geysers and air coolers, and another of 5 A rating for bulbs and fans. The earth wire is connected to a metal plate deep in the earth near the house. All appliances are connected in parallel, each with its own switch.

- (a) Name the colours of insulation of the live, neutral and earth wires. What is the potential difference between live and neutral in India? **(1)**
- (b) Why is the earth wire used for appliances with a metallic body? **(1)**
- (c) A 2 kW electric oven is connected to the 5 A circuit of a 220 V supply. Find the current it draws and state what will happen. Which circuit should it be connected to? **(2)**

OR

- (c) Why are domestic appliances connected in parallel? Suggest one precaution to avoid overloading. **(2)**

Solution:

(a) Live – **red**; neutral – **black**; earth – **green**. Potential difference = **220 V**. [$\frac{1}{2} + \frac{1}{2}$]

(b) It provides a **low-resistance path** for any leakage current to the metallic body, keeping its potential equal to that of the earth, so the user does not get a **severe electric shock**. [1]

(c) $I = P/V = 2000/220 \approx 9.1 \text{ A}$, which is more than the 5 A rating. [1]

The circuit gets **overloaded**; the fuse will **melt** and break the circuit. The oven should be connected to the **15 A circuit**. [1]

OR

(c) In parallel, each appliance gets the **same potential difference** (220 V) and can be switched on/off **independently**. [1]

Precaution: do not connect **too many appliances to a single socket** (use a fuse of proper rating). [1]