CBSE CLASS X

Science (086)

ANSWER KEY

AI-generated question paper

Code: PXUUEA	Questions: 36	Maximum Marks: 72	Generated: 2026-06-25 17:52

SELECTIONS USED

Subject	Science
Lessons	12 Magnetic Effects of Electric Current
Level of understanding	Exam-ready
Question selection	CBSE board paper, whole lesson (~80 marks across Sections A-E)
Model	claude-sonnet-4-6

Composition — Difficulty: 11 straightforward · 20 medium · 5 deep | Types: 14 MCQ · 6 Assertion–reason · 5 Very short · 5 Short · 3 Long · 3 Case-based | Sections: A 20Q/20m · B 5Q/10m · C 5Q/15m · D 3Q/15m · E 3Q/12m

Q1. straightforward exam-ready **[1]**

The magnetic field lines produced by a long straight current-carrying conductor are:
(A) Straight lines parallel to the conductor
(B) Straight lines perpendicular to the conductor
(C) Concentric circles centred on the conductor
(D) Radial lines emerging from the conductor

- A Straight lines parallel to the conductor
- B Straight lines perpendicular to the conductor
- C Concentric circles centred on the conductor
- D Radial lines emerging from the conductor

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Model Answer

(C) Concentric circles centred on the conductor

The field lines about a current-carrying straight wire consist of a series of concentric circles whose direction is given by the right-hand thumb rule.

Explanation

The textbook explicitly states in the summary: *"The field lines about the wire consist of a series of concentric circles whose direction is given by the right-hand rule."* Examiners expect the correct option letter AND a brief justification for MCQs. Avoid confusing this with a circular coil (where field lines at the centre appear as straight lines).

Q2. straightforward exam-ready **[1]**

If the current through a straight conductor is increased, the magnetic field at a fixed point near it will:
(A) Decrease
(B) Remain unchanged
(C) Increase
(D) First increase then decrease

A Decrease
B Remain unchanged
C Increase
D First increase then decrease

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Model Answer

(C) Increase

The magnetic field at a fixed point near a straight current-carrying conductor increases when the current through it is increased.

Explanation

The magnetic field produced by a current-carrying conductor is directly proportional to the current flowing through it. As shown in Activity 12.1 and 12.4 (Chapter 12), greater current produces a stronger magnetic effect. So more current → stronger field. Examiner expects you to simply select (C) with a one-line justification.

Q3. straightforward exam-ready **[1]**

Which rule is used to find the direction of the force experienced by a current-carrying conductor placed perpendicular to a magnetic field?

(A) Right-hand thumb rule

(B) Fleming's left-hand rule

(C) Maxwell's right-hand rule

(D) Fleming's right-hand rule

A Right-hand thumb rule
B Fleming's left-hand rule
C Maxwell's right-hand rule
D Fleming's right-hand rule

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Model Answer

(B) Fleming's left-hand rule

Fleming's left-hand rule gives the direction of force on a current-carrying conductor placed perpendicular to a magnetic field.

Source: Chapter 12, Section 12.3

Explanation

- **Right-hand thumb rule** is used to find the direction of the *magnetic field* around a current-carrying conductor — not the force on it.
- **Fleming's left-hand rule** specifically deals with the *force (motion)* on a conductor: forefinger → magnetic field, middle finger → current, thumb → force/motion.
- **Fleming's right-hand rule** is used for *induced current* (generators), not force.
- In MCQs, examiners expect you to clearly distinguish between these three rules. Option (B) is the one stated explicitly in the textbook's summary: *"the force acting on the conductor will be given by Fleming's left-hand rule."*

Q4. straightforward exam-ready **[1]**

The magnetic field inside a long current-carrying solenoid is:
(A) Zero everywhere
(B) Uniform and parallel to the axis
(C) Strongest near the ends
(D) Directed radially outward

- A Zero everywhere
- B Uniform and parallel to the axis
- C Strongest near the ends
- D Directed radially outward

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Model Answer

(B) Uniform and parallel to the axis

The field lines inside a solenoid are parallel straight lines, indicating the magnetic field is uniform (same at all points) inside it.

Explanation

The source passage explicitly states: "The field lines inside the solenoid are in the form of parallel straight lines… the field is uniform inside the solenoid." Examiners expect option (B) with a one-line justification. Options C and D are incorrect; the field is NOT zero (A) nor strongest at the ends (C) inside a long solenoid.

Q5. straightforward exam-ready **[1]**

In domestic wiring, the wire with green insulation is the:
(A) Live wire
(B) Neutral wire
(C) Earth wire
(D) Phase wire

- A Live wire
- B Neutral wire
- C Earth wire
- D Phase wire

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Model Answer

(C) Earth wire

The wire with green insulation is the **earth wire**, which is connected to a metal plate deep in the earth and acts as a safety measure for metallic appliances.

Source: Chapter 12, Section 12.4 Domestic Electric Circuits

Explanation

The passage explicitly states: *"The earth wire, which has insulation of green colour..."* Note that Exercise Q3(b) also tests this as a **false** statement — "A wire with green insulation is usually the **live** wire" is FALSE. The live wire is red and neutral is black. Students often confuse these colour codes, so memorise all three: Red = Live, Black = Neutral, Green = Earth.

Q6. medium exam-ready **[1]**

An alpha particle projected towards the east is deflected towards the south by a magnetic field. The direction of the magnetic field is:

(A) Upward

(B) Downward

(C) Towards the north

(D) Towards the west

- A Upward
- B Downward
- C Towards the north
- D Towards the west

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Model Answer

(A) Upward

Using Fleming's Left-Hand Rule: velocity (east), force/deflection (south) → the magnetic field points **upward** (out of the ground).

Explanation

Apply Fleming's Left-Hand Rule: the middle finger points in the direction of current/velocity (east), the index finger in the direction of the magnetic field, and the thumb gives the force direction (south). Arranging these, the index finger (field) must point **upward**. Note: an alpha particle is positively charged, so its direction of motion = direction of conventional current.

Q7. medium exam-ready **[1]**

Two magnetic field lines can never intersect each other because:
(A) Magnetic field has no physical existence at the point of intersection
(B) At a point of intersection, the compass needle would have to point in two directions simultaneously, which is impossible
(C) Field lines always form closed loops
(D) The magnetic field is zero at the point of intersection

A Magnetic field has no physical existence at the point of intersection
B At a point of intersection, the compass needle would have to point in two directions simultaneously, which is impossible
C Field lines always form closed loops
D The magnetic field is zero at the point of intersection

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Model Answer

(B) At a point of intersection, the compass needle would have to point in two directions simultaneously, which is impossible.

Source: Magnetic Field and Field Lines, Chapter 12

Explanation

The textbook explicitly states: *"No two field-lines are found to cross each other. If they did, it would mean that at the point of intersection, the compass needle would point towards two directions, which is not possible."* Options A and D are incorrect — the field exists but has a unique direction. Option C (closed loops) is a property of field lines, not the reason they don't intersect.

Q8. medium exam-ready **[1]**

A circular coil of wire has 50 turns. Compared to a single-turn coil of the same size carrying the same current, the magnetic field at the centre of the 50-turn coil is:
(A) 50 times smaller
(B) The same
(C) 50 times larger
(D) 2500 times larger

A 50 times smaller
B The same
C 50 times larger
D 2500 times larger

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Model Answer

(C) 50 times larger

The magnetic field at the centre of a circular coil is *n* times that of a single turn, since the field due to each turn adds up in the same direction.

Explanation

The key principle (stated directly in section 12.2.3) is: *"if there is a circular coil having n turns, the field produced is n times as large as that produced by a single turn."* For n = 50, the field is simply 50 times larger — not 2500 times (that would be n^2, which is incorrect here).

Q9. straightforward exam-ready **[1]**

At the time of a short circuit in a domestic wiring system, the current in the circuit:
(A) Reduces substantially
(B) Does not change
(C) Increases heavily
(D) Varies continuously

A Reduces substantially
B Does not change
C Increases heavily
D Varies continuously

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Model Answer

(C) Increases heavily

At the time of a short circuit, the resistance in the circuit drops to nearly zero, causing the current to increase heavily.

Explanation

This is directly from Section 12.4: when the live and neutral wires come into direct contact, "the current in the circuit abruptly increases — this is called short-circuiting." The fuse then melts to break the circuit. Remember: short circuit → very low resistance → very high current (by Ohm's law, I = V/R).

Q10. straightforward exam-ready **[1]**

The force on a current-carrying conductor placed in a magnetic field is maximum when the angle between the current direction and the magnetic field is:
(A) 0°
(B) 45°
(C) 90°
(D) 180°

- A 0°
- B 45°
- C 90°
- D 180°

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Model Answer

(C) 90°

The force on a current-carrying conductor is maximum when the current direction is perpendicular (90°) to the magnetic field, as stated in the textbook.

Explanation

The textbook (section 12.3) explicitly states: *"the displacement of the rod is largest when the direction of current is at right angles to the direction of the magnetic field."* Right angles = 90°. Examiners expect direct selection of option (C) with a one-line justification. Options 0° and 180° give zero force (current parallel/antiparallel to field).

Q11. medium exam-ready **[1]**

The core of an electromagnet is made of soft iron rather than steel because soft iron:
(A) Is cheaper than steel
(B) Has higher electrical resistance
(C) Loses its magnetism easily when current is switched off
(D) Conducts electricity better than steel

A Is cheaper than steel
B Has higher electrical resistance
C Loses its magnetism easily when current is switched off
D Conducts electricity better than steel

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Model Answer

(C) Loses its magnetism easily when current is switched off

Soft iron is used as the core of an electromagnet because it loses its magnetism easily when the current is switched off, making it a **temporary magnet** — ideal for electromagnets.

Explanation

The textbook states that an electromagnet consists of a **core of soft iron** wrapped with insulated copper wire. The key property is that soft iron is easily magnetised and demagnetised — when current stops, the magnetic field disappears. Steel retains magnetism and would become a permanent magnet, which is undesirable for an electromagnet. Options A and D are irrelevant to magnetism; Option B (resistance) has nothing to do with core material selection.

Source: Chapter 12, "What you have learnt" / Section 12.2.4

Q12. medium exam-ready **[1]**

In a domestic circuit, different electrical appliances are connected in parallel rather than in series primarily so that:
(A) Each appliance gets the full supply voltage
(B) The circuit carries less total current
(C) Fuses are not required
(D) The earth wire is not needed

- A Each appliance gets the full supply voltage
- B The circuit carries less total current
- C Fuses are not required
- D The earth wire is not needed

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Model Answer

(A) Each appliance gets the full supply voltage

In a parallel circuit, each appliance is connected across the live and neutral wires, so all appliances receive equal (full) potential difference of 220 V.

Explanation

The textbook explicitly states: *"In order that each appliance has equal potential difference, they are connected parallel to each other."* This is the primary reason. Option B is wrong — parallel connection actually increases total current. Options C and D are unrelated to why parallel connection is used.

Q13. straightforward exam-ready **[1]**

The direction of the magnetic field lines inside a bar magnet is:
(A) From north pole to south pole
(B) From south pole to north pole
(C) Perpendicular to the axis of the magnet
(D) In random directions

- A From north pole to south pole
- B From south pole to north pole
- C Perpendicular to the axis of the magnet
- D In random directions

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Model Answer

(B) From south pole to north pole

Inside a bar magnet, the direction of field lines is from its south pole to its north pole.

Explanation

The textbook explicitly states: *"Inside the magnet, the direction of field lines is from its south pole to its north pole."* Outside the magnet, field lines go from north to south — a common trap. Remember: field lines form closed curves, so they must return from south to north inside the magnet.

Source: Chapter 12, Section 12.1 (Magnetic Field and Field Lines)

Q14. deep exam-ready **[1]**

Which of the following properties of a proton moving freely in a magnetic field can change?
(A) Mass
(B) Speed
(C) Velocity
(D) Both speed and velocity

A Mass
B Speed
C Velocity
D Both speed and velocity

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Model Answer

(C) Velocity

A magnetic force is always perpendicular to the velocity, so it changes the *direction* of motion but does no work, leaving speed (and hence kinetic energy and mass) unchanged. Since direction changes, velocity changes.

Explanation

- Speed is a scalar (magnitude only) — it stays constant in a magnetic field.
- Velocity is a vector — its direction changes continuously (circular motion), so velocity changes.
- Mass is invariant.
- Option D ("both speed and velocity") is wrong because speed does NOT change.
- Examiners expect you to identify **velocity** as the correct answer and briefly justify using the perpendicular nature of magnetic force.

Q15. medium exam-ready **[1]**

Assertion (A): The magnetic field produced by a current-carrying solenoid resembles the field of a bar magnet.
Reason (R): One end of the current-carrying solenoid acts as a north pole and the other end acts as a south pole.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Explanation

The textbook explicitly states that one end of a current-carrying solenoid behaves as a north pole and the other as a south pole — this **directly causes** the solenoid's field to resemble a bar magnet's field. So R correctly explains A, making option (A) correct.

Q16. medium exam-ready **[1]**

Assertion (A): When the current through a straight conductor is reversed, the direction of the magnetic field around it also reverses.
Reason (R): The magnetic field around a straight conductor depends on the magnitude but not the direction of the current.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(C) Assertion (A) is true, but Reason (R) is false.

The Assertion is true — reversing current reverses the magnetic field (Activity 12.4). The Reason is false — the direction of the magnetic field depends on the **direction** of current, not just its magnitude (Right-Hand Thumb Rule).

Explanation

The key is that the Reason contradicts the Right-Hand Thumb Rule. The direction of the magnetic field around a straight conductor depends on **both** magnitude and direction of current. Since the Reason incorrectly states "direction does not matter," it is false, making option (C) correct.

Q17. deep exam-ready **[1]**

Assertion (A): An electric fuse is connected in series with the live wire of a domestic circuit.
Reason (R): If the fuse were connected to the neutral wire, it would still protect appliances from overloading and short-circuiting equally well.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

- A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
- C Assertion (A) is true, but Reason (R) is false.
- D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(C) Assertion (A) is true, but Reason (R) is false.

The fuse must be on the live wire so that when it blows, the appliance is disconnected from the high-potential wire, making it safe to touch. A fuse on the neutral wire would leave the appliance connected to the live wire even after blowing.

Explanation

The Assertion is correct as per the textbook (Section 12.4). The Reason is false because connecting the fuse to the neutral wire does NOT provide equal protection — the appliance would still remain at a high (live) potential after the fuse melts, posing a shock hazard. Examiners expect students to identify this safety distinction.

Q18. straightforward exam-ready **[1]**

Assertion (A): The magnetic field near the poles of a bar magnet is stronger than the field at the midpoint along its equator.
Reason (R): The density of magnetic field lines at a point represents the relative magnitude of the magnetic field at that point.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Field lines are crowded near the poles, indicating a stronger field there, and the density of field lines represents the relative strength of the magnetic field.

Explanation

The textbook states: "The field is stronger where the field lines are crowded." Field lines are closest (most dense) near the poles and most spread out at the equatorial midpoint — so A is true. R is also true and directly explains A, as the crowding (density) of field lines is precisely the reason the pole region has a stronger field.

Q19. medium exam-ready **[1]**

Assertion (A): Metallic bodies of electrical appliances such as electric irons and refrigerators are connected to the earth wire.
Reason (R): The earth wire provides a low-resistance path so that any leakage current flows to the earth, keeping the metallic body at earth potential and protecting the user from severe electric shock.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(A)

Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Explanation

The textbook (Section 12.4) states exactly that the earth wire provides a low-resistance conducting path, keeps the metallic body at earth potential, and prevents severe electric shock — so R directly and correctly explains A. Choose option (A).

Q20. medium exam-ready **[1]**

Assertion (A): The magnetic field lines of a bar magnet are closed curves.
Reason (R): Outside the magnet, field lines go from north to south pole, and inside the magnet they continue from south to north pole, forming a complete closed loop.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

A Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
B Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
C Assertion (A) is true, but Reason (R) is false.
D Assertion (A) is false, but Reason (R) is true.

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Model Answer

(A)

Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Explanation

The textbook states: "Outside the magnet, field lines emerge from the north pole and merge at the south pole; inside the magnet, they go from south to north — thus magnetic field lines are closed curves." The Reason correctly and completely explains why the Assertion is true.

Q21. medium exam-ready **[2]**

State the right-hand thumb rule. A vertical wire carries current in the downward direction. Using the right-hand thumb rule, state the direction of the magnetic field at a point to the east of this wire.

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Model Answer

Right-Hand Thumb Rule: Imagine holding a current-carrying straight conductor in your right hand such that the thumb points in the direction of current. Then the fingers wrap around the conductor in the direction of the magnetic field lines.

Direction of field: The current flows downward (south). Applying the right-hand thumb rule, the magnetic field at a point to the **east** of the wire is directed **towards the south (i.e., into the page / from north to south horizontally)** — specifically, at the east side, the field points **towards the south**.

> Using the rule: thumb points downward; fingers on the east side point **southward** — so the magnetic field at the east is directed **towards the south**.

Source: Chapter 12, Section 12.2.2

Explanation

- **1 mark** for stating the rule correctly using the key phrase: thumb → current direction, fingers → field direction.
- **1 mark** for correctly applying it: current downward → at a point to the east, the field is directed **towards the south** (curl fingers: on the east side of a downward current, field points southward).
- Examiners look for the rule stated in your own words but with the essential idea intact, followed by a clear directional answer. A common mistake is confusing east/west sides — practice by physically mimicking the hand position.

Q22. straightforward exam-ready **[2]**

What is a solenoid? State two ways in which the magnetic field pattern produced by a current-carrying solenoid is similar to that of a bar magnet.

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Model Answer

A **solenoid** is a coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder.

Two similarities with a bar magnet:

1. One end of the solenoid behaves as a north pole and the other as a south pole, just like a bar magnet.
2. The overall pattern of magnetic field lines outside the solenoid is similar to that of a bar magnet.

Source: Chapter 12, Section 12.2.4

Explanation

- The definition must mention: insulated copper wire, many turns, cylindrical shape — all three earn marks.
- For the two similarities, examiners expect the **pole behaviour** (N and S at the two ends) and the **similarity in field line pattern**. Avoid copying vague statements — be specific.
- Do not write about the uniform field *inside* the solenoid here; that is a difference from a bar magnet, not a similarity.

Q23. medium exam-ready **[2]**

A current-carrying horizontal aluminium rod is placed between the poles of a horseshoe magnet with the magnetic field directed vertically upward. State the direction of the force on the rod if the current flows from west to east. Name the rule you used.

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Model Answer

Current flows from **West to East**; magnetic field is directed **vertically upward**.

Applying **Fleming's Left-Hand Rule**: stretch the forefinger (magnetic field – upward), middle finger (current – west to east), and thumb mutually perpendicular. The thumb points towards the **South** direction. Therefore, the force on the rod acts **towards the South**.

Rule used: Fleming's Left-Hand Rule.

Explanation

- Examiners expect two things: (1) the correct direction of force, and (2) the name of the rule — both are needed for full 2 marks.
- Fleming's Left-Hand Rule: forefinger → field, middle finger → current, thumb → force/motion. Always state which finger represents which quantity to show clear understanding.
- Here: Field = up, Current = west→east, so by the rule, force = southward (perpendicular to both).

Q24. medium exam-ready **[2]**

What causes short-circuiting in a domestic electric circuit? State one consequence and one measure to prevent it.

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Model Answer

Short-circuiting occurs when the live wire and neutral wire come into direct contact due to damaged insulation or a fault in the appliance.

Consequence: The current in the circuit increases abruptly/heavily, which can damage appliances or cause fire.

Preventive measure: Use an **electric fuse** in the circuit, which melts and breaks the circuit when current becomes unduly high.

Source: Chapter 12, Section 12.4 — Domestic Electric Circuits

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Explanation

The question has three parts packed into 2 marks, so keep each part to one short sentence. Examiners look for: (1) correct cause — direct contact of live and neutral wires / damaged insulation, (2) consequence — abrupt/heavy increase in current (or fire/damage to appliances), and (3) prevention — use of electric fuse. Avoid vague answers like "wires touch"; specify *live* and *neutral* wires for full credit.

Q25. medium exam-ready **[2]**

Why does the deflection of a compass needle placed near a current-carrying wire decrease when the compass is moved farther away from the wire?

◆ Magnetic Effects of Electric Current

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Model Answer

A current-carrying wire produces a magnetic field around it. The strength of this magnetic field **decreases as the distance from the wire increases**. Since the compass needle deflects due to this magnetic field, a weaker field at a greater distance exerts a smaller force on the needle, causing less deflection.

Source: Chapter 12, Section 12.2 – Magnetic Field due to a Current-Carrying Conductor

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Explanation

- The key concept is that **magnetic field strength decreases with distance** from the source.
- Link two ideas for full marks: (1) current produces a magnetic field, and (2) field weakens with distance → less deflection.
- Avoid just saying "the field becomes weak" without explaining *why* deflection depends on field strength — connect both steps explicitly.

Q26. medium exam-ready **[3]**

Draw labelled diagrams showing the magnetic field lines (a) around a bar magnet and (b) around a current-carrying circular loop. State one similarity between the two field patterns.

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Model Answer

(a) Bar Magnet – Magnetic Field Lines:

` ` `

N ——→—— S
(Field lines emerge from N, curve around, and enter S)

` ` `

(Labelled diagram showing closed curved lines emerging from North pole, curving around outside, entering South pole, and continuing inside from S to N.)

(b) Current-carrying Circular Loop – Magnetic Field Lines:

(Labelled diagram showing concentric arcs around the wire that straighten into parallel straight lines at the centre of the loop, with the direction determined by the right-hand thumb rule.)

Similarity: In both cases, the magnetic field lines form **closed loops** — they have no starting or ending point.

Explanation

- Examiners expect **two separate labelled diagrams** — even rough sketches with labels (N, S; direction arrows; current direction I) earn full credit.
- The key similarity tested here is that **field lines are always closed and continuous** in both patterns (a property of all magnetic fields).
- For the circular loop, mention that field lines appear as straight parallel lines **at the centre** — this is a commonly tested detail from §12.2.3.
- Do not confuse similarity with the solenoid; the question asks only about the circular loop.

Source: Chapter 12, §12.2 and §12.2.3

Q27. medium exam-ready **[3]**

Explain how an electromagnet is made. Mention two ways in which the strength of an electromagnet can be increased.

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Model Answer

An electromagnet is made by winding a coil of insulated copper wire around a soft iron core. When electric current flows through the coil (solenoid), a strong magnetic field is produced inside it, which magnetises the soft iron core, forming an electromagnet.

Two ways to increase its strength:

1. Increasing the number of turns of wire in the coil.
2. Increasing the amount of current flowing through the coil.

Source: Chapter 12, Section 12.2.4

Explanation

- The key definition expected is: **insulated copper wire coil + soft iron core** — both parts must be mentioned.
- The textbook states the electromagnet is formed when a soft iron piece placed inside a current-carrying solenoid gets magnetised.
- For the two ways, examiners accept: more turns, more current, or using a stronger core material. Pick any two clearly.
- Avoid writing long paragraphs; a one-sentence construction explanation + two labelled points is the ideal board-exam format for 3 marks.

Q28. medium exam-ready **[3]**

A student connects a 3 kW electric geyser to a domestic circuit of 220 V that has a 5 A fuse. What will happen? Show your calculation and explain the reason for the outcome.

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Model Answer

Calculation:

Current drawn by the geyser:

$$I = \frac{P}{V} = \frac{3000\ \text{W}}{220\ \text{V}} \approx 13.6\ \text{A}$$

Result: The fuse will blow/melt.

Reason: The geyser requires ~13.6 A, which far exceeds the 5 A rating of the fuse. As per the domestic circuit, appliances like geysers require a 15 A circuit, not a 5 A circuit. The excess current causes Joule heating in the fuse wire, which melts it and breaks the circuit, preventing damage to the wiring and appliance.

Source: Chapter 12, Section 12.4 — Domestic Electric Circuits

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Explanation

- The key formula here is $I = P/V$. Always show this step explicitly — it earns a mark.
- The second mark is for stating the fuse melts/blows, and the third for explaining *why* (current exceeds fuse rating → Joule heating melts fuse wire).
- The textbook (Section 12.4) explicitly states geysers need a **15 A circuit**; connecting to a 5 A circuit causes overloading — use this fact to strengthen your answer.
- Don't forget units in your calculation.

Q29. straightforward exam-ready **[3]**

State Fleming's left-hand rule. Name any two devices that work on the principle of force experienced by a current-carrying conductor in a magnetic field.

◆ Magnetic Effects of Electric Current

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Model Answer

Fleming's Left-Hand Rule: Stretch the thumb, forefinger, and middle finger of the left hand so that they are mutually perpendicular. If the **forefinger** points in the direction of the **magnetic field** and the **middle finger** points in the direction of **current**, then the **thumb** points in the direction of **force (motion)** on the conductor.

Two devices based on the force on a current-carrying conductor in a magnetic field:

1. Electric motor
2. Loudspeaker

Source: Chapter 12, Section 12.3

Explanation

- Examiners expect the rule stated with all three fingers identified clearly — forefinger = field, middle finger = current, thumb = force/motion. Missing any finger assignment loses marks.
- The source passage explicitly lists "electric motor, electric generator, loudspeakers, microphones and measuring instruments" — pick any two. Electric motor is the safest choice as it is discussed in detail in the chapter.
- This question is typically 3 marks: ~1 mark for each finger's role in the rule (or 2 marks for the complete rule) + 1 mark for naming two devices.

Q30. deep exam-ready **[3]**

Explain why the magnetic field at the centre of a current-carrying circular loop appears to consist of parallel straight lines. How does increasing the number of turns in the circular coil affect this field?

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Model Answer

At every point on a current-carrying circular loop, the magnetic field lines form concentric circles. As we move toward the **centre** of the loop, these circles become larger and larger, so their arcs appear as **parallel straight lines** at the centre. By the right-hand rule, every section of the wire contributes field lines in the **same direction** within the loop, reinforcing this parallel pattern.

Effect of increasing turns: If the coil has n turns, the magnetic field at the centre becomes n times stronger than that of a single turn, because the current in each turn flows in the same direction and the fields due to all turns add up.

Source: Chapter 12, Section 12.2.3

Explanation

- The key idea is that *large arcs of concentric circles look like straight lines* — this is the geometric reason examiners expect you to state.
- Mention the right-hand rule to show all sections reinforce field in the same direction.
- For the second part, the formula "n times" with the reason (same direction → fields add up) earns the mark.
- Avoid writing about solenoids here; this question is strictly about circular loops.

Q31. medium exam-ready **[5]**

(i) State the rule used to find the direction of the magnetic field produced by a current-carrying straight conductor.
(ii) A horizontal power line carries current from west to east. Using the appropriate rule, determine the direction of the magnetic field at a point (a) directly above the wire and (b) directly below the wire.
(iii) How would the magnetic field change at those points if the current in the power line were doubled?

◆ Magnetic Effects of Electric Current

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Model Answer

(i) Right-Hand Thumb Rule:
Imagine holding the current-carrying straight conductor in your right hand such that the **thumb points in the direction of current**. Then the **fingers wrap around the conductor in the direction of the magnetic field lines**.

(ii) Current flows from West to East:

Applying the right-hand thumb rule — point the thumb eastward (direction of current). The fingers curl such that the field lines form **concentric circles** around the wire.

- **(a) Directly above the wire:** The magnetic field is directed **from South to North** (i.e., towards the north).
- **(b) Directly below the wire:** The magnetic field is directed **from North to South** (i.e., towards the south).

(iii) Effect of doubling the current:
The magnetic field produced by a current-carrying conductor is **directly proportional to the current**. If the current is doubled, the **strength (magnitude) of the magnetic field at both points will also double**. The **direction of the field remains unchanged**.

Source: Chapter 12, Section 12.2.2

Explanation

- The right-hand thumb rule is the key rule examiners expect — state it precisely with "thumb = current direction, fingers = field direction."
- For part (ii), note the question flips the direction from the textbook example (which uses east-to-west); here current is west-to-east, so directions reverse. Above: northward; below: southward.
- For part (iii), the textbook states field depends **directly** on current — doubling current doubles field strength; direction is unaffected. These two points (magnitude doubles, direction unchanged) are both needed for full marks.

Q32. medium exam-ready **[5]**

(i) With a neat labelled diagram, describe the pattern of the magnetic field produced by a current-carrying solenoid. How does the field inside the solenoid differ from the field outside it?
(ii) What is an electromagnet? Name the material used for its core and give one reason why that material is preferred.
(iii) List any two applications of electromagnets in everyday life.

◆ Magnetic Effects of Electric Current

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Model Answer

(i) Magnetic Field due to a Current-Carrying Solenoid:

A solenoid is a coil of many turns of insulated copper wire wound in the shape of a cylinder.

Diagram:
```
N |====|====|====|====| S
→ field lines inside (parallel, uniform)
field lines outside resemble a bar magnet
```

(Diagram shows parallel field lines inside and curved lines outside, with N and S poles marked.)

- **Inside:** Field lines are parallel and straight → field is **uniform**.
- **Outside:** Field pattern resembles that of a **bar magnet**; one end acts as N-pole, the other as S-pole.

(ii) Electromagnet:
An electromagnet is a magnet formed by placing a piece of **soft iron** inside a current-carrying solenoid.

Core material: Soft iron.
Reason: Soft iron loses its magnetism as soon as the current is switched off (temporary magnet), making it suitable for electromagnets.

(iii) Two Applications of Electromagnets:

1. Electric bells
2. Cranes used in scrap yards to lift heavy iron/steel objects.

Source: Chapter 12, Section 12.2.4

Explanation

- The diagram must be labelled with N-pole, S-pole, current direction, and field lines (inside straight/parallel, outside curved). Examiners award 1 mark for a correct labelled diagram.
- Key contrast: **uniform inside** vs **bar-magnet pattern outside** — both parts must be stated.
- For the electromagnet, naming **soft iron** and giving the reason (loses magnetism easily / temporary) are both needed for full marks.
- Any two valid real-life uses (electric bell, telephone earpiece, MRI, scrap-lifting cranes) are acceptable.

Q33. deep exam-ready **[5]**

(i) Describe, with a diagram, the domestic electric circuit used in homes, identifying the live wire, neutral wire, and earth wire by their insulation colours and stating the potential difference between live and neutral wires.
(ii) Why are appliances with metallic bodies connected via a three-pin plug, but an ordinary electric bulb uses only a two-pin plug?
(iii) State two causes of overloading in a domestic circuit and explain how a fuse protects the circuit in such a situation.

◆ Magnetic Effects of Electric Current

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Model Answer

(i) In domestic circuits, power is supplied through three wires:

- **Live wire** — red insulation (positive)
- **Neutral wire** — black insulation (negative)
- **Earth wire** — green insulation (connected to a metal plate buried in earth)

The potential difference between live and neutral wires is **220 V**.

Diagram:

```
Live (Red) ──┬── Switch ── Appliance ──┐
│ │
Neutral(Blk)─┴──────────────────────────┘
Earth (Grn) ── Metallic body of appliance
```

Appliances are connected **in parallel** so each gets equal potential difference.

(ii) Appliances with metallic bodies (e.g., electric press, refrigerator) are earthed via the third pin. If current leaks to the metallic body, the earth wire provides a low-resistance path, keeping the body's potential equal to earth's, preventing electric shock. An ordinary bulb has no metallic body to touch, so earthing is unnecessary; a two-pin plug suffices.

(iii) Two causes of overloading:

1. **Short circuit** — live and neutral wires touch directly (damaged insulation or faulty appliance), causing current to increase abruptly.
2. **Too many appliances** connected to a single socket, or an accidental hike in supply voltage.

Fuse protection: The fuse wire has low melting point. When excess current flows, Joule heating melts the fuse wire, breaking the circuit and protecting appliances from damage.

Source: Chapter 12, Section 12.4 — Domestic Electric Circuits

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Explanation

- **Part (i):** Examiners expect the three wire colours, the 220 V figure, and a neat labelled diagram showing parallel connections. Mention the meter board/main fuse if space allows.
- **Part (ii):** The key phrase is "low-resistance conducting path" keeping the metallic body at earth potential. Contrast with a bulb — no exposed metallic part the user touches.
- **Part (iii):** Name both causes clearly (short circuit + excess appliances/voltage hike). For the fuse, mention *Joule heating* and *melting* — these are the two marks-earning terms examiners look for.

Q34. medium exam-ready **[4]**

Read the following and answer the questions below.

Oersted's accidental discovery in 1820 revealed that a compass needle placed near a current-carrying wire gets deflected. This showed that a moving electric charge creates a magnetic field in the surrounding space. It was later established that a current-carrying conductor, when placed in an external magnetic field, experiences a mechanical force. This discovery led to the development of several devices that convert electrical energy into mechanical energy.

(a) What conclusion did Oersted draw from the deflection of the compass needle placed near the current-carrying wire? [1]
(b) In what direction does a compass needle placed below a horizontal wire (with current flowing from south to north) deflect — towards the east or towards the west? [1]
(c) State the rule that gives the direction of the force on a current-carrying conductor placed perpendicular to a magnetic field. [1]
(d) Name one device that converts electrical energy into mechanical energy using the force on a current-carrying conductor in a magnetic field. [1]

◆ Magnetic Effects of Electric Current

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Model Answer

(a) Oersted concluded that a current-carrying wire produces a magnetic field around it, showing that electricity and magnetism are linked phenomena.

(b) When current flows from south to north and the compass is placed **below** the wire, the needle deflects towards the **west** (opposite to when the compass is above the wire with the same current direction).

(c) Fleming's Left-Hand Rule: Stretch the thumb, forefinger, and middle finger of the left hand mutually perpendicular. If the forefinger points in the direction of the magnetic field and the middle finger in the direction of current, then the thumb points in the direction of force on the conductor.

(d) Electric motor — it converts electrical energy into mechanical energy using the force on a current-carrying conductor in a magnetic field.

Source: Chapter 12, Sections 12.1, 12.2, 12.3

Explanation

- **(a)** The key conclusion is the *link between electricity and magnetism* — examiners expect this exact phrase.
- **(b)** Activity 12.4 states: current south→north, compass *above* → deflects west. When the compass is placed *below*, by symmetry the field direction reverses relative to the needle, so it deflects **west** in the scenario given. Stick to what the textbook Activity describes.
- **(c)** Fleming's Left-Hand Rule must name all three fingers and what each represents. Missing any part loses marks.
- **(d)** Electric motor is the most direct answer from the textbook. Loudspeaker is also acceptable but electric motor is preferred.

Q35. medium exam-ready **[4]**

Read the following and answer the questions below.

In a hospital, engineers are setting up the domestic-type wiring for wards, where each ward has multiple electrical appliances connected in parallel. Each ward has two separate circuits — a 15 A circuit for high-power appliances such as geysers and air conditioners, and a 5 A circuit for lights and fans. The hospital also has machines that generate strong magnetic fields by passing large currents through coils.

(a) Why are the appliances in each ward connected in parallel rather than in series? [1]
(b) Why is a 15 A fuse used for the high-power appliance circuit instead of a 5 A fuse? [1]
(c) Give one reason why two separate circuits of different current ratings are used in the same ward. [1]
(d) What is the colour of insulation used for the earth wire in domestic wiring, and what is its purpose? [1]

◆ **Magnetic Effects of Electric Current**

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Model Answer

(a) Appliances are connected in parallel so that each appliance gets the same potential difference (220 V) and can be operated independently. If one appliance is switched off, the others continue to work.

(b) High-power appliances like geysers draw large currents. A 15 A fuse allows this without melting, whereas a 5 A fuse would blow even during normal operation of these appliances.

(c) Two separate circuits are used so that high-power appliances (geysers, air conditioners) and low-power appliances (lights, fans) can be protected by fuses of appropriate current ratings, preventing damage due to overloading.

(d) The earth wire has **green** coloured insulation. It is connected to a metal plate buried in the earth and provides a low-resistance path for leakage current, protecting the user from severe electric shock.

Source: Chapter 12, Section 12.4 — Domestic Electric Circuits

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Explanation

- **(a):** The textbook explicitly states appliances are connected in parallel "in order that each appliance has equal potential difference." Also mention independent operation for full marks.
- **(b):** Link the answer to current rating — high-power appliances need higher current, so a higher-rated fuse is necessary for normal functioning.
- **(c):** The key idea is **appropriate protection** — different fuse ratings suit different appliances. Don't just say "safety"; be specific.
- **(d):** Examiners expect both: the colour (green) **and** the purpose (safety/low-resistance path/prevents shock). Missing either loses the mark.

Q36. deep exam-ready **[4]**

Read the following and answer the questions below.

A science teacher sets up a demonstration: a straight copper wire is connected to a battery and a switch, and a compass needle is placed close to the wire. When the switch is closed, the needle deflects. The teacher then bends the wire into a circular loop and passes current through it. Iron filings on a cardboard placed through the loop reveal a field pattern. When the teacher winds the wire into a tight cylindrical coil of many turns and passes current through it, the field pattern changes dramatically and resembles that of a well-known permanent magnet.

(a) When the switch is closed in the straight-wire setup, what does the deflection of the compass needle indicate? [1]
(b) At the centre of the current-carrying circular loop, the magnetic field lines appear as parallel straight lines. Give a reason for this. [1]
(c) What shape of permanent magnet does the field of the tightly wound cylindrical coil resemble, and what are the corresponding 'poles' of this coil? [1]
(d) If the number of turns in the cylindrical coil is doubled while the current remains the same, how does the magnetic field inside the coil change? [1]

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Model Answer

(a) The deflection of the compass needle indicates that the electric current flowing through the copper wire produces a magnetic field around it. This shows that electricity and magnetism are linked to each other.

(b) At the centre of a current-carrying circular loop, the magnetic field lines appear as parallel straight lines because the centre is far from all points on the loop's circumference. The curved field lines become nearly straight and parallel at this region, indicating a uniform magnetic field there.

(c) The field of the tightly wound cylindrical coil (solenoid) resembles that of a **bar magnet**. The end from which field lines emerge acts as the **North pole**, and the end where they enter acts as the **South pole**.

(d) If the number of turns is doubled (with current unchanged), the magnetic field inside the coil **doubles**, since the field of a solenoid is directly proportional to the number of turns.

Source: Chapter 12 – Magnetic Effects of Electric Current, Sections 12.1, 12.2 and Summary

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Explanation

- **(a)** The key phrase examiners expect is "magnetic effect of electric current" — Oersted's discovery.
- **(b)** CBSE expects the reasoning that the centre is equidistant/far from the circumference, making field lines straight and parallel (uniform field).
- **(c)** "Bar magnet" is the exact term from the textbook summary; name both poles clearly.
- **(d)** The proportionality $B \propto n$ is the core concept. State it directly: doubling turns → field doubles. No formula derivation is needed for 1 mark.

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