CBSE CLASS X

Science (086)

ANSWER KEY

From previous CBSE Board Exam questions

Code: TXMNO3	Questions: 74	Maximum Marks: 186	Generated: 2026-06-15 13:05

SELECTIONS USED

Source	Previous-year board
Subject	Science
Lessons	Magnetic Effects of Electric Current
Year	2022-2026
Questions selected	74

Composition — Types: 25 Short · 14 MCQ · 13 Assertion–reason · 12 Long · 6 Very short · 5 Case-based

Q1. § Introduction § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR **[1]**

Assertion (A) : The deflection of a compass needle placed near a current carrying wire decreases when the magnitude of an electric current in the wire is increased.
Reason (R) : Strength of the magnetic field at a point due to a current carrying conductor increases on increasing the current in the conductor.

(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.

Previously asked in: 2024 31/2/1 Q20

◆ **Magnetic Effects of Electric Current** Magnetic field due to current-carrying conductor and compass needle deflection

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Model Answer

(D) (A) is false, but (R) is true.

The Assertion is false — increasing current *increases* the deflection of the compass needle, not decreases it. The Reason is true — magnetic field strength increases with increasing current.

Explanation

Examiners expect you to identify that the Assertion directly contradicts what Oersted's experiment shows: greater current → stronger magnetic field → *greater* deflection of the needle. The Reason is a correct statement of the principle. Option (D) is the only choice where R is true and A is false.

Q2. § Introduction | § 12.1 MAGNETIC FIELD AND FIELD LINES | § 12.2.4 Magnetic Field due to a Current in a Solenoid **[4]**

What is electromagnetic induction ? What is observed in the galvanometer when a strong bar magnet is held stationary near one end of a coil of large number of turns ? Justify your answer.

Previously asked in: 2022 31/4/1 Q14 (OR)

◆ **Magnetic Effects of Electric Current** | Effect of stationary magnet on a coil – no deflection in galvanometer | Electromagnetic Induction

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Model Answer

Electromagnetic Induction: The phenomenon of producing an induced electric current in a coil (or conductor) due to a changing magnetic field (or relative motion between a coil and a magnet) is called electromagnetic induction.

Observation: When a strong bar magnet is held **stationary** near one end of a coil, the galvanometer shows **no deflection**.

Justification: Electromagnetic induction occurs only when there is a **change** in the magnetic flux linked with the coil. When the magnet is stationary, the magnetic flux through the coil remains constant — it does not change with time. Since there is no change in flux, no EMF is induced in the coil, no current flows, and hence the galvanometer needle remains at zero.

Source: Chapter 13 — Magnetic Effects of Electric Current (Electromagnetic Induction section)

Explanation

- Examiners expect the **definition** clearly stated (1 mark), the **correct observation** — no deflection — stated explicitly (1 mark), and a **reason** based on the concept of changing flux (2 marks).
- A common mistake is writing "the galvanometer deflects" — remember, only a *moving* or *changing* magnet induces current. Stationary magnet = no change in flux = no induced current.
- The key phrase to use: "no change in magnetic flux."

Q3. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule **[2]**

Answer the following based on the given figures 'a' and 'b':

(a) Name the poles P, Q, R and S of the magnets in the following figures 'a' and 'b'. (½+½+1=2)

(b) State the inference drawn about the direction of the magnetic field lines on the basis of these diagrams.

Previously asked in: 2022 31/2/1 Q6 (OR-1)

◆ **Magnetic Effects of Electric Current** | Magnetic poles and field lines between magnets (attraction and repulsion)

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Model Answer

(a) In figure 'a', the field lines emerge outward from the facing ends, indicating both P and Q are **North poles**.

In figure 'b', field lines emerge from R and merge into S, so **R is North pole** and **S is South pole**.

(b) The magnetic field lines emerge from the North pole and merge (enter) at the South pole outside the magnet. Inside the magnet, they travel from South pole to North pole. Thus, magnetic field lines are **closed curves**.

Source: Chapter 12, Section 12.1 – Magnetic Field and Field Lines

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Explanation

- Examiners look for correct pole identification based on direction of field lines (emerging = North, entering = South).
- In figure 'a', both inner ends repel field lines outward → both are North poles (like poles facing each other).
- The key inference the textbook states: field lines are closed curves — always mention this for inference-based questions.
- Part (a) carries 2 marks (½+½+1), so name all four poles clearly.

Q4. § 12.1 MAGNETIC FIELD AND FIELD LINES | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[1]**

Which one of the following statements is not true about a bar magnet ?

(A) It sets itself in north-south direction when suspended freely.
(B) It has attractive power for iron filings.
(C) It produces magnetic field lines.
(D) The direction of magnetic field lines inside a bar magnet is from its north pole to its south pole.

Previously asked in: 2025 31/3/1 Q14

◆ **Magnetic Effects of Electric Current** | Properties of a Bar Magnet

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Model Answer

(D) The direction of magnetic field lines inside a bar magnet is from its north pole to its south pole.

This is **not true** — inside a bar magnet, field lines run from the **south pole to the north pole**.

Explanation

The passage 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. Examiners expect students to recall this key distinction. Options A, B, and C are all correct properties of a bar magnet.

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

Q5. § 12.1 MAGNETIC FIELD AND FIELD LINES **[1]**

Assertion (A) : The needle of a compass, kept in an external magnetic field, always aligns itself in the North-South direction of the Earth.
Reason (R) : The behaviour of the needle of the compass is similar to the behaviour of a freely suspended bar magnet.

(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.

Previously asked in: 2026 31/3/1 Q32

◆ **Magnetic Effects of Electric Current** | Compass needle and Earth's magnetic field – alignment in North-South direction | Compass needle as a freely suspended bar magnet

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Model Answer

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

The needle aligns along the **external magnetic field's direction**, not always North-South. However, R is true — a compass needle behaves exactly like a freely suspended bar magnet.

Explanation

- **A is false** because in an external magnetic field, the compass needle aligns along *that field's* direction, not Earth's geographic North-South. It aligns N-S only when no other external field is present.
- **R is true** because the textbook states "A compass needle is, in fact, a small bar magnet," so its behaviour mirrors a freely suspended bar magnet.
- Choose option **(D)** when the Assertion is wrong but the Reason correctly states a true fact independently.

Q6. § 12.1 MAGNETIC FIELD AND FIELD LINES **[1]**

Assertion (A) : The needle of a magnetic compass kept in strong external magnetic field, always aligns itself in north-south direction on the earth.
Reason (R) : Behaviour of the needle of a compass is same as that of a freely suspended bar magnet.

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

Previously asked in: 2026 31/5/1 Q32

◆ **Magnetic Effects of Electric Current** Magnetic compass and bar magnet behaviour in external magnetic field

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Model Answer

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

A compass needle in a *strong external* magnetic field aligns with that field, not necessarily north-south. Reason (R) is correct — the compass needle behaves like a freely suspended bar magnet.

Explanation

The Assertion is false because a compass needle aligns with the **net/dominant magnetic field** at its location. Earth's field is weak; a strong external field will deflect the needle away from north-south. The Reason is true as the textbook states the compass needle is itself a small bar magnet, behaving exactly like a freely suspended bar magnet. Since A is false and R is true, option (D) is correct.

Q7. § 12.2.2 Right-Hand Thumb Rule **[2]**

"Magnetic field is a physical quantity that has both direction and magnitude." How can this statement be proved with the help of magnetic field lines of a bar magnet ?

Previously asked in: 2022 31/4/1 Q2 (OR)

◆ **Magnetic Effects of Electric Current** | Magnetic field as a vector quantity – direction and magnitude from field lines of a bar magnet

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Model Answer

Magnetic field lines of a bar magnet prove this as follows:

- **Direction:** By convention, field lines emerge from the north pole and merge at the south pole (outside the magnet), and run from south to north inside it. The direction of the field at any point is the direction a free north pole would move there.
- **Magnitude:** Where field lines are crowded (near the poles), the field is stronger; where they are spread apart, the field is weaker.

Since field lines show both direction and magnitude, magnetic field is proved to be a vector quantity.

Source: Chapter 12, Section 12.1 — Magnetic Field and Field Lines

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Explanation

Examiners expect two distinct points: one linking field-line direction to the direction of the field, and one linking crowding/spacing of field lines to the magnitude/strength. Mentioning "vector quantity" as the conclusion is a bonus but keeps the answer crisp. Avoid lengthy descriptions of the bar-magnet diagram; just state the two properties directly.

Q8. § 12.2.2 Right-Hand Thumb Rule **[2]**

State the rule to determine the direction of a (a) magnetic field produced around a straight conductor carrying current and (b) force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it.

Previously asked in: 2023 31/6/1 Q26

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule – direction of force on a current-carrying conductor in a magnetic field | Right-Hand Thumb Rule (Maxwell's Corkscrew Rule) – direction of magnetic field around a current-carrying straight conductor

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Model Answer

(a) Right-Hand Thumb Rule: Imagine holding the current-carrying straight conductor in your right hand with the thumb pointing in the direction of current. The fingers wrapping around the conductor give the direction of the magnetic field.

(b) 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, the thumb points in the direction of force on the conductor.

Source: Chapter 12, Sections 12.2.2 and 12.3

Explanation

- Two distinct rules are being asked — one per sub-part, so label them clearly.
- Examiners look for the **name** of the rule plus a correct brief description of finger/thumb positions.
- A common mistake is confusing the **right** hand (for magnetic field direction) with the **left** hand (for force direction) — remember: **R**ight-hand for fi**R**eld, **L**eft-hand for force (**L**orentz/motor).
- You don't need a diagram in a 2-mark answer, but correct finger assignments are essential.

Q9. § 12.2.2 Right-Hand Thumb Rule **[1]**

The resultant magnetic field at point 'P' situated midway between two parallel wires (placed horizontally) each carrying a steady current I is

(a) in the same direction as the current in the wires.
(b) in the vertically upward direction.
(c) zero
(d) in the vertically downward direction.

Previously asked in: 2023 31/1/1 Q16

◆ **Magnetic Effects of Electric Current** | Magnetic field due to parallel current-carrying wires and superposition at midpoint

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Model Answer

(c) zero

By the right-hand thumb rule, the magnetic field due to the upper wire at P is directed out of the page, and the field due to the lower wire at P is directed into the page. Since both currents are equal and P is equidistant, the two fields are equal in magnitude but opposite in direction, giving a resultant of zero.

Explanation

For two parallel wires carrying current in the **same direction**, apply the right-hand thumb rule to each wire separately at point P (midway between them). The field from the upper wire curves downward at P (into the page on one side), while the field from the lower wire curves upward at P (out of the page on the same side) — they cancel exactly. This is why the answer is **(c) zero**. Had the currents been in opposite directions, the fields would add up instead of cancelling.

Q10. § 12.2.2 Right-Hand Thumb Rule **[3]**

Name and state the rule to determine the direction of a :

(i) magnetic field produced around a current carrying straight conductor.

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

Previously asked in: 2024 31/1/1 Q32

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule – direction of force on a current-carrying conductor in a magnetic field | Right-Hand Thumb Rule (Maxwell's Corkscrew Rule) – direction of magnetic field around a current-carrying straight conductor

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Model Answer

(i) 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 wrapping around the conductor indicate the direction of the magnetic field** lines around it.

(ii) Fleming's Left-Hand Rule:
Stretch the **thumb, forefinger, and middle finger** of the left hand mutually perpendicular to each other. 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 the force** (motion) on the conductor.

Source: Chapter 12, Sections 12.2.2 and 12.3

Explanation

- This is a standard 3-mark question: 1 mark for naming + stating rule (i), 1 mark for naming + stating rule (ii), 1 mark for correctness/clarity overall.
- **Do not confuse** the two rules: Right-Hand Thumb Rule → direction of *magnetic field*; Fleming's Left-Hand Rule → direction of *force*.
- Bold key terms (thumb, forefinger, middle finger, directions) to make the answer scannable for examiners.
- A small diagram of Fleming's Left-Hand Rule, if time permits, can earn you bonus clarity marks.

Q11. § 12.2.2 Right-Hand Thumb Rule **[3]**

Draw the pattern of the magnetic field produced around a vertical current carrying straight conductor passing through a horizontal cardboard. Mark the direction of current and the magnetic field lines. Name and state the rule which is used to determine the direction of magnetic field associated with a current carrying conductor.

Previously asked in: 2023 31/5/1 Q32 (b)

◆ **Magnetic Effects of Electric Current** | Magnetic field pattern around a straight current-carrying conductor | Right-Hand Thumb Rule (Maxwell's Corkscrew Rule)

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Model Answer

Diagram:

```
↑ Current (upward)
|
···←··|··←···
↓ | ↑
···→··|··→···
|
(Concentric circles around wire, anticlockwise when current flows upward)
```

The magnetic field appears as **concentric circles** centred on the wire, lying in the horizontal plane of the cardboard. When current flows upward, field lines are anticlockwise (viewed from above).

Name of Rule: Right-Hand Thumb Rule

Statement: 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**.

Source: Chapter 12, Section 12.2.1 and 12.2.2

Explanation

- **1 mark** for the diagram — show the wire passing through the cardboard, concentric circles around it, arrows on circles showing field direction, and arrow on wire showing current direction.
- **1 mark** for naming the rule (Right-Hand Thumb Rule).
- **1 mark** for the correct statement of the rule — both parts (thumb → current, fingers → field) must be mentioned.
- Examiners expect the rule to be stated in the exact textbook language. Avoid describing the left-hand rule by mistake.

Q12. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR § 12.2.2 Right-Hand Thumb Rule **[1]**

A constant current flows in a horizontal wire in the plane of the paper from east to west as shown in the figure. The direction of the magnetic field will be north to south at a point :

(a) directly above the wire.
(b) directly below the wire.
(c) located in the plane of the paper on the north side of the wire.
(d) located in the plane of the paper on the south side of the wire.

Previously asked in: 2023 31/5/1 Q14

◆ **Magnetic Effects of Electric Current**

Magnetic field due to a straight current-carrying conductor (direction using Right-Hand Thumb Rule)

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Model Answer

(a) directly above the wire.

Using the right-hand thumb rule with current flowing east to west, the magnetic field above the wire points from north to south.

Source: Chapter 12, Section 12.2.2 (Right-Hand Thumb Rule), Example 12.1

Explanation

Apply the right-hand thumb rule: point the right thumb westward (direction of current). The fingers curl **downward in front** (south side → downward) and **upward at the back**. Specifically, at the point **directly above** the wire, the field is directed from **north to south**. At a point directly below, it would be south to north. This matches Example 12.1 in the textbook, which uses the identical current direction. Examiners expect you to cite the right-hand thumb rule and state the correct option clearly.

Q13. § 12.2.2 Right-Hand Thumb Rule **[5]**

The given figure shows the current passing through the straight conductor XY.

(i) Copy the diagram and draw the magnetic field lines when current flows from conductor X to Y. [2]

(ii) Name and state the rule used in determining the direction of the magnetic field lines in the situation given above. [1]

(iii) State Fleming's left hand rule. Using this rule, determine the direction of force applied on an electron entering a uniform magnetic field as shown in the figure. [2]

Previously asked in: 2025 31/2/1 Q36 (a)

◆ **Magnetic Effects of Electric Current** · Fleming's Left-Hand Rule and force on a charged particle in a magnetic field · Magnetic field due to a straight current-carrying conductor · Right-Hand Thumb Rule (Maxwell's Corkscrew Rule)

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Model Answer

(i) When current flows from X to Y (upward), the magnetic field lines form **concentric circles** around the conductor. The direction of circles is **anticlockwise** when viewed from above (i.e., from Y end), as determined by the right-hand thumb rule.
(Student should draw concentric circles around conductor XY with anticlockwise arrows when current goes X→Y upward.)

(ii) The rule used is the **Right-Hand Thumb Rule**.
Statement: Imagine holding the current-carrying 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.

(iii) Fleming's Left-Hand Rule: Stretch the thumb, forefinger, and middle finger of the left hand mutually perpendicular to each other. 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.

Direction of force on the electron: Since electrons move opposite to conventional current direction, applying Fleming's left-hand rule (reversing current direction), the force on the electron is directed **into the page**.

Source: Chapter 12, Sections 12.2.2 and 12.3

Explanation

- **(i)** The key point is *concentric circles* — examiners expect this term plus arrows showing correct direction (anticlockwise for upward current when viewed from top).
- **(ii)** Name the rule first, then state it exactly as in the textbook. Both are needed for the 1 mark.
- **(iii)** Two things are tested: the statement of Fleming's Left-Hand Rule (forefinger = field, middle finger = current, thumb = force/motion) AND applying it correctly to an electron. The crucial trick: current direction is **opposite** to electron motion, so reverse the conventional current before applying the rule. The standard textbook answer (Example 12.2) gives "into the page" — match the diagram given.

Q14. § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[4]**

> A student was asked to perform an experiment to study the force on a current carrying conductor in a magnetic field. He took a small aluminum rod AB, a strong horse shoe magnet, some connecting wires, a battery and a switch and connected them as shown. He observed that on passing current, the rod gets displaced. On reversing the direction of current, the direction of displacement also gets reversed.

Answer the following:

(c) Draw the pattern of magnetic field lines produced around a current carrying straight conductor held vertically on a horizontal cardboard. Indicate the direction of the field lines as well as the direction of current flowing through the conductor.

Previously asked in: 2022 31/2/1 Q15 (OR-2)

◆ **Magnetic Effects of Electric Current** | Magnetic field lines around a current-carrying straight conductor | Right-hand thumb rule / direction of magnetic field

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Model Answer

(c)

Diagram:

```
↑ (Current flowing upward, out of page at top)
|
← ← | → →
↖ | ↗
← ← • → → • = current coming OUT of page
↙ | ↘
← ← | → →
|
```

The magnetic field lines around a current-carrying straight conductor are **concentric circles** centred on the conductor.

- The conductor is held vertically; current flows **upward** (indicated by arrow ↑).
- The magnetic field lines are **closed concentric circles** in the horizontal plane around the conductor.
- Direction of field lines is determined by the **Right-Hand Thumb Rule**: wrap the right hand around the conductor with thumb pointing in the direction of current — the curled fingers give the direction of field lines (**anticlockwise** when current comes towards you).
- Field lines are **closer near the conductor** (stronger field) and farther apart away from it (weaker field).

Source: Chapter 13 – Magnetic Effects of Electric Current, Oersted's Experiment / Magnetic Field due to Current in Straight Wire

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Explanation

Examiners award marks for: (1) a clear diagram with concentric circles, (2) arrow on the conductor showing current direction, (3) arrows on field lines showing correct direction (anticlockwise for current towards viewer), and (4) mention of Right-Hand Thumb Rule. Make sure the diagram is neat and labelled — roughly 2 marks are for the diagram and 2 for the written explanation/rule.

Q15. § 12.2.2 Right-Hand Thumb Rule **[3]**

Draw a diagram to show the pattern of magnetic field lines on a horizontal sheet of paper due to a straight conductor passing through its centre and carrying current vertically upwards. Mark on it (i) the direction of current in the conductor and (ii) the corresponding magnetic field lines. State right hand thumb rule and check whether the directions marked by you are in accordance with this rule or not.

Previously asked in: 2024 31/2/1 Q32

◆ Magnetic Effects of Electric Current | Magnetic field lines due to a straight current-carrying conductor | Right Hand Thumb Rule

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Model Answer

Diagram:

```

↑ (current upward, marked with dot •)

← ⊙ →
(anti-clockwise concentric circles)
```

The magnetic field lines form **concentric circles** around the conductor, directed **anti-clockwise** when current flows vertically upward (out of the page, shown by ⊙).

(i) Direction of current: **upward / out of the page** (⊙)
(ii) Magnetic field lines: **concentric circles, anti-clockwise**

Right-Hand Thumb Rule: If a current-carrying straight conductor is held in the right hand such that the **thumb points in the direction of current**, then the **curled fingers show the direction of magnetic field lines** around the conductor.

Verification: With the thumb pointing upward (current direction), the fingers curl **anti-clockwise** — this matches the directions marked in the diagram. Hence, the directions are in accordance with the right-hand thumb rule.

Source: Chapter 12, Section 12.2.2

Explanation

- The diagram must show ⊙ (dot) at the centre to indicate current coming out/upward, and concentric circles going anti-clockwise.
- Examiners award 1 mark for the correct diagram, 1 mark for stating the rule correctly, and 1 mark for the verification.
- The key phrase in the rule is: "thumb → current direction; curled fingers → field direction."
- Do not confuse anti-clockwise (current upward) with clockwise (current downward).

Q16. § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[1]**

The correct pattern of magnetic field lines of the field produced by a current carrying circular loop is :

(a) Magnetic field pattern option (a)
(b) Magnetic field pattern option (b)
(c) Magnetic field pattern option (c)
(d) Magnetic field pattern option (d)

Previously asked in: 2023 31/4/1 Q14

◆ **Magnetic Effects of Electric Current** | Magnetic field lines due to a current-carrying circular loop

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Model Answer

(c)

The correct pattern shows closed magnetic field lines passing straight through the centre of the loop and looping around the outside, which matches the description in the textbook.

Source: Chapter 12, Section 12.2.3

Explanation

The textbook (Fig. 12.8) shows that field lines of a current-carrying circular loop form closed loops: they pass through the interior of the loop (appearing as straight lines at the centre) and curve around the outside. Examiners expect you to identify the option that shows this — closed, continuous field lines threading through the loop's centre, denser inside and spreading out symmetrically outside.

Q17. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule | § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[1]**

Assertion (A) : Magnetic field lines do not intersect each other.
Reason (R) : Magnetic field lines are imaginary lines, the tangent to which at any point gives the direction of the field at that point.

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

Previously asked in: 2023 31/2/1 Q20

◆ **Magnetic Effects of Electric Current** | Properties of Magnetic Field Lines

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Model Answer

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). Field lines don't intersect because that would imply two directions of field at one point, which is impossible. Reason (R) merely defines field lines.

Explanation

- **A is true**: Two magnetic field lines never intersect. The correct reason is that if they did, there would be two tangents at the point of intersection, meaning two directions of the magnetic field at the same point — which is impossible.
- **R is true**: Field lines are indeed imaginary lines; the tangent at any point gives the field direction. But this statement only *defines* field lines; it does not *explain why* they cannot intersect.
- So both statements are correct, but R does not explain A → option **(b)**.

Q18. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR **[1]**

Assertion (A) : Magnetic field lines never intersect each other.
Reason (R) : If they intersect, then at the point of intersection, the compass needle would point towards two directions, which is not possible.

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.

Previously asked in: 2024 31/4/1 Q19

◆ **Magnetic Effects of Electric Current** Properties of Magnetic Field Lines

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Model Answer

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

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."* This makes both A and R true, with R directly explaining A. Source: Chapter 12, Section 12.1 – Magnetic Field and Field Lines.

Q19. § 12.2.2 Right-Hand Thumb Rule § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[3]**

Consider a rectangular cardboard having two holes P and Q through which a current carrying circular loop has been inserted as shown in the diagram.

(a) Make this diagram on your answer sheet and draw three magnetic field lines, one each passing through the points 1 (near P), 2 (at the centre of the loop) and 3 (near Q). [1]

(b) List two factors on which the intensity of the magnetic field produced at the centre of the loop depends. [1]

(c) Name the rule you will apply to determine the direction of magnetic field produced due to a current carrying straight conductor. [1]

Previously asked in: 2025 31/3/1 Q32

◆ **Magnetic Effects of Electric Current** Factors affecting magnetic field intensity at the centre of a circular loop
Magnetic field lines due to a current-carrying circular loop Right-Hand Thumb Rule for current-carrying straight conductor

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Model Answer

(a) [Diagram to be drawn in answer sheet]

The magnetic field lines should be drawn as follows:

- **Point 1 (near P):** Concentric circles around the wire where it passes through hole P.
- **Point 2 (centre of loop):** Straight parallel lines through the centre of the loop (all pointing in the same direction).
- **Point 3 (near Q):** Concentric circles around the wire where it passes through hole Q (direction opposite to those at P).

(b) The intensity of the magnetic field at the centre of a circular loop depends on:

1. The **magnitude of current** flowing through the loop (field increases with current).
2. The **number of turns** of the coil (field is n times for n turns).

(c) Right-Hand Thumb Rule — To determine the direction of the magnetic field produced by a current-carrying straight conductor.

Source: Chapter 12, Sections 12.2.1 and 12.2.3

Explanation

- **(a)** The key point: at the centre of the loop, the arcs appear as straight lines (all contributions add up in the same direction). Near P and Q, the wire is straight, so field lines are concentric circles. Examiners want the contrast between straight-line field at centre vs. concentric circles near holes.
- **(b)** From the textbook: field depends on current AND number of turns. A common error is writing "radius/distance" — while valid in general, the textbook specifically highlights current and number of turns for the centre of a circular loop.
- **(c)** "Right-Hand Thumb Rule" is specifically mentioned for straight conductors. Don't confuse with Fleming's Left-Hand Rule (for force on conductor) or the Right-Hand rule for circular loops.

Q20. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2.2 Right-Hand Thumb Rule **[1]**

Assertion (A) : Magnetic field lines around a bar magnet never intersect each other.
Reason (R) : Magnetic field produced by a bar magnet is a quantity that has both magnitude and direction.

(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.

Previously asked in: 2025 31/3/1 Q19

◆ **Magnetic Effects of Electric Current** Magnetic field as a vector quantity (magnitude and direction) Magnetic field lines properties – non-intersection

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Model Answer

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

Field lines don't intersect because at any point of intersection the compass needle would point in two directions simultaneously, which is impossible — not because the field has both magnitude and direction.

Explanation

- **A is true:** Field lines never intersect — stated directly in the textbook.
- **R is true:** Magnetic field does have both magnitude and direction (it is a vector quantity) — also stated in the textbook.
- **R does NOT explain A:** The real reason lines don't cross is that a field can have only one direction at any point. The vector nature of the field is a general property, not the specific cause of non-intersection. Hence option **(B)**.

Q21. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR **[1]**

Assertion (A) : No two magnetic field lines are found to cross each other.
Reason (R) : The compass needle cannot point towards two directions at the point of intersection of two magnetic field lines.

(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.

Previously asked in: 2025 31/1/1 Q19

◆ **Magnetic Effects of Electric Current** Properties of Magnetic Field Lines – Non-intersection of Field Lines

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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: "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." So R directly explains A — option (A) is correct.

Q22. § Introduction § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR **[4]**

> AB is a coil of copper wire having a large number of turns. The ends of the coil are connected with a galvanometer as shown. When the north pole of a strong bar magnet is moved towards the end B of the coil, a deflection is observed in the galvanometer.

Answer the sub-questions based on the case below. Part (a) and (b) are compulsory; an internal choice has been provided in Part (c).

(a) State the reason for using galvanometer in the activity and why does its needle deflects momentarily when magnet is moved towards the coil.

(b) What would be observed in the galvanometer in a situation when the coil and the bar magnet both move with the same speed in the same direction ? Justify your answer.

(c) State the conclusion that can be drawn from this activity. Will there be any change in the momentary deflection in the galvanometer if number of turns in the coil is increased and a more stronger magnet is moved towards the coil ?

Previously asked in: 2022 31/4/1 Q14 (main)

◆ **Magnetic Effects of Electric Current** | Electromagnetic Induction – Galvanometer deflection and induced current | Factors affecting induced EMF – number of turns and strength of magnet | Relative motion between coil and magnet

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Model Answer

(a) A galvanometer is used because it can detect very small currents. When the magnet moves towards the coil, the magnetic flux through the coil changes, inducing an EMF and a momentary current — causing the needle to deflect. The deflection is momentary because current is induced only while flux is changing.

(b) No deflection would be observed. When coil and magnet move with the same speed in the same direction, there is no relative motion between them, so magnetic flux does not change and no EMF is induced.

(c) *Conclusion:* A changing magnetic flux (relative motion between magnet and coil) induces an electric current — this is electromagnetic induction.
Yes, deflection increases — more turns increase the flux linkage and a stronger magnet produces greater flux change, both resulting in higher induced EMF and larger deflection.

Source: Chapter – Magnetic Effects of Electric Current (Electromagnetic Induction activity)

Explanation

- Examiner expects the term **relative motion** in (b) — this is the key justification.
- For (c), two sub-points are expected: the conclusion (electromagnetic induction) **and** the effect of more turns + stronger magnet (more deflection). Don't miss either.
- "Momentary" deflection must be explained by flux *changing* only while motion occurs — steady flux = no current.

Q23. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[3]**

What is a solenoid ? When does a solenoid behave as a magnet ? Draw the pattern of the magnetic field produced inside it showing the directions of the magnetic field lines.

Previously asked in: 2023 31/6/1 Q32

◆ **Magnetic Effects of Electric Current** | Magnetic field lines pattern inside a solenoid | Solenoid behaving as a magnet (current-carrying solenoid) | Solenoid – definition and structure

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Model Answer

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

When it behaves as a magnet: When electric current flows through a solenoid, one end behaves as a north pole and the other as a south pole, just like a bar magnet.

Diagram:

```
N |——————————————————————| S
→ → → → → → →
→ → → → → → →
→ → → → → → →
```

(Field lines inside are parallel and straight, indicating a uniform magnetic field directed from S-pole end to N-pole end inside the solenoid.)

Source: Chapter 12, Section 12.2.4

Explanation

- **Definition (1 mark):** Must mention "many circular turns," "insulated copper wire," and "cylindrical shape."
- **Condition (1 mark):** Current must flow through it; one end = N pole, other = S pole.
- **Diagram (1 mark):** Show parallel, equally spaced, straight field lines inside pointing from south to north end (inside the solenoid). Examiners check that lines are parallel and the direction is marked. Even a neat sketch with arrows scores full marks.

Q24. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

The magnetic field inside a long straight current carrying solenoid :

(a) is zero.
(b) decreases as we move towards its end.
(c) increases as we move towards its end.
(d) is same at all points.

Previously asked in: 2023 31/6/1 Q15

◆ **Magnetic Effects of Electric Current** | Magnetic field inside a solenoid

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Model Answer

(d) is same at all points.

The field lines inside a solenoid are parallel straight lines, indicating a uniform magnetic field at all points inside it.

Source: Chapter 12, Section 12.2.4 – Magnetic Field due to a Current in a Solenoid

Explanation

The passage explicitly states: *"The field lines inside the solenoid are in the form of parallel straight lines. This indicates that the magnetic field is the same at all points inside the solenoid."* Examiners expect you to select option (d) and may ask for a one-line justification — always mention "uniform" or "same at all points."

Q25. § 12.2.2 Right-Hand Thumb Rule § 12.2.4 Magnetic Field due to a Current in a Solenoid **[3]**

Answer the following:

(i) Draw the pattern of magnetic field lines of (1) a current carrying solenoid (2) a bar magnet

(ii) List two distinguishing features between the two fields.

Previously asked in: 2023 31/1/1 Q32(b)

◆ **Magnetic Effects of Electric Current** Comparison between magnetic field of solenoid and bar magnet Magnetic field lines of a bar magnet Magnetic field lines of a current-carrying solenoid

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Model Answer

(i) Magnetic field line patterns:

Solenoid: Field lines inside are parallel and straight (uniform field); outside they emerge from one end and re-enter the other, similar to a bar magnet pattern.

Bar Magnet: Field lines emerge from the North pole, curve around, and enter the South pole; inside the magnet, lines run from South to North. All lines are closed curves.

(Diagrams should show these patterns with arrows indicating direction.)

(ii) Two distinguishing features:

1. The magnetic field of a solenoid is produced by electric current and can be switched on/off, whereas a bar magnet's field is permanent and always present.
2. The strength of a solenoid's field can be varied by changing the current, but the bar magnet's field strength cannot be easily changed.

Explanation

- Examiners expect recognisable labelled diagrams for (i) — draw clearly with arrows showing field direction (N→S outside, S→N inside).
- For distinguishing features, focus on **origin of field** (current vs. permanent magnetism) and **controllability** — these are the most scoring points.
- Both diagrams carry ~1 mark together; the two features carry 1 mark each. Keep the answer concise.

Q26. § 12.1 MAGNETIC FIELD AND FIELD LINES | § 12.2.4 Magnetic Field due to a Current in a Solenoid | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[2]**

Name the device used to magnetise a piece of magnetic material. Draw a labelled diagram to show the arrangement used for the magnetisation of a cylinder made of soft iron.

Previously asked in: 2024 31/3/1 Q25(b)

◆ **Magnetic Effects of Electric Current** | Magnetisation of magnetic materials using a solenoid

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Model Answer

Device used: Solenoid (a coil of insulated copper wire carrying electric current).

Diagram:

```
Battery (B)
+---|===|---+
| |
| S N |
====|============|==== ← Solenoid coil
| [soft iron cylinder inside]
| |
+-----------+
Switch (K)
```

A soft iron cylinder is placed inside a current-carrying solenoid. The strong uniform magnetic field inside the solenoid magnetises the soft iron, forming an **electromagnet**.

Source: Chapter 12, Section 12.2.4

Explanation

- The key device is a **solenoid** connected to a battery.
- The diagram must show: the solenoid coil, soft iron core inside, battery, and switch — all labelled. Examiners award 1 mark for naming the device and 1 mark for the correct labelled diagram.
- Remember: the magnetic field inside a solenoid is **uniform**, which is why it effectively magnetises the material placed inside it.

Q27. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

Strength of magnetic field produced by a current carrying solenoid DOES NOT depend upon :

(A) number of turns in the solenoid
(B) direction of the current flowing through it
(C) radius of solenoid
(D) material of core of the solenoid

Previously asked in: 2024 31/2/1 Q16

◆ **Magnetic Effects of Electric Current** | Factors affecting magnetic field strength of a current-carrying solenoid

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Model Answer

(B) direction of the current flowing through it

The strength (magnitude) of the magnetic field of a solenoid depends on the number of turns, current magnitude, and core material — but NOT on the direction of current, which only affects the polarity, not the strength.

Explanation

- The question tests the difference between **strength** (magnitude) and **direction** of the magnetic field.
- Changing current direction reverses the poles (north↔south) but does not change the magnitude of the field.
- Number of turns, current magnitude, and core material (e.g., soft iron core increases field strength) all affect the strength.
- Option (C) "radius of solenoid" is a slight distractor — for an ideal solenoid the field inside is largely independent of radius, but the syllabus-level answer the examiner expects is **(B)**.

Q28. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

The pattern of the magnetic field produced inside a current carrying solenoid is :

(a) [diagram a]
(b) [diagram b]
(c) [diagram c]
(d) [diagram d]

Previously asked in: 2024 31/1/1 Q14

◆ **Magnetic Effects of Electric Current** Magnetic field pattern inside a current-carrying solenoid

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Model Answer

(a) — Parallel straight horizontal lines with arrows pointing right (uniform field inside the solenoid).

The field lines inside a current-carrying solenoid are parallel straight lines, indicating a uniform magnetic field throughout its interior.

Source: Chapter 12, Section 12.2.4

Explanation

Examiners expect you to identify option **(a)** and state the key reason: field lines inside a solenoid are **parallel and straight**, showing the field is **uniform**. Option (b) is for a straight wire (concentric circles); option (c) may look like a solenoid shape but is incorrect; option (d) resembles the external field of a bar magnet. The textbook explicitly states: *"The field lines inside the solenoid are in the form of parallel straight lines."*

Q29. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

Assertion (A) : The pattern of the magnetic field of a solenoid carrying a current is similar to that of a bar magnet.
Reason (R) : The pattern of the magnetic field around a current carrying conductor is independent of the shape of the conductor.

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

Previously asked in: 2025 31/5/1 Q19

◆ **Magnetic Effects of Electric Current** | Dependence of magnetic field pattern on shape of conductor | Magnetic field of a solenoid and its similarity to a bar magnet

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Model Answer

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

The magnetic field of a current-carrying solenoid is indeed similar to a bar magnet, but the pattern of magnetic field *depends* on the shape of the conductor, not is independent of it.

Explanation

- **A is true**: The textbook explicitly states "The magnetic field of a solenoid carrying a current is similar to that of a bar magnet."
- **R is false**: The textbook states "The pattern of the magnetic field around a conductor due to an electric current flowing through it **depends on the shape** of the conductor" — directly contradicting the Reason.
- So R does not explain A; in fact R is factually incorrect as per the chapter. Choose **C**.

Q30. § Introduction § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR **[3]**

In the diagram given below, Coil 1 is connected in series with a battery and a plug key while Coil 2 is connected with a galvanometer.

(i) Why does the galvanometer show deflection only when the key (K) is plugged in and not when a steady current starts flowing in the circuit? [1]

(ii) What is observed in the galvanometer, when the key is plugged out? [1]

(iii) State the conclusion based on the observation of this activity. [1]

Previously asked in: 2022 31/3/1 Q12(a)

◆ **Magnetic Effects of Electric Current** Electromagnetic Induction – Mutual Induction between Two Coils Induced Current and Changing Magnetic Flux

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Model Answer

(i) When key K is plugged in, the current in Coil 1 **changes** from zero to a steady value. This **changing** current produces a changing magnetic flux through Coil 2, which induces an EMF (and hence deflection). Once current becomes steady, the flux no longer changes, so no EMF is induced and the galvanometer shows no deflection.

(ii) When the key is plugged out, the current in Coil 1 decreases from steady value to zero. This again causes a **change** in magnetic flux through Coil 2, so the galvanometer shows a **momentary deflection**, but in the **opposite direction** to that observed when the key was plugged in.

(iii) Conclusion: A changing magnetic field (or changing current) in Coil 1 induces an electric current in the neighbouring Coil 2. A **steady current** does **not** induce any current in the adjacent coil.

Explanation

- The key concept is **electromagnetic induction**: current is induced only when there is a *change* in magnetic flux.
- Examiners expect the words **"changing flux"** or **"changing current"** in (i); without this, full marks are unlikely.
- In (ii), mentioning **opposite direction** earns the mark — the reversal indicates the flux is now decreasing instead of increasing.
- In (iii), the conclusion must clearly state that a *changing* (not steady) current/field causes induction — this is the core principle of Faraday's law at this level.

Q31. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[3]**

What is a Solenoid? Draw the pattern of the magnetic field lines around a current carrying solenoid. Mark on the pattern the region where the magnetic field is uniform.

Previously asked in: 2022 31/3/1 Q11

◆ **Magnetic Effects of Electric Current** | Solenoid – definition and magnetic field pattern

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Model Answer

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

Magnetic field pattern:

```
N S
|→ → → → → → → → → → → →|
|→ → → → → → → → → → → →| ← Uniform field (inside)
|→ → → → → → → → → → → →|
```

The field lines outside the solenoid are similar to those of a bar magnet. One end acts as the North pole and the other as the South pole.

Uniform field region: The magnetic field is **uniform inside the solenoid**, where the field lines are parallel and equally spaced straight lines.

Source: Chapter 12, Section 12.2.4

Explanation

- **Definition (1 mark):** Always mention "many turns," "insulated copper wire," and "cylindrical shape."
- **Diagram (1 mark):** Draw a rectangular coil with arrows showing field lines — parallel inside, curved outside resembling a bar magnet. Label N and S poles.
- **Uniform region (1 mark):** Explicitly state it is *inside* the solenoid; parallel straight lines indicate uniform field. Examiners look for this specific statement.

Q32. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[2]**

Answer the following:

(i) What is a solenoid ?

(ii) Draw the pattern of magnetic field lines of the magnetic field produced by a solenoid through which a steady current flows.

Previously asked in: 2022 31/1/1 Q6 (b)

◆ **Magnetic Effects of Electric Current** | Solenoid – definition and magnetic field line pattern

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Model Answer

(i) A solenoid is a coil consisting of many circular turns of insulated copper wire wound closely in the shape of a cylinder. When current flows through it, it behaves like a bar magnet and produces a strong, uniform magnetic field inside it.

(ii) The magnetic field lines of a solenoid:

\`\`\`

N S
|←←←←←←←←←←←←←←←←←←←←←←←|
| ———————————————————————— |
| ———————————————————————— |
|←←←←←←←←←←←←←←←←←←←←←←←|
\`\`\`

The field lines inside the solenoid are parallel and equally spaced (uniform field), and outside they resemble the field of a bar magnet — emerging from the north end and merging at the south end.

Explanation

- **(i)** Define solenoid clearly — "many turns of insulated wire wound in cylindrical shape" earns the mark. Mention it acts like a bar magnet for full credit.
- **(ii)** Key features examiners look for in the diagram: parallel, equally-spaced lines **inside** (uniform field) and curved closed lines **outside** similar to a bar magnet. Label N and S poles. Since drawing cannot be shown perfectly in text, in the actual exam draw neat closed curved lines outside and straight parallel lines inside the coil shape.

Q33. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

For a current in a long straight solenoid, N and S poles are created at the two ends. Among the following statements, the incorrect statement is :

(a) The magnetic field lines inside the solenoid are in the form of straight lines, which indicates that the magnetic field is uniform at all points inside the solenoid.
(b) The strong magnetic field produced inside the solenoid can magnetize the soft iron placed inside it.
(c) The pattern of the magnetic field associated with a current carrying solenoid is different from the pattern of the magnetic field around a bar magnet.
(d) The N and S poles exchange positions when the direction of current through the solenoid is reversed.

Previously asked in: 2023 31/5/1 Q16

◆ **Magnetic Effects of Electric Current** Magnetic field due to a solenoid and polarity of its ends

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Model Answer

The incorrect statement is **(c)**.

The magnetic field pattern of a current-carrying solenoid is **similar** (not different) to that of a bar magnet, as stated in the textbook.

Explanation

The passage explicitly says: *"Compare the pattern of the field with the magnetic field around a bar magnet... they are similar."* Options (a), (b), and (d) are all correct facts from the chapter. Examiners expect you to directly identify the contradiction with the textbook statement. Source: Chapter 12, Section 12.2.4.

Q34. § 12.2.2 Right-Hand Thumb Rule § 12.2.4 Magnetic Field due to a Current in a Solenoid **[3]**

(B) For the current carrying solenoid as shown, draw magnetic field lines and give reason to explain that out of the three points A, B and C, at which point the field strength is maximum and at which point it is minimum ?

Previously asked in: 2023 31/4/1 Q32 (B)

◆ **Magnetic Effects of Electric Current** Comparison of magnetic field strength at different points (inside and outside a solenoid) Magnetic field lines of a current-carrying solenoid

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Model Answer

Magnetic Field Lines of a Solenoid:

The field lines inside the solenoid are parallel and straight (uniform field), while outside they resemble the field of a bar magnet — spreading out from the poles and looping around.

Field Strength at A, B, and C:

- **Point B (inside the solenoid)** — field strength is **maximum**. The field lines inside are parallel and closely packed, indicating a strong, uniform magnetic field.
- **Point A (just outside, near the end/pole)** — field strength is **moderate**, as field lines are less concentrated.
- **Point C (far outside the solenoid)** — field strength is **minimum**, because field lines spread out widely and are far apart, indicating a weak field.

Reason: Field lines are shown closer together where the magnetic field is greater. Inside a solenoid, they are densest; far outside, they spread the most.

Source: Magnetic Field due to a Current in a Solenoid, Chapter 12

Explanation

- Examiners expect a labelled description of field lines (parallel inside, bar-magnet pattern outside) — even without the diagram, describe it clearly.
- The key principle to cite: **closer field lines = stronger field**; this is stated directly in the textbook.
- Typically, B is inside (maximum), and the farthest external point is minimum. Adjust A/B/C labels to match your diagram if positions differ.
- Always link your answer to the reason — "because field lines are closer/farther apart" — to earn the reasoning mark.

Q35. § 12.2.2 Right-Hand Thumb Rule | § 12.2.4 Magnetic Field due to a Current in a Solenoid | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[1]**

The current carrying device which produces a magnetic field similar to that of a bar magnet is :

(A) A straight conductor
(B) A circular loop
(C) A solenoid
(D) A circular coil

Previously asked in: 2024 31/5/1 Q14

◆ **Magnetic Effects of Electric Current** | Solenoid and its magnetic field (similar to bar magnet)

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Model Answer

(C) A solenoid

The magnetic field of a current-carrying solenoid is similar to that of a bar magnet, with one end acting as north pole and the other as south pole.

Source: Section 12.2.4, Chapter 12

Explanation

The key fact from the textbook is: *"The magnetic field of a solenoid carrying a current is similar to that of a bar magnet."* A circular loop produces a field at its centre, but a **solenoid** (many turns wound cylindrically) replicates the complete dipole field pattern of a bar magnet — this is the distinguishing point examiners test. Do not confuse a solenoid with a single circular loop or coil.

Q36. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

The strength of magnetic field produced inside a long straight current carrying solenoid does not depend upon :

(A) number of turns in the solenoid
(B) direction of current flowing through the solenoid
(C) material of the core filled inside the solenoid
(D) radius of the coil of the solenoid

Previously asked in: 2025 31/3/1 Q15

◆ **Magnetic Effects of Electric Current** | Magnetic field inside a solenoid and factors affecting it

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Model Answer

(D) radius of the coil of the solenoid

The magnetic field inside a solenoid depends on the number of turns, current direction, and core material, but **not** on the radius (diameter) of the solenoid coil.

Explanation

The key fact is that the magnetic field inside a solenoid is uniform and depends on the number of turns per unit length, the current, and the permeability of the core material. The radius of the solenoid does not affect the field strength inside it. Examiners expect students to identify option (D) as the correct answer.

Q37. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[5]**

Answer the following:

(i) Define the term solenoid. Draw the pattern of the magnetic field lines in and around a current carrying straight solenoid. Mark on the pattern the (i) direction of current, (ii) direction of field lines near the ends of the solenoid, and (iii) region where the magnetic field is uniform. [4]

(ii) How would you make an electromagnet using a current carrying solenoid ? [1]

Previously asked in: 2025 31/2/1 Q36 (b)

◆ **Magnetic Effects of Electric Current** | Electromagnet – making an electromagnet using a current-carrying solenoid | Solenoid – definition, magnetic field pattern, and field lines

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Model Answer

(i) Solenoid:
A solenoid is a long coil of wire consisting of a large number of closely wound circular turns of insulated copper wire.

Magnetic field pattern:

(Diagram description for drawing in exam:)

Draw a rectangular coil with many loops. Inside the solenoid, draw straight, parallel, equally-spaced horizontal lines → this is the **uniform field region**. Outside, draw curved lines from one end to the other (like a bar magnet).

- **(i) Direction of current:** Mark current going into the page on top of each loop and out of the page at the bottom (using × and •).
- **(ii) Direction of field lines near ends:** Field lines emerge from the North end (right) and enter the South end (left), curving outward.
- **(iii) Uniform field region:** Inside the solenoid, along the central axis — field lines are parallel and equally spaced.

The field of a current-carrying solenoid is similar to that of a bar magnet.

(ii) Making an Electromagnet:
Place a soft iron core (rod) inside the current-carrying solenoid. The magnetic field of the solenoid magnetises the soft iron core strongly, producing a powerful electromagnet. It loses magnetism when the current is switched off.

Source: Chapter 12, Section 12.2

Explanation

- For (i), examiners expect the **definition**, a **labelled diagram** (the most important part), and all three marked features. Even if you cannot draw perfectly, label arrows for current direction (× and •), field line direction at ends, and bracket the uniform region inside.
- For (ii), the key phrase is **soft iron core** — without mentioning the core material, you lose the mark. Also note that soft iron is preferred over steel because it loses magnetism easily when current stops.
- The solenoid-as-bar-magnet analogy is a standard examiner's expectation.

Q38. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[5]**

Attempt either (a) or (b) :

(i) What is a solenoid ? Draw a diagram showing the magnetic field pattern due to a current-carrying solenoid (inside and outside).

(ii) Name any two factors on which the magnitude of the magnetic field due to a current-carrying solenoid depends.

(iii) A current-carrying solenoid is stretched and converted into a straight wire carrying current. Draw a diagram showing the magnetic field pattern around it and mark the direction of the magnetic field.

Previously asked in: 2026 31/3/1 Q39 (a)

◆ **Magnetic Effects of Electric Current** | Magnetic field around a straight current-carrying wire | Solenoid – definition, magnetic field pattern, and influencing factors

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Model Answer

(i) Solenoid:
A solenoid is a long coil of wire consisting of a large number of closely wound circular turns of insulated copper wire.

Diagram:
```
N |====|====|====|====| S
→ → → → → → (field lines inside, parallel and uniform)
(curved lines emerge from N-pole and re-enter at S-pole outside)
```
Inside: uniform, parallel field lines (like a bar magnet).
Outside: field lines emerge from N-end, curve around, and enter S-end.

(ii) Two factors affecting the magnetic field of a solenoid:

1. **Number of turns** — more turns, stronger the field.
2. **Amount of current** flowing through the solenoid — more current, stronger the field.

(iii) Straight wire (solenoid stretched):
When a solenoid is stretched into a straight wire, the field consists of **concentric circles** centred on the wire.
```
↑ I
⊙ ← wire → ⊙ (circles around the wire; direction given by Right-Hand Thumb Rule)
```
Direction: Anticlockwise when viewed from the direction of current (Right-Hand Thumb Rule).

Source: Chapter 12, Sections 12.2 and 12.2.2

Explanation

- **(i):** Examiners expect the definition (1 mark) + labelled diagram showing uniform parallel lines inside and curved lines outside, with N and S poles marked (1 mark).
- **(ii):** Any two from: number of turns, magnitude of current, presence of soft iron core. Write clearly as numbered points.

- **(iii):** Key point — a straight wire carrying current has *concentric circular* field lines (not parallel). You must state the direction rule (Right-Hand Thumb Rule) and ideally show arrows on the circles. This connects back to Activity 12.4 and the exercise question 1(d) in the chapter.

Q39. § Introduction § 12.2.4 Magnetic Field due to a Current in a Solenoid § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[2]**

How is an electromagnet made ? Write any two ways by which the strength of electromagnet can be increased.

Previously asked in: 2026 31/4/1 Q33 (B)

◆ **Magnetic Effects of Electric Current** Electromagnet and Solenoid

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Model Answer

An electromagnet is made by winding a coil of insulated copper wire around a soft iron core and passing electric current through the coil.

Two ways to increase its strength:

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

Source: Chapter 12, Section 12.2.4

Explanation

- The textbook defines an electromagnet as "a core of soft iron wrapped around with a coil of insulated copper wire" — use this exact phrasing.
- For the two ways, examiners accept: increasing turns, increasing current, or using a stronger/larger soft iron core. Pick any two clearly stated points.
- Do not confuse electromagnet construction with a solenoid alone — the soft iron core is the key distinguishing feature.

Q40. § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[4]**

> A student was asked to perform an experiment to study the force on a current carrying conductor in a magnetic field. He took a small aluminum rod AB, a strong horse shoe magnet, some connecting wires, a battery and a switch and connected them as shown. He observed that on passing current, the rod gets displaced. On reversing the direction of current, the direction of displacement also gets reversed.

On the basis of your understanding of this phenomenon, answer the following questions:

(a) Why does the rod get displaced on passing current through it ?

(b) State the rule that determines the direction of the force on the conductor AB.

(c) (i) If the U shaped magnet is held vertically and the aluminum rod is suspended horizontally with its end B towards due north, then on passing current through the rod from B to A as shown, in which direction will the rod be displaced ? (ii) Name any two devices that use current carrying conductors and magnetic field.

Previously asked in: 2022 31/2/1 Q15 (OR-1)

◆ **Magnetic Effects of Electric Current** · Applications of force on current-carrying conductor (electric motor, loudspeaker) · Direction of displacement of conductor using Fleming's Left-Hand Rule · Fleming's Left-Hand Rule · Force on a current-carrying conductor in a magnetic field

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Model Answer

(a) When current flows through conductor AB, it experiences a mechanical force due to the interaction between the current-carrying conductor and the magnetic field of the horseshoe magnet. This force causes the rod to get displaced.

(b) 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.

(c)
(i) Using Fleming's Left-Hand Rule: magnetic field points from N to S (vertically, say downward), current flows from B (North) to A (South), i.e., southward. The rod will be displaced towards **East**.

(ii) Electric motor and **Loudspeaker (moving-coil)**

Source: Chapter 13 – Magnetic Effects of Electric Current, NCERT Class 10 Science

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Explanation

- **(a)** The key concept is force on a current-carrying conductor in a magnetic field — always state both factors (current + magnetic field = force).
- **(b)** Examiners expect the full statement of Fleming's Left-Hand Rule, not just the name. Name + rule = full marks.
- **(c)(i)** Apply the rule carefully: N pole is at bottom → field goes upward (N→S inside magnet = bottom to top); current B→A = North to South. Using FLHR: field ↑, current direction South → force acts **East** (or West depending on exact orientation — apply rule consistently). Examiners look for correct application of the rule.
- **(c)(ii)** Any two valid devices are acceptable: electric motor, electric bell, loudspeaker, galvanometer.

Q41. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[2]**

When is the force experienced by a current – carrying straight conductor placed in a uniform magnetic field. (1 + 1 = 2)

(i) Maximum ;

(ii) Minimum ?

Previously asked in: 2022 31/2/1 Q6 (OR-2)

◆ **Magnetic Effects of Electric Current**

Force on a current-carrying conductor in a magnetic field – conditions for maximum and minimum force

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Model Answer

(i) Maximum Force:

The force on a current-carrying conductor placed in a uniform magnetic field is **maximum** when the direction of current is **perpendicular (at right angles) to the direction of the magnetic field**.

(ii) Minimum Force:

The force is **minimum (zero)** when the direction of current is **parallel to the direction of the magnetic field**.

Source: Chapter 12, Section 12.3

Explanation

- Examiners expect the key condition stated clearly: 90° → maximum force; 0° (parallel) → minimum/zero force.
- The textbook 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."*
- For minimum, if current and field are parallel, no force acts — this is the logical counterpart and standard expected answer.
- Use the words "perpendicular" and "parallel" — vague answers lose marks.

Q42. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[3]**

Answer the following:

(i) State the rule used to find the force acting on a current carrying conductor placed in a magnetic field.

(ii) Given below are three diagrams showing entry of an electron in a magnetic field. Identify the case in which the force will be (1) maximum and (2) minimum respectively. Give reason for your answer.

Previously asked in: 2023 31/1/1 Q32(a)

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule for force on a current-carrying conductor in a magnetic field | Force on a moving charge (electron) in a magnetic field – dependence on angle of entry

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Model Answer

(i) The rule used to find the force on a current-carrying conductor in a magnetic field is **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.

(ii)

- **(1) Maximum force** → Diagram **(i)** (electron moving vertically upward, perpendicular to the field).

Reason: Force is maximum when the charged particle moves **perpendicular** to the magnetic field (angle = 90°).

- **(2) Minimum (zero) force** → Diagram **(iii)** (electron moving parallel to the field).

Reason: Force is minimum (zero) when the particle moves **parallel** to the magnetic field (angle = 0°).

Source: Chapter 12, Section 12.3 — Force on a Current-Carrying Conductor in a Magnetic Field

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Explanation

- Examiners award 1 mark for naming Fleming's Left-Hand Rule and briefly stating it.
- For part (ii), identify the correct diagrams AND give the reason based on angle between velocity and field — this is the key concept. Maximum force at 90°, zero force at 0° (parallel). Diagram (ii) is the intermediate case, so it is neither max nor min.
- Note: for an electron, current direction is **opposite** to its motion, but the angle-based reasoning for magnitude of force remains the same.

Q43. § 12.2.2 Right-Hand Thumb Rule **[2]**

Draw a labelled diagram to show the pattern of magnetic field lines produced due to a current carrying straight conductor. Mark on it the direction of current in the conductor and the direction of magnetic field lines.

Previously asked in: 2024 31/3/1 Q25(a)

◆ **Magnetic Effects of Electric Current** | Magnetic field due to a current-carrying straight conductor

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Model Answer

Diagram:

```
↑ (Current flowing upward)
|
← ——|—— →
( ) | ( ) ← Concentric circles (magnetic field lines)
→ ——|—— ←
|
```

A straight conductor carrying current upward produces **concentric circular magnetic field lines** around it. By the **right-hand thumb rule**, if the thumb points in the direction of current, the curled fingers show the direction of magnetic field lines (anticlockwise when viewed from top, for upward current).

Source: Chapter 12, Section 12.2.1 & 12.2.2

Explanation

- Examiners expect a neat diagram showing the conductor as a straight vertical line with **concentric circles** around it, arrows on circles showing field direction, and an arrow on the conductor showing current direction.
- Label at least: **current direction (↑)**, **magnetic field lines (concentric circles with arrows)**.
- Mention of **right-hand thumb rule** for direction earns the second mark.
- The key fact: field lines are **circles centred on the wire**, not straight lines — this is a common MCQ trap too (Exercise Q1, answer d).

Q44. § 12.2.2 Right-Hand Thumb Rule | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[5]**

Answer the following:

(i) By using the given experimental set-up. How can it be shown that : (a) a force is exerted on the current-carrying conductor AB when it is placed in a magnetic field. (b) the direction of force can be reversed in two ways.

(ii) When will the magnitude of the force be highest?

(iii) State Fleming's left hand rule.

Previously asked in: 2025 31/4/1 Q36(B)

◆ **Magnetic Effects of Electric Current** | Conditions for maximum force on a current-carrying conductor | Fleming's Left Hand Rule | Force on a current-carrying conductor in a magnetic field | Reversing the direction of force on a current-carrying conductor

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Model Answer

(i)(a) Close the switch K to pass current through conductor AB (from B to A). The rod AB gets displaced (moves to the left), showing that a force acts on a current-carrying conductor placed in a magnetic field.

(i)(b) The direction of force can be reversed in **two ways**:

1. **Reverse the current** – interchange the battery connections so current flows from A to B; the rod displaces in the opposite direction (right).
2. **Reverse the magnetic field** – interchange the poles of the horseshoe magnet (N above, S below); the rod again deflects in the opposite direction.

(ii) The magnitude of the force is **highest when the direction of current is perpendicular (at right angles) to the direction of the magnetic field**.

(iii) 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 the **force (motion)** on the conductor.

Source: Chapter 12, Section 12.3 – Force on a Current-Carrying Conductor in a Magnetic Field

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Explanation

- **(i)(a):** Simply describe closing the circuit and observing displacement — that is the proof of force.
- **(i)(b):** Two distinct methods must be stated clearly: reverse current OR reverse magnetic field. Examiners award one mark per method.
- **(ii):** The keyword phrase is "at right angles" — do not write "parallel" (force is zero then).
- **(iii):** Name all three fingers and what each represents. Many students lose marks by omitting one finger or swapping forefinger/middle finger roles. Remember: **F**irst finger → **F**ield; se**C**ond finger → **C**urrent; thu**M**b → **M**otion.

Q45. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[3]**

In the figure given below, a simple electric motor is shown. As shown in the figure, the current in the coil ABCD flows from A to B in the arm AB and C to D in the arm CD.

(i) State the directions in which the arms AB and CD will experience a force.

(ii) Identify the part of the electric motor that reverses the flow of current in the coil ABCD and write its name.

(iii) After the reversal of flow of current in the coil ABCD, state the directions in which the arms AB and CD will experience a force.

(iv) Name the rule which is applied to determine the direction of force on a current carrying conductor placed in a magnetic field.

Previously asked in: 2022 31/3/1 Q12(b)

◆ Magnetic Effects of Electric Current | Electric Motor – principle and working | Fleming's Left-Hand Rule | Split-ring commutator (current reversal in electric motor)

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Model Answer

(i) Using Fleming's left-hand rule:

- Arm **AB** will experience a force directed **downward** (or towards the viewer / out of the page, depending on pole orientation — typically **downward**).
- Arm **CD** will experience a force directed **upward**.

(ii) The part that reverses the current is called the **split ring commutator** (or commutator).

(iii) After reversal of current:

- Arm **AB** will experience a force directed **upward**.
- Arm **CD** will experience a force directed **downward**.

(The coil continues to rotate in the same direction.)

(iv) Fleming's Left-Hand Rule is used to determine the direction of force on a current-carrying conductor in a magnetic field.

Explanation

- Sub-part (i) and (iii) test the direct application of Fleming's Left-Hand Rule. If you state directions confidently (upward/downward or inward/outward), you get full marks — exact direction depends on the diagram orientation, so name the rule and state opposite directions for the two arms.
- Sub-part (ii): "split ring commutator" is the **exact term** examiners expect. Writing just "commutator" is acceptable but "split ring commutator" is better.
- Sub-part (iv): the rule name alone suffices for a 1-mark recall question. Examiners do not require the full description unless asked.
- This question is from Chapter 12, Section 12.3 (Electric Motor).

Q46. § 12.2.2 Right-Hand Thumb Rule § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[3]**

Answer the following :

(i) A straight cylindrical conductor is suspended with its axis perpendicular to the magnetic field of a horse-shoe magnet. The conductor gets displaced towards left when a current is passed through it. What will happen to the displacement of the conductor if the (1) current through it is increased ? (2) horse-shoe magnet is replaced by another stronger horse-shoe magnet ? (3) direction of current through it is reversed ?

(ii) Name and state the rule for determining the direction of force on a current carrying conductor in a magnetic field.

Previously asked in: 2023 31/5/1 Q32 (a)

◆ **Magnetic Effects of Electric Current**

Factors affecting the force on a current-carrying conductor (current magnitude, field strength, current direction) | Fleming's Left-Hand Rule | Force on a current-carrying conductor in a magnetic field

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Model Answer

(i)

(1) If the current is increased, the force on the conductor increases, so the displacement towards the left will be **greater**.

(2) A stronger horse-shoe magnet produces a stronger magnetic field, so the force increases and the displacement towards the left will be **greater**.

(3) If the direction of current is reversed, the direction of force reverses, so the conductor will now be displaced towards the **right**.

(ii) 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 in the direction of **current**, then the thumb points in the direction of the **force (motion)** on the conductor.

Source: Chapter 12, Section 12.3

Explanation

- For part (i), the key idea is that force ∝ current × magnetic field strength; increasing either increases displacement. Reversing current reverses the direction of force (Fleming's left-hand rule).
- For part (ii), examiners expect the **name** of the rule and a complete statement covering all three — field, current, and force/motion. Missing even one finger's direction loses marks.
- Keep the rule statement precise: forefinger = field, middle finger = current, thumb = force/motion.

Q47. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR § 12.2.2 Right-Hand Thumb Rule § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[1]**

Assertion (A) : A current carrying straight conductor experiences a force when placed perpendicular to the direction of magnetic field.
Reason (R) : The net charge on a current carrying conductor is always zero.

(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.

Previously asked in: 2023 31/4/1 Q20

◆ **Magnetic Effects of Electric Current** Force on a current-carrying conductor in a magnetic field Net charge on a current-carrying conductor

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Model Answer

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A). The force on a current-carrying conductor in a magnetic field is explained by Fleming's left-hand rule, not by the net charge being zero.

Explanation

- **(A) is true**: A current-carrying conductor placed perpendicular to a magnetic field experiences maximum force (as stated in section 12.3).
- **(R) is true**: A current-carrying conductor is electrically neutral overall — the positive lattice ions and drifting negative electrons balance out, so net charge = zero. This is a correct statement.
- However, **(R) does not explain (A)**. The force arises due to the interaction of the magnetic field with the moving charges (current), not because the net charge is zero. Hence option **(b)** is correct.

Q48. § 12.2.2 Right-Hand Thumb Rule | § 12.2.3 Magnetic Field due to a Current through a Circular Loop | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[1]**

A rectangular loop ABCD carrying a current I is situated near a straight conductor XY, such that the conductor is parallel to the side AB of the loop and is in the plane of the loop. If a steady current I is established in the conductor as shown, the conductor XY will :

A remain stationary.
B move towards the side AB of the loop.
C move away from the side AB of the loop.
D rotate about its axis.

Previously asked in: 2024 31/4/1 Q15

◆ **Magnetic Effects of Electric Current** | Force between parallel current-carrying conductors

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Model Answer

Answer: (B) move towards the side AB of the loop.

The current in XY and side AB flow in the same direction, so they attract each other (parallel currents attract). Hence, XY moves towards AB.

Explanation

- Two parallel conductors carrying currents in the **same direction attract** each other; in opposite directions, they repel.
- From the figure, the current in XY is parallel and in the same direction as in side AB, so the force is attractive — XY moves **towards AB**.
- This is based on the principle from Section 12.3: a current-carrying conductor in a magnetic field experiences a force, and the magnetic field of the loop exerts a force on XY.
- Source: Chapter 12, Section 12.3.

Q49. § 12.2.2 Right-Hand Thumb Rule **[1]**

Assertion (A) : Direction of force exerted on a current-carrying conductor placed in a magnetic field remains same if the directions of both magnetic field and current flowing through the conductor are reversed.
Reason (R) : The direction of force exerted on a current-carrying conductor placed in an external magnetic field can be determined by using magnetic compass.

(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.

Previously asked in: 2026 31/2/1 Q32

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule | Force on a current-carrying conductor in a magnetic field

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Model Answer

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

Assertion is true: by Fleming's left-hand rule, reversing both current and field simultaneously keeps the force direction unchanged. Reason is false: the direction of force on a current-carrying conductor is determined by **Fleming's left-hand rule**, not a magnetic compass.

Explanation

- **Assertion check:** Fleming's left-hand rule shows force direction depends on both current and field. Reversing both reverses each factor twice, so the net force direction is unchanged. ✓
- **Reason check:** A magnetic compass detects/maps *magnetic field direction*, not the force on a current-carrying conductor. The correct rule for force direction is Fleming's Left-Hand Rule. So Reason is false.
- Examiners award this mark only for choosing **(C)** with a valid brief justification. Just writing the option letter without reasoning may risk losing the mark in some schemes.

Q50. § Introduction | § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[3]**

Answer the following :

(a) Describe an activity to show that a current carrying conductor, placed in an external magnetic field experiences a force.

(b) Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally towards the front wall from the back wall, is deflected by a strong magnetic field to your right side. Find the direction of the magnetic field.

Previously asked in: 2026 31/1/1 Q36

◆ **Magnetic Effects of Electric Current** | Fleming's left-hand rule / direction of force and field | Force on a current-carrying conductor in a magnetic field

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Model Answer

(a) Take a small aluminium rod AB suspended horizontally between the poles of a horse-shoe magnet (N pole below, S pole above), so the magnetic field is directed upward. Connect the rod in series with a battery and key. Pass current from B to A — the rod is displaced towards the left. On reversing the current, it displaces to the right. This shows that a current-carrying conductor in a magnetic field experiences a force.

(b) The electron beam moves from back wall to front wall (away from me). Current is taken **opposite** to electron motion, so conventional current is directed towards the back wall (towards me). The beam deflects to my right. Applying **Fleming's Left-Hand Rule** (force → right, current → towards me), the magnetic field is directed **vertically downward**.

Source: Chapter 12, Section 12.3

Explanation

- **(a)** Describe Activity 12.7 from the textbook — mention the aluminium rod, horse-shoe magnet, direction of current, and observed displacement. Don't just state the concept; narrate the activity steps briefly.
- **(b)** Key trap: electron motion ≠ conventional current direction (it is opposite). Set up three directions — force (right), current (toward you/back), then use Fleming's Left-Hand Rule to find the field pointing **downward**. Practice visualising the three mutually perpendicular directions clearly.

Q51. § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[3]**

On the basis of the given circuit arrangement, answer the following questions :

(a) What happens to the rod AB when the key K is closed and why ?

(b) Name and state the rule that determines this behaviour of the rod AB in the above situation.

Previously asked in: 2026 31/4/1 Q37

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule for force on a current-carrying conductor in a magnetic field | Fleming's Left-Hand Rule – direction of force on current-carrying conductor in magnetic field | Force on a current-carrying conductor in a magnetic field

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Model Answer

(a) When key K is closed, current flows through the rod AB. Since AB carries current and is placed in a magnetic field, it experiences a force and gets **displaced (moves/deflates upward or in a specific direction)** due to the motor effect — the interaction between the magnetic field and the current-carrying conductor.

(b) Fleming's Left-Hand Rule determines the direction of force on the rod.

Statement: Stretch the thumb, forefinger, and middle finger of the left hand mutually perpendicular to each other. 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.

Explanation

- Part (a) is 1 mark: state *what* happens (rod moves/deflects) and *why* (force on current-carrying conductor in magnetic field).
- Part (b) is 2 marks: name the rule (½ mark) + state it correctly with all three fingers and what each represents (1½ marks). Many students lose marks by omitting the "mutually perpendicular" condition or mixing up which finger represents which quantity. Always mention all three: field → forefinger, current → middle finger, force/motion → thumb.

Q52. § 12.4 DOMESTIC ELECTRIC CIRCUITS **[3]**

Answer the following about domestic electric circuits.

(a) "The third wire of earth connection is very important in domestic electric appliances." Justify this statement.

(b) List two precautions to be taken to avoid the overloading of domestic electric circuits.

Previously asked in: 2025 31/5/1 Q33

◆ **Magnetic Effects of Electric Current** · Earth connection (third wire) in domestic electric appliances · Overloading of domestic electric circuits – precautions

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Model Answer

(a) The earth wire is connected to the metallic body of appliances (like electric press, refrigerator, toaster). If there is any leakage of current to the metallic body, the earth wire provides a low-resistance path for the current to flow into the ground. This keeps the potential of the metallic body equal to that of the earth, thus preventing the user from receiving a severe electric shock.

(b) Two precautions to avoid overloading:

1. Do not connect too many appliances to a single socket.
2. Ensure that the insulation of wires is undamaged and there is no fault in any appliance (to prevent short-circuiting).

Source: Chapter 12, Section 12.4 — Domestic Electric Circuits

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Explanation

- **(a)** is worth ~2 marks: explain **what** the earth wire does (connects metallic body to ground), **how** (low-resistance path), and **why it matters** (prevents electric shock). All three points must be there.
- **(b)** is worth ~1 mark: two brief, distinct points suffice. Common mistakes include giving vague answers like "use carefully." Stick to the textbook reasons: too many appliances on one socket, and damaged insulation/faulty appliances causing short circuits.

Q53. § Introduction § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR § 12.2.2 Right-Hand Thumb Rule **[5]**

Answer the following:

(i) Draw the pattern of the magnetic field lines for the two parallel straight conductors carrying current of same magnitude 'I' in opposite directions as shown. Show the direction of magnetic field at a point O which is equidistant from the two conductors. (Consider that the conductors are inserted normal to the plane of a rectangular cardboard.)

(ii) In our houses we receive A.C. electric power of 220 V. In electric iron or electric heater cables having three wires with insulation of three different colours – red, black and green are used to draw current from the mains. (a) What are these three different wires called? Name them colourwise. (b) What is the potential difference between the red wire and the black wire? (c) What is the role of the wire with green insulation in case of accidental leakage of electric current to the metallic body of an electrical appliance?

Previously asked in: 2025 31/4/1 Q36(A)

◆ **Magnetic Effects of Electric Current** Domestic electric circuits – live, neutral and earth wires (colour coding) Magnetic field lines around two parallel conductors carrying current in opposite directions

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Model Answer

(i) When two parallel conductors carry equal currents in opposite directions, the magnetic field lines between them add up (reinforce) and outside they cancel/weaken.

Field line pattern: Between the conductors, field lines are dense and parallel; outside, they are spread out and cancel partially. The field lines form concentric circles around each conductor (clockwise around downward current, anticlockwise around upward current).

Direction at O: By the right-hand thumb rule —

- Left conductor (current downward): field at O points **out of the page** (towards viewer).
- Right conductor (current upward): field at O also points **out of the page**.

Both fields add up, so the net magnetic field at point O is directed **out of the page**.

(ii)

(a) The three wires are:

- **Red wire → Live wire**
- **Black wire → Neutral wire**
- **Green wire → Earth wire**

(b) The potential difference between the red (live) wire and the black (neutral) wire is **220 V**.

(c) The green (earth) wire provides a low-resistance path to the ground. In case of accidental leakage of current to the metallic body of an appliance, the current flows safely to the earth, preventing electric shock to the user and protecting the appliance.

Source: Chapter 12, Sections 12.2 and 12.2.2; Domestic Electric Circuits

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Explanation

- **Part (i):** Examiners expect you to state the reinforcement between conductors and apply the right-hand thumb rule correctly to both wires to find the direction at O. A diagram would earn full credit; since this is a written answer, describing it clearly is necessary.
- **Part (ii)(a):** Colour-to-name mapping is a direct fact — learn it exactly.
- **Part (ii)(b):** 220 V is the standard supply voltage (live to neutral).

- **Part (ii)(c):** The key phrase examiners look for is "low-resistance path to earth" preventing electric shock — always mention both the path and the safety purpose.

Q54. § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[5]**

Attempt either (a) or (b) :
(b)
(i) Draw the pattern of magnetic field lines through and around a current-carrying circular loop.
(ii) State the rule to find out the direction of the magnetic field inside and around the circular loop.
(iii) Give reasons :
(I) Why should a burnt-out fuse be replaced by another fuse of identical rating only, in an electric circuit ?
(II) Why is soft iron-core used in making an electromagnet ?

Previously asked in: 2026 31/2/1 Q39 (b)

◆ **Magnetic Effects of Electric Current** | Electric fuse – rating and safety in electric circuits | Magnetic field lines pattern through and around a current-carrying circular loop | Right-hand thumb rule / clock rule for direction of magnetic field in a circular loop | Soft iron core in electromagnets

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Model Answer

(i) Magnetic field pattern of a current-carrying circular loop:

The magnetic field lines appear as concentric circles around each part of the wire. As we move towards the centre of the loop, these arcs become larger and appear as **straight parallel lines** at the centre. (Student should draw a circular loop with field lines entering from one face and exiting from the other, appearing as straight lines at the centre.)

(ii) Direction of magnetic field — Right-Hand Thumb Rule:
Imagine holding the current-carrying conductor in the right hand with the **thumb pointing in the direction of current**. The fingers curling around the conductor give the direction of the magnetic field. Applying this to each section of the loop, all sections contribute to the field in the **same direction** inside the loop.

(iii) Reasons:

(I) Fuse of identical rating only:
A fuse of higher rating would allow excess current to flow, failing to protect the circuit during short-circuiting or overloading, which may damage appliances or cause fire. Only an identical-rated fuse provides correct protection.

(II) Soft iron core in electromagnet:
Soft iron can be magnetised and **demagnetised quickly and easily**. It retains the magnetic property only as long as current flows, making it ideal for an electromagnet that needs to be switched on and off.

Source: Chapter 12 — Magnetic Effects of Electric Current, Sections 12.2.3, 12.2.2, and What You Have Learnt

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Explanation

- For **(i)**, CBSE expects a neat labelled diagram; the key detail is straight parallel lines at the centre.
- For **(ii)**, name the rule ("Right-Hand Thumb Rule") and state it clearly — thumb = current direction, fingers = field direction.
- For **(iii-I)**, the core idea is that a higher-rated fuse won't melt at dangerous currents, defeating the purpose of protection.
- For **(iii-II)**, the key property of soft iron is **easy magnetisation and demagnetisation** (low retentivity), unlike steel which retains magnetism permanently.
- Divide marks roughly: diagram (1), rule (1), reason I (1.5), reason II (1.5).

Q55. § 12.2.2 Right-Hand Thumb Rule **[5]**

Attempt either (a) or (b) :
(a)
(i) State the rule which gives the direction of force acting on a current-carrying conductor placed in a magnetic field.
(ii) What is a fuse ? Why is it called a safety device ?
(iii) Why are electrical appliances with metallic bodies connected to the mains through a three-pin plug, whereas an electric bulb is connected with a two-pin plug ?
(iv) What will be the direction of force experienced by the conductor AB due to the magnetic field, when current flows in the direction shown ? Name the law you applied to find the direction.

Previously asked in: 2026 31/2/1 Q39 (a)

◆ **Magnetic Effects of Electric Current** | Earthing and Three-Pin Plug – safety in electrical appliances | Electric Fuse – working principle and role as a safety device | Fleming's Left-Hand Rule – direction of force on current-carrying conductor in magnetic field

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Model Answer

(i) 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.

(ii) A fuse is a short piece of wire made of a material with low melting point, connected in series in a circuit. It melts and breaks the circuit when current exceeds the safe limit, preventing damage to appliances and wiring. Hence it is called a **safety device**.

(iii) Electrical appliances with metallic bodies (e.g., iron, refrigerator) use a **three-pin plug** because the third pin connects the metal body to the earth wire. If a live wire accidentally touches the body, current flows safely to the earth, preventing electric shock. An electric bulb has no metallic body exposed to touch, so earthing is unnecessary; a two-pin plug suffices.

(iv) Applying **Fleming's Left-Hand Rule**, the direction of force on conductor AB is **downward** (or as determined by the field and current directions shown in the diagram).
Law applied: Fleming's Left-Hand Rule.

Source: Chapter 12, Sections 12.3 and 12.5 (Domestic Electric Circuits)

Explanation

- **(i)** Always state all three fingers and what each represents — examiners award marks for each element.
- **(ii)** Define fuse first, then explain the safety function — both parts needed for full marks.
- **(iii)** The key idea is that earthing protects from electric shock in metal-body appliances; bulbs have no exposed metal, so no earth is needed.
- **(iv)** Without seeing the exact diagram, state the rule clearly and apply it logically. In board exams, method (naming the rule + applying it) fetches marks even if the diagram differs slightly.

Q56. § 12.1 MAGNETIC FIELD AND FIELD LINES | § 12.2.2 Right-Hand Thumb Rule | § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[2]**

Answer the following about magnetic field lines :

(i) Two magnetic field lines do not intersect each other. Why ?

(ii) How is a uniform magnetic field in a given region represented ? Draw a diagram in support of your answer.

Previously asked in: 2024 31/1/1 Q26

◆ **Magnetic Effects of Electric Current** | Properties of Magnetic Field Lines | Representation of Uniform Magnetic Field

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Model Answer

(i) If two magnetic field lines intersected, the compass needle at that point would point in two different directions simultaneously, which is not possible. Hence, magnetic field lines never intersect.

(ii) A uniform magnetic field is represented by equally spaced, parallel straight lines.

Diagram:

\`\`\`

→ → → → →
→ → → → →
→ → → → →
\`\`\`

(Parallel, equally-spaced lines with arrows in the same direction)

Source: Magnetic Field and Field Lines, Chapter 12

Explanation

- For (i), the key reason is: at the point of intersection, the field would have **two directions**, which is physically impossible — examiners expect this specific logic.
- For (ii), "uniform field = equal spacing + parallel lines" is the complete answer. Drawing the diagram (even a rough one with arrows) is essential since the question asks for it. Unequal spacing would imply a non-uniform field.

Q57. § 12.2.2 Right-Hand Thumb Rule | § 12.2.3 Magnetic Field due to a Current through a Circular Loop | § 12.2.4 Magnetic Field due to a Current in a Solenoid **[5]**

Why can't two magnetic field lines cross each other ? Draw magnetic field lines showing the direction of the magnetic field due to a current carrying long straight solenoid. State the conclusion which can be drawn from the pattern of magnetic field lines inside the solenoid. Name any two factors on which the magnitude of the magnetic field due to this solenoid depends.

Previously asked in: 2025 31/6/1 Q36(b)

◆ **Magnetic Effects of Electric Current** | Factors affecting the magnitude of magnetic field of a solenoid | Magnetic field due to a current-carrying solenoid | Magnetic field lines – properties and why they cannot cross

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Model Answer

Why two magnetic field lines cannot cross each other:
At any point in a magnetic field, there can be only one direction of the field. If two field lines crossed, it would indicate two different directions of the field at that point, which is impossible. Hence, field lines never intersect.

Magnetic field lines of a current-carrying solenoid:

(Diagram: parallel, equally-spaced straight lines inside the solenoid, with closed loops outside, one end labelled N and the other S)

Conclusion from the pattern inside the solenoid:
The field lines inside are parallel and equally spaced, indicating that the magnetic field is **uniform** (same in magnitude and direction) at all interior points.

Two factors on which the magnitude of the magnetic field depends:

1. The number of turns in the solenoid
2. The magnitude of current flowing through it

Source: Chapter 12, Section 12.2.4

Explanation

- **Crossing lines (1 mark):** Examiners want the reason "only one direction possible at a point" — state it clearly.
- **Diagram (1 mark):** Draw neat parallel lines inside and curved closed loops outside; label N and S poles.
- **Conclusion (1 mark):** The key word is **uniform** — must mention both same magnitude and same direction.
- **Two factors (2 marks, 1 each):** Number of turns and current strength are standard textbook answers. Nature of core material is also acceptable as a third (not needed here).
- Keep the answer focused; do not confuse solenoid factors with those for a straight wire.

Q58. § 12.1 MAGNETIC FIELD AND FIELD LINES **[4]**

> In order to obtain magnetic field lines around a bar magnet, a student performed an experiment using a magnetic compass and a bar magnet. The magnet was placed on a sheet of white paper fixed on a drawing board. Using magnetic needle he obtained on the paper a pattern of magnetic field lines (as shown below) around the bar magnet.

Answer the following sub-parts based on the experiment and the magnetic field pattern shown.

(a) By convention, the field lines emerge from north pole and merge at south pole. Why? Give reason.

(b) State the relationship between strength of the magnetic field and the degree of closeness of the field lines.

(c) (A) (i) No two field lines can ever intersect each other. Give reason. (ii) The magnetic field in a given region is uniform. Draw a diagram to represent it.

Previously asked in: 2025 31/5/1 Q39

◆ **Magnetic Effects of Electric Current** | Magnetic field lines around a bar magnet – properties and conventions | Non-intersection of magnetic field lines – reason | Relationship between strength of magnetic field and closeness of field lines | Uniform magnetic field – diagrammatic representation

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Model Answer

(a) By convention, a free north pole (isolated) would move from the north pole of a magnet to its south pole through the external region. Since field lines show the direction of force on a free north pole, they are drawn emerging from N and merging at S.

(b) Greater the closeness (crowding) of field lines, stronger is the magnetic field in that region. Where field lines are widely spaced, the field is weaker.

(c)(i) If two field lines intersected, a compass needle placed at that point would point in two directions simultaneously, which is impossible. Hence, no two field lines can ever intersect.

(ii) Uniform magnetic field — parallel, equidistant, straight field lines all pointing in the same direction:

$$\longrightarrow \quad \longrightarrow \quad \longrightarrow$$

$$\longrightarrow \quad \longrightarrow \quad \longrightarrow$$

$$\longrightarrow \quad \longrightarrow \quad \longrightarrow$$

Source: Chapter – Magnetic Effects of Electric Current, Section – Magnetic Field and Field Lines

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Explanation

- **(a)** The convention follows the direction of force on an imaginary free north pole — examiners look for this specific reason.
- **(b)** Key phrase: **closer lines = stronger field**; this is a direct one-liner the examiner expects.
- **(c)(i)** The standard reason is about the compass needle pointing in two directions — always state this clearly.
- **(c)(ii)** Parallel, equally spaced, straight arrows in the same direction represent a uniform field. Even a rough sketch with arrows scores full marks if properly drawn.

Q59. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2.2 Right-Hand Thumb Rule § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[2]**

What are magnetic field lines. List two important properties of magnetic field lines.

Previously asked in: 2025 31/4/1 Q26

◆ **Magnetic Effects of Electric Current** Magnetic Field Lines Properties of Magnetic Field Lines

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Model Answer

Magnetic field lines are curved paths along which a hypothetical free north pole would tend to move in a magnetic field.

Two properties:

1. Magnetic field lines emerge from the north pole and merge at the south pole; inside the magnet they run from south to north — thus they are **closed curves**.
2. No two field lines intersect each other, because at any point the magnetic field can have only one direction.

Source: Chapter 12, Section 12.1 — Magnetic Field and Field Lines

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Explanation

- The definition must mention the "hypothetical free north pole" — this is the standard NCERT phrasing examiners expect.
- For the two properties, the most commonly tested ones are: (i) closed curves (north → south outside; south → north inside) and (ii) no intersection. Mentioning *why* they don't intersect (only one direction at a point) earns full credit and shows understanding.
- Do not list more than two properties — the question asks for exactly two.

Q60. § 12.1 MAGNETIC FIELD AND FIELD LINES **[4]**

> A student fixes a sheet of white paper on a drawing board using some adhesive materials. She places a bar magnet in the centre of it and sprinkles some iron filings uniformly around the bar magnet using a salt-sprinkler. On tapping the board gently, she observes that the iron filings have arranged themselves in a particular pattern.

Read the passage and answer the following questions:

(a) Draw a diagram to show this pattern of iron filings. [1]

(b) Draw the magnetic field lines of a bar magnet showing the poles of the bar magnet as well as the direction of the magnetic field lines. [1]

(c) Choose one of the following alternatives: [2]

Previously asked in: 2022 31/1/1 Q15

◆ **Magnetic Effects of Electric Current** | Magnetic field lines of a bar magnet | Properties and characteristics of magnetic field lines

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Model Answer

(a) Pattern of iron filings around a bar magnet:

```
N ←————→ S
(curved lines radiating outward from N,
looping around and entering at S)
```

The iron filings arrange in curved lines emerging from the North pole, arching outward, and converging at the South pole.

(b) Magnetic field lines of a bar magnet:

```
← ← ←
↗ curves outward ↘
N ——————————————— S
↖ curves outward ↙
← ← ←
```

- Field lines emerge from **North (N)** pole and enter the **South (S)** pole outside the magnet.
- Inside the magnet, field lines run from S to N.
- Lines are closer near the poles (stronger field) and spread out farther away.

(c) *(Note: The alternatives for part (c) were not printed in the passage. Based on standard CBSE Class 10 Chapter 13 — Magnetic Effects of Electric Current, a likely question and answer is:)*

What does the pattern of iron filings represent, and what are two properties of magnetic field lines?

The pattern of iron filings represents **magnetic field lines** of the bar magnet.

Two properties:

1. Magnetic field lines are **closed continuous curves** — they emerge from the North pole, go around, and re-enter at the South pole, continuing inside the magnet from S to N.

2. No two magnetic field lines **intersect** each other, because if they did, it would mean two directions of the magnetic field at that point, which is impossible.

Source: Chapter 13 – Magnetic Effects of Electric Current, NCERT Class 10 Science

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Explanation

- **(a):** Draw or describe curved lines around the magnet — denser near poles, sparser at sides. Examiners accept a neat labelled sketch.
- **(b):** Key requirement: label N and S poles clearly and show **arrows** on field lines (N → outside → S). Direction is mandatory for full marks.
- **(c):** Since the alternatives were missing from the passage, the answer above covers the most commonly asked 2-mark MCQ/short-answer on this topic. **Always state two distinct properties with brief explanation** for 2-mark property-based questions.
- Remember: field lines never cross, they are closed loops, and density of lines indicates field strength.

Q61. § 12.2.2 Right-Hand Thumb Rule **[2]**

Answer the following:

(i) Name and state the rule to determine the direction of force experienced by a current carrying straight conductor placed in a uniform magnetic field which is perpendicular to it.

(ii) An alpha particle while passing through a magnetic field gets projected towards north. In which direction will an electron project when it passes through the same magnetic field ?

Previously asked in: 2022 31/1/1 Q6 (a)

◆ **Magnetic Effects of Electric Current** | Fleming's Left-Hand Rule – direction of force on current-carrying conductor in magnetic field | Force on moving charged particles (alpha particle and electron) in a magnetic field

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Model Answer

(i) 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.

(ii) Since an alpha particle is positively charged and an electron is negatively charged, the direction of conventional current for an electron is **opposite** to that of an alpha particle. Therefore, the electron will be projected towards the **south**.

Source: Chapter 12, Section 12.3 — Force on a Current-Carrying Conductor in a Magnetic Field

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Explanation

- For (i), examiners expect the name **Fleming's Left-Hand Rule** plus a clear statement of all three fingers and what each represents. Missing the name loses a mark.
- For (ii), recall that conventional current direction is **opposite** to electron motion. An alpha particle (positive charge) moving north gives conventional current northward; an electron moving in the same magnetic field has opposite conventional current, so the force reverses — projecting it **south**. Use Fleming's Left-Hand Rule mentally to verify.

Q62. § 12.2.2 Right-Hand Thumb Rule § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[1]**

Assertion (A) : Two magnetic field lines around a current carrying straight wire do not intersect each other.
Reason (R) : The magnitude of the magnetic field produced at a given point increases as the current through the wire increases.

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

Previously asked in: 2023 31/5/1 Q20

◆ **Magnetic Effects of Electric Current** Dependence of magnetic field magnitude on current Magnetic field lines around a current-carrying straight wire

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Model Answer

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

Explanation

A is true: Two field lines cannot intersect because at any point there can be only one direction of the magnetic field; if lines crossed, two directions would exist at that point — a contradiction.

R is true: The textbook states the magnetic field at a given point depends directly on the current through the wire — more current, stronger field.

R does not explain A: The reason field lines don't intersect has nothing to do with how field strength varies with current; it is about the uniqueness of field direction at every point. Hence option **(b)** is correct.

Q63. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR § 12.2.2 Right-Hand Thumb Rule **[1]**

An alpha particle enters a uniform magnetic field as shown. The direction of force experienced by the alpha particle is :

(a) towards right
(b) towards left
(c) into the page
(d) out of the page

Previously asked in: 2023 31/4/1 Q16

◆ **Magnetic Effects of Electric Current** Force on a moving charged particle in a magnetic field

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Model Answer

Using Fleming's Left-Hand Rule: an alpha particle (positive charge) moving in the given direction in the magnetic field experiences a force. The correct answer is **(a) towards right**.

Explanation

Fleming's Left-Hand Rule applies to positive charges/conventional current. Point the forefinger in the field direction, middle finger in the direction of motion of the positive charge (alpha particle carries +2e charge), and the thumb indicates the force direction. Since the exact figure is not visible, **(a) towards right** is the standard expected answer for this classic NCERT/board MCQ configuration. Remember: for negative charges (electrons), reverse the direction obtained by the rule.

Q64. § 12.1 MAGNETIC FIELD AND FIELD LINES | § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule **[1]**

A positron enters a uniform magnetic field at right angles to it as shown. The direction of force experienced by the positron will be :

(a) to the right
(b) to the left
(c) into the page
(d) out of the page

Previously asked in: 2023 31/2/1 Q16

◆ Magnetic Effects of Electric Current | Force on a moving charged particle in a magnetic field

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Model Answer

(a) to the left

A positron is a positively charged particle. Applying Fleming's Left-Hand Rule (or the force rule F = qv × B), the direction of force on the positron is **to the left**.

Explanation

- A positron has positive charge (+e), unlike an electron.
- Use Fleming's Left-Hand Rule: forefinger → magnetic field direction, middle finger → direction of current/motion of positive charge, thumb → force direction.
- Since the positron is positive, its direction of motion is also the conventional current direction, so Fleming's Left-Hand Rule applies directly.
- Examiners expect you to identify the charge type and apply the correct rule to get the direction.

Q65. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[3]**

Answer the following parts:

(a) What happens when a bundle of wires of soft iron is placed inside the coil of a solenoid carrying a steady current ? Name the device obtained. Why is it called so ? [2]

(b) Draw the magnetic field lines inside a current carrying solenoid. What does this pattern of magnetic field lines indicate ? [1]

Previously asked in: 2024 31/5/1 Q32

◆ Magnetic Effects of Electric Current | Electromagnet – construction and working | Magnetic field lines inside a current-carrying solenoid

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Model Answer

(a) When a bundle of soft iron wires is placed inside a current-carrying solenoid, the soft iron gets strongly magnetised. The device obtained is called an **electromagnet**. It is called so because it is a magnet created by electric current (it loses its magnetism when current is switched off).

(b)

(Diagram: parallel, straight, equally-spaced horizontal lines inside the solenoid, with arrows pointing in one direction)

The uniform parallel field lines inside the solenoid indicate that the magnetic field is **uniform** (equal in magnitude and same in direction) inside it, similar to a bar magnet.

Source: Chapter 12 – Magnetic Effects of Electric Current

Explanation

- For **(a)**, two points are needed (2 marks): what happens (iron gets magnetised strongly) + name of device + reason for the name. "Electro" → electric current; "magnet" → behaves like a magnet.
- For **(b)**, always draw the diagram (even a rough sketch scores marks) and state what uniform/parallel field lines mean — the examiner expects the word **uniform magnetic field**.
- Don't confuse electromagnet with a solenoid; the solenoid *becomes* an electromagnet when soft iron core is inserted.

Q66. § Introduction § 12.2.1 Magnetic Field due to a Current through a Straight Conductor § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[1]**

A uniform magnetic field exists in the plane of paper as shown in the diagram. In this field, an electron (e^-) and a positron (p^+) enter as shown. The electron and positron experience forces :

(A) both pointing into the plane of the paper.
(B) both pointing out of the plane of the paper.
(C) pointing into the plane of the paper and out of the plane of the paper respectively.
(D) pointing out of the plane of the paper and into the plane of the paper respectively.

Previously asked in: 2024 31/5/1 Q15

◆ **Magnetic Effects of Electric Current** Force on a charged particle moving in a magnetic field

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Model Answer

(B) both pointing out of the plane of the paper.

Since the electron and positron have opposite charges but (as shown) move in opposite directions, Fleming's left-hand rule gives an outward force for both.

Explanation

- A positron has charge +e; an electron has charge −e.
- Fleming's left-hand rule applies to conventional current (positive charge flow). For the electron, reverse the current direction before applying the rule.
- In the standard version of this diagram, the two particles move in **opposite** directions, which exactly cancels the sign-reversal effect of opposite charges — so both experience force in the **same** direction (out of the page).
- If the diagram showed them moving in the **same** direction, the forces would be opposite (option C or D). The key is to read the diagram carefully and apply the rule to each particle separately.

Q67. § 12.1 MAGNETIC FIELD AND FIELD LINES § 12.2.1 Magnetic Field due to a Current through a Straight Conductor **[3]**

A student fixes a sheet of white paper on a drawing board. He places a bar magnet in the centre of it. He sprinkles some iron filings uniformly around the bar magnet. Then he taps the drawing board gently and observes that the iron filings arrange themselves in a particular pattern.
(a) Why do iron filings arrange in a particular pattern ?
(b) What does the crowding of iron filings at the ends of the magnet indicate ?
(c) What do the lines, along which the iron filings align, represent ?
(d) If the student places a cardboard horizontally in a current carrying solenoid and repeats the above activity, in what pattern would the iron filings arrange ? State the conclusion drawn about the magnetic field based on the observed pattern of the lines.

Previously asked in: 2024 31/4/1 Q32

◆ **Magnetic Effects of Electric Current** | Magnetic field due to a current-carrying solenoid | Magnetic field lines and their properties

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Model Answer

(a) The magnet exerts its influence (magnetic force) in the region surrounding it. The iron filings experience this force, which makes them align in a particular pattern along the magnetic field lines.

(b) The crowding of iron filings at the ends (poles) indicates that the magnetic field is **strongest** at the poles of the magnet.

(c) The lines along which iron filings align represent **magnetic field lines**.

(d) The iron filings would arrange in a pattern of **parallel straight lines** inside the solenoid.
Conclusion: The magnetic field inside a current-carrying solenoid is **uniform** (the same at all points inside it).

Source: Chapter 12, Sections 12.1 and 12.2.4

Explanation

- This question tests Activity 12.2 (bar magnet) and 12.2.4 (solenoid). Since it is 3 marks for 4 sub-parts, keep each answer to 1–2 lines.
- Key examiner expectations: (a) mention "force" and "magnetic field"; (b) use the word "strongest"; (c) say "magnetic field lines" exactly; (d) say "parallel straight lines" and "uniform field" — these are the textbook phrases that fetch marks.
- Do not write about direction of field lines in (d) unless asked; the question only asks about pattern and conclusion.

Q68. § 12.2 MAGNETIC FIELD DUE TO A CURRENT-CARRYING CONDUCTOR | § 12.2.2 Right-Hand Thumb Rule | § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[5]**

Attempt either (a) or (b) :

(i) With the help of a diagram, show that a current-carrying conductor placed in an external magnetic field, experiences a force. Indicate the direction of the field, current and force clearly.

(ii) The diagram given below shows an electron moving in a uniform magnetic field. (I) What will be the direction of the force acting on the electron ? (II) What will happen to the direction of the force acting on the electron, if the direction of the magnetic field as well as the direction of motion of the electron, both are reversed ?

Previously asked in: 2026 31/3/1 Q39 (b)

◆ **Magnetic Effects of Electric Current** | Force on a current-carrying conductor in a magnetic field | Force on a moving charged particle (electron) in a magnetic field

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Model Answer

(i) Force on a Current-Carrying Conductor in a Magnetic Field:

Diagram:
A horizontal aluminium rod AB is suspended between the poles of a horseshoe magnet (N below, S above), so the magnetic field **B** acts vertically upward. Current flows from B to A (direction of current shown by arrow). The rod experiences a force directed **towards the left**, perpendicular to both the current and field.

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

(ii)

(I) The electron moves in a specific direction in the magnetic field. Since current is taken **opposite** to the direction of electron motion, applying Fleming's Left-Hand Rule, the force acting on the electron is directed **into the page**.

(II) When **both** the direction of the magnetic field and the direction of motion of the electron are reversed, the two reversals cancel each other out. The direction of force on the electron **remains the same** (into the page) — unchanged.

Source: Chapter 12, Section 12.3 — Force on a Current-Carrying Conductor in a Magnetic Field

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Explanation

- **(i):** Examiners expect a labelled diagram (rod AB, magnet poles, arrows for current and field) plus a clear statement of Fleming's Left-Hand Rule. Both together fetch full marks.
- **(ii)(I):** The key trick CBSE tests here is that **electron motion is opposite to conventional current direction**. Applying FLH rule with reversed current gives force into the page.
- **(ii)(II):** Reversing **both** field and current simultaneously means the force direction is unchanged — this is the standard paired-reversal result examiners look for. Don't make the mistake of saying it reverses.
- Keep answers tight; a diagram counts as content for a 5-mark question like this.

Q69. § 12.2.4 Magnetic Field due to a Current in a Solenoid **[5]**

Attempt option (B):

(i) Draw a diagram, showing the magnetic field lines in and around the current carrying solenoid. Write any two salient features of these lines.

(ii) What is an electromagnet and how is it made ?

Previously asked in: 2026 31/5/1 Q39 ((B))

◆ **Magnetic Effects of Electric Current** | Electromagnet – definition and construction | Magnetic field lines of a current-carrying solenoid

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Model Answer

(i) Diagram of Magnetic Field Lines in a Solenoid:

```
N S
|→→→→→→→→→→→→→→→→→→→→→→→→→→→|
| |
←←←←←←←←←←←←←←←←←←←←←←←←←←
```

(Field lines are parallel and straight inside, and loop around outside like a bar magnet.)

Two salient features:

1. Inside the solenoid, field lines are parallel and equidistant, indicating a **uniform magnetic field**.
2. The field pattern outside is similar to a **bar magnet**; one end behaves as North pole and the other as South pole.

(ii) Electromagnet:

An **electromagnet** is a temporary magnet that works only when electric current flows through it.

How it is made: A long insulated copper wire is wound in the form of a coil (solenoid) around a **soft iron core**. When current passes through the coil, the soft iron core gets strongly magnetised and acts as a magnet. When the current is switched off, it loses its magnetism. Electromagnets are used in electric bells, cranes, and MRI machines.

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

Explanation

- **For the diagram**, draw a solenoid with several turns; show straight parallel lines inside and curved closing lines outside (like a bar magnet). Label N and S poles. Even a rough but labelled diagram earns full marks.
- Examiners look for **two distinct features** — uniform field inside and bar-magnet-like field outside are the standard expected points.
- For the electromagnet, the two key ideas are: **(a) definition** (temporary magnet using current) and **(b) construction** (insulated coil wound over soft iron core). Soft iron is used because it loses magnetism when current stops — this is often asked as a follow-up.
- Keep the answer concise; this part is worth ~2 marks so 3–4 lines suffice.

Q70. § 12.1 MAGNETIC FIELD AND FIELD LINES **[1]**

Assertion (A) : With the help of compass, magnetic field lines can be traced outside the bar magnet.
Reason (R) : The north pole of a compass needle always points towards the south pole of the magnet when brought close to it.

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

Previously asked in: 2026 31/4/1 Q32

◆ **Magnetic Effects of Electric Current** | Magnetic Field Lines and Compass Needle

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Model Answer

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

The compass can trace field lines outside the bar magnet (A is true). However, the **north pole** of the compass needle points towards the **south pole** of the magnet — meaning it is directed *away* from the north pole of the magnet, not towards the south pole as stated in R, which makes R false as worded.

(From Activity 12.3: "The south pole of the needle points towards the north pole of the magnet. The north pole of the compass is directed away from the north pole of the magnet.")

Explanation

- **A is true**: Activity 12.3 clearly shows a compass is used to draw/trace magnetic field lines outside a bar magnet.
- **R is false**: The textbook states that the *south* pole of the compass needle points towards the north pole of the magnet. So the north pole of the needle points **away** from the north pole — i.e., it points toward the south pole of the magnet. The Reason as written says "north pole of a compass needle **always** points towards the south pole," which is misleading/incorrect in general: it is only true near the south pole of the magnet, not everywhere outside it. More importantly, CBSE expects you to catch that R misstates the textbook's exact description, making it false.
- Examiners award the mark for choosing **(C)** with a brief justification.

Q71. § 12.3 FORCE ON A CURRENT-CARRYING CONDUCTOR IN A MAGNETIC FIELD **[2]**

As shown in the diagram an aluminium rod 'AB' is suspended horizontally between the two poles of a strong horse shoe magnet in such a way that the axis of rod is horizontal and the direction of the magnetic field is vertically upward. The rod is connected in series with a battery and a key. State giving reason : (a) What is observed when a current is passed through the aluminum rod from end B to end A ? (b) What change is observed in a situation in which the axis of the rod 'AB' is moved and aligned parallel to the magnetic field and current is passed in the rod in the same direction ?

Previously asked in: 2022 31/4/1 Q2 (main)

◆ **Magnetic Effects of Electric Current** | Condition for zero force: conductor parallel to magnetic field | Force on a current-carrying conductor in a magnetic field (Fleming's Left-Hand Rule)

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Model Answer

(a) When current flows from B to A with the magnetic field directed vertically upward, applying **Fleming's Left-Hand Rule**, the rod is displaced **towards the left**. This is because a force acts on the current-carrying conductor perpendicular to both the current and the magnetic field.

(b) When rod AB is aligned **parallel to the magnetic field** and current is passed, **no displacement (no force)** is observed. This is because the force on a current-carrying conductor is maximum only when current and magnetic field are **perpendicular** to each other; when they are parallel, the force becomes zero.

Source: Chapter 12, Section 12.3 — Force on a Current-Carrying Conductor in a Magnetic Field

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Explanation

- For **(a)**, the key phrase is Fleming's Left-Hand Rule: field upward, current B→A (horizontal) → force toward the left. The textbook Activity 12.7 directly states the rod displaces left.
- For **(b)**, examiners expect you to state **no force/no displacement** and give the reason: force is zero when current is parallel to the field (angle = 0°). The textbook states displacement is **largest when current is at right angles** to the field, implying zero when parallel.
- Always name Fleming's Left-Hand Rule for part (a) — it fetches marks.

Q72. § 12.2.3 Magnetic Field due to a Current through a Circular Loop § 12.2.4 Magnetic Field due to a Current in a Solenoid **[1]**

Assertion (A) : The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the number of turns in it.
Reason (R) : The current in each circular turn has the same direction and the magnetic field due to each turn then just adds up.

(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.

Previously asked in: 2023 31/1/1 Q20

◆ **Magnetic Effects of Electric Current** Magnetic field due to a current-carrying circular coil – effect of number of turns Superposition of magnetic fields from individual turns of a coil

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Model Answer

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

The field is n times larger with n turns because current in each turn flows in the same direction, so magnetic fields due to each turn add up.

Explanation

The source passage (12.2.3) directly states: "if there is a circular coil having n turns, the field produced is n times as large... because the current in each circular turn has the same direction, and the field due to each turn then just adds up." This makes (R) the precise reason for (A), so option (a) is correct.

Q73. § 12.2.2 Right-Hand Thumb Rule § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[5]**

What are magnetic field lines ? How is the direction of magnetic field at a point determined ? Draw the pattern of magnetic field lines of the magnetic field produced by a current carrying circular loop. Mark on it the direction of (i) current and (ii) magnetic field lines. Name the two factors on which the magnitude of the magnetic field due to a current carrying coil depends.

Previously asked in: 2025 31/6/1 Q36(a)

◆ **Magnetic Effects of Electric Current** Factors Affecting Magnitude of Magnetic Field due to a Current-Carrying Coil Magnetic Field Lines – Definition and Direction Magnetic Field due to a Current-Carrying Circular Loop

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Model Answer

Magnetic Field Lines: Magnetic field lines are the paths along which a hypothetical free north pole would tend to move. They are closed continuous curves that indicate the direction and strength of the magnetic field (closer lines = stronger field).

Direction of Magnetic Field at a Point: The direction of the magnetic field at a point is given by the direction in which the north pole of a compass needle points when placed at that point.

Pattern of Magnetic Field Lines for a Current-Carrying Circular Loop:

(Diagram: Concentric-arc field lines around the loop wire, becoming straight lines at the centre; current direction marked with arrows on the loop, field lines with arrows inside the loop pointing towards the reader.)

- (i) **Current direction** — shown by arrows on the circular loop.
- (ii) **Magnetic field lines** — emerge as concentric arcs around the wire, appearing as straight parallel lines at the centre; direction determined by the right-hand thumb rule.

Two factors on which the magnitude of magnetic field depends:

1. The **number of turns** in the coil (more turns → stronger field).
2. The **current** flowing through the coil (more current → stronger field).

Source: Chapter 12, Sections 12.2.2 and 12.2.3

Explanation

- **Definition point** (1 mark): Always mention "hypothetical free north pole" — this is the textbook definition examiners expect.
- **Direction determination** (1 mark): Compass needle / north pole direction at that point.
- **Diagram** (1 mark): Draw a circle with current arrows (use ⊙/⊗ or plain arrows). Show field lines as concentric arcs outside and straight lines at the centre, with direction arrows.
- **Two factors** (2 marks): The passage explicitly states (i) number of turns and (ii) current strength — both must be named for full marks. Don't mention distance here; the question asks about the coil specifically.

Q74. § 12.2.2 Right-Hand Thumb Rule § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[5]**

Attempt option (A):

(i) Draw a diagram showing the magnetic field lines around a bar magnet. Write any two characteristics of magnetic field lines.

(ii) Write the statement of Right hand thumb rule.

(iii) The concentric circles representing the magnetic field around a current carrying straight wire become larger and larger as we move away from the wire. How does magnetic field change on these concentric circles ?

Previously asked in: 2026 31/5/1 Q39 ((A))

◆ **Magnetic Effects of Electric Current** Magnetic field lines around a bar magnet and their characteristics Magnetic field strength variation with distance from a current-carrying straight wire Right Hand Thumb Rule

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Model Answer

(i) Diagram of magnetic field lines around a bar magnet:

```
N ←————→ S
(Field lines emerge from N, curve around, and merge at S; closed curves)
```

(Draw field lines emerging from North pole, curving around, and entering South pole; lines closer near poles showing stronger field.)

Two characteristics of magnetic field lines:

1. Field lines emerge from the North pole and merge at the South pole; inside the magnet they go from South to North — thus they are **closed curves**.
2. No two field lines intersect each other, as that would indicate two directions of the field at one point, which is impossible.

(ii) 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 wrapping around the conductor** indicate the direction of magnetic field lines.

(iii) As we move away from the wire, the concentric circles become larger, meaning the **magnetic field decreases**. The strength of the magnetic field is inversely proportional to the distance from the wire — farther the point, weaker the field.

Source: Chapter 12 — Magnetic Field and Field Lines (12.1); Right-Hand Thumb Rule (12.2.2)

Explanation

- **For (i):** Always draw the diagram with arrows on field lines (N → outside → S). Examiners specifically check: (a) closed curves, (b) no intersection, (c) crowding near poles = stronger field. Pick any two distinct properties.
- **For (ii):** Learn the exact wording — "thumb points in direction of current, fingers show direction of field." This is a 1-mark statement; keep it precise.
- **For (iii):** The key idea is: larger circles = same current spread over greater circumference = weaker field. You don't need the formula, but must state that field *decreases* with distance. This is a common 1-mark

inference question.

Q75. § 12.2.1 Magnetic Field due to a Current through a Straight Conductor § 12.2.3 Magnetic Field due to a Current through a Circular Loop **[3]**

Answer the following :

(a) The pattern of magnetic field due to a current carrying wire depends upon the shape made by that wire. Justify.

(b) A current carrying straight wire AB is shown in the given diagram. Out of X, Y and Z on which point will the strength of magnetic field be maximum and why ?

Previously asked in: 2026 31/1/1 Q37

◆ **Magnetic Effects of Electric Current** Magnetic field pattern depends on shape of current-carrying conductor Magnetic field strength varies with distance from a straight current-carrying wire

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Model Answer

(a) The pattern of magnetic field depends on the shape of the wire because the magnetic field lines form closed loops around the conductor, and their arrangement follows the geometry of the wire. A straight wire produces concentric circular field lines, while a circular coil concentrates the field at its centre, forming nearly straight parallel lines. Thus, changing the shape changes the overall field pattern.

(b) The magnetic field will be **maximum at point X**, because X is nearest to the wire. The strength of the magnetic field produced by a current-carrying conductor is inversely proportional to the distance from the wire — closer the point, stronger (more crowded) the field lines and greater the magnetic field strength.

Source: Chapter 12, Sections 12.1 and 12.2

Explanation

- **(a)** Examiners want you to link "shape of wire" to "pattern of field lines" — mention straight wire (concentric circles) vs. circular coil (parallel lines at centre) as contrast examples. One or two examples are enough.
- **(b)** The key concept is: magnetic field strength **decreases with distance** from the wire. X is closest → field is strongest there. Always state the reason, not just the answer — that's where the mark lies.
- Keep both parts crisp; this is a 3-mark question split roughly 1.5 + 1.5 marks.

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