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MAGNETIC EFFECT OF CURRENT
REVISION MODULE
CBSE-X

Topic Coverage: The revision module covers essential topics such as magnetic field and field lines, magnetic poles and their properties, electromagnets, electric motor, and electromagnetic induction – aligning with the CBSE Class 10 Physics curriculum.

Concise and Clear: The content is presented in a concise and clear manner, focusing on the most critical aspects of the Magnetic Effect of Current. It serves as an effective tool for quick revision before exams.

Important Formulas: The module includes a compilation of important formulas and equations related to the Magnetic Effect of Current. This aids in quick recall and application during problem-solving.

Application-Based Questions: Practice with a set of application-based questions to enhance your problem-solving skills and understand the real-world applications of magnetic effects of current.

Concept Reinforcement: Reinforce your understanding of the underlying concepts through targeted explanations and examples, ensuring a solid foundation in the Magnetic Effect of Current.

Exam-Style Questions: Familiarize yourself with the types of questions that could appear in the CBSE Class 10 Physics exam. Solve exam-style questions to refine your exam-taking strategies.

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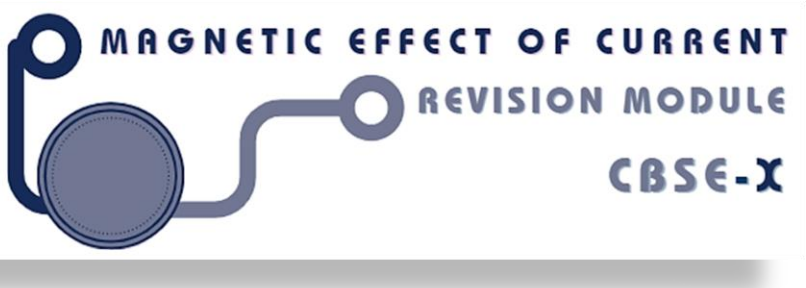

Syllabus

Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule, Electric Generator, Electromagnetic induction, Induced potential difference, Induced current, Fleming's Right Hand Rule, Electric Motor, Direct current, Alternating current: frequency of AC, Advantage of AC over DC. Domestic electric circuits.

Trend Analysis

List of Concepts	2018	2019		2020	
	OD/D	OD	D	OD	D
Magnetic effects of current		1 Q (5 M)	1 Q (5 M)		1 Q (5 M)
Electric motor, Electric Generator	1 Q (5 M)			1 Q (3 M)	1 Q (1 M)

TOPIC - 1
Magnetic Effects

Revision Notes

Magnet:

- The black ore of iron (Fe_3O_4) called magnetite, capable of attracting similar pieces of iron is called lodestone. They are naturally existing magnets used by human to find the directions.
- There are two poles of a magnet namely North pole and South pole. Like poles repel each other, while unlike poles attract each other.
- H.C. Oersted, a Danish physicist first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.
- Magnet is any substance that attracts iron or iron-like substances.
- **Properties of magnet**

  (i) Every magnet has two poles i.e., North and South.

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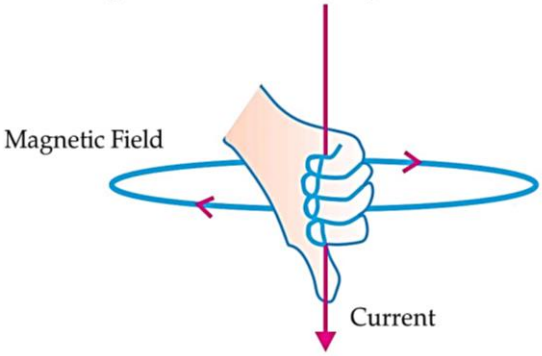
(ii) Like poles repel each other.

(iii) Unlike poles attract each other.

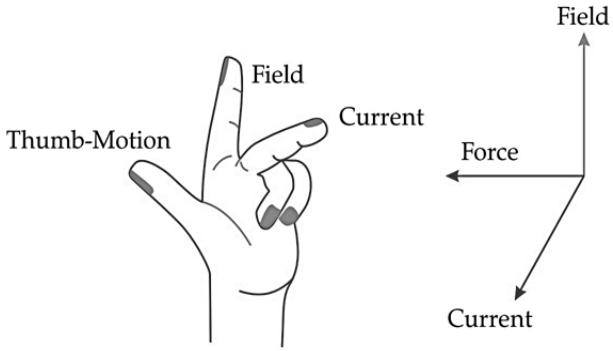
(iv) A freely suspended bar magnet aligns itself in nearly north-south direction, with its north pole towards north direction.

- The substances which are attracted by a magnet are called **magnetic substances**. **Examples:** Iron, nickel, cobalt, steel. The substances which are not attracted by a magnet are called **non-magnetic substances. Examples:** wood, glass, copper, aluminium, brass, paper etc.
- **Magnetic Field:** The area around a magnet in which its magnetic force can be experienced.
  - **(i)** Its SI unit is Tesla (T).
  - **(ii)** Magnetic field has both magnitude and direction.
  - **(ii)** Magnetic field can be described with help of a magnetic compass.
- **Magnetic needle:** The needle of a magnetic compass is a freely suspended bar magnet.
- **Characteristics of Field Lines**
  - **(i)** Field lines arise from North pole and end into South pole of the magnet.
  - **(ii)** Field lines are closed curves.
  - **(iii)** Field lines are closer in stronger magnetic field.
  - **(iv)** Field lines never intersect each other as for two lines to intersect, there must be two directions of magnetic field at a point, which is not possible.
  - **(v)** Direction of field lines inside a magnet is from South to North.
  - **(vi)** The relative strength of magnetic field is shown by degree of closeness of field lines.
- **Right Hand Thumb Rule:** Imagine you are holding a current carrying straight conductor in your right hand such that the thumb is pointing towards the direction of current. Then the fingers wrapped around the conductor give the direction of magnetic field.

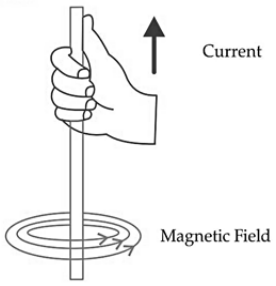


- **Magnetic Field Due to Current through a Straight Conductor**
  - It can be represented by concentric circles at every point on conductor.
  - Direction can be given by right hand thumb rule or compass.
  - Circles are closer near the conductor.
  - Magnetic field $\propto$ Strength of current
  - Magnetic field $\propto \dfrac{1}{\text{Distance from the conductor}}$
- **Magnetic Field Due to Current through a Circular Loop**
  - It can be represented by concentric circles at every point.
  - Circles become larger and larger as we move away.
  - Every point on wire carrying current would give rise to magnetic field appearing as straight line at centre of the loop.
  - The direction of magnetic field inside the loop is same.
- **Factors affecting magnetic field of a circular current carrying conductor**
  - **(i)** Magnetic field $\propto$ Current passing through the conductor
  - **(ii)** Magnetic field $\propto \dfrac{1}{\text{Distance from conductor}}$
  - **(iii)** Magnetic field $\propto$ No. of turns in the coil

- Magnetic field is additive in nature *i.e.*, magnetic field of one loop adds up to magnetic field to another loop. This is because the current in each circular turn has some direction.
- A coil of large number of turns closely wound on a hollow cylinder of insulated material or otherwise is called a **solenoid**. The end of the solenoid having clockwise current will act as south while on the other hand having anti-clockwise current will act as north pole. Thus, a solenoid acts as a normal magnet.
- **Permanent magnets:** They are made of carbon steel, chromium steel, tungsten steel and some alloys like Alnico and Nipermag. Alnico is an alloy of aluminium, nickel and cobalt. Nipermag is an alloy of iron that contains nickel, aluminium and titanium..
- When a material is placed inside a coil carrying current, it will get magnetised. A bunch of nails or an iron rod placed along the axis of the coil can be magnetised by the current when allowed to pass through the coil. Such magnets are called electromagnets.
- **Ampere** suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B, then the force experienced is given by $F = IBl \sin\theta$, where θ is the angle between the length of the conductor and magnetic field.
- **Fleming's Left Hand Rule:** Stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If fore finger points in the direction of magnetic field, middle finger in the direction of current then thumb will point in the direction of motion or force.



Mnemonics

Concept: **Right Hand Thumb Rule**	Concept: **Direction of field lines**
Mnemonics: **When current move upwards, wrap magnetic field**	Mnemonics: **O** Maria **M**r. **F**ox is moving from **N**orth to **S**outh
Interpretation: 	**Interpretation:** **O**utside **M**agnet **M**agnetic **F**ield **N**orth **S**outh

How is it done on the GREENBOARD?

Q. What is meant by solenoid? How does a current carrying solenoid behave?

Solution:

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

Step II: A current carrying solenoid behaves like a bar magnet.

Step III: To convert piece of soft iron into magnet.

Objective Type Questions — 1 mark each

A Multiple Choice Questions

Q. 1. Choose the incorrect statement from the following regarding magnetic lines of field :

(a) The direction of magnetic field at a point is taken to be the direction in which the north pole of a magnetic compass needle points.

(b) Magnetic field lines are closed curves.

(c) If magnetic field lines are parallel and equidistant, they represent zero field strength.

(d) Relative strength of magnetic field is shown by the degree of closeness of the field lines. [NCERT Exemp.]

Ans. Correct option : (c)

Explanation : Magnetic field lines appear parallel when they are far from the magnet. But this does not mean that field strength is zero. No field line would be present where field strength becomes zero.

Q. 2. Which of the following correctly describes the magnetic field near a long straight current carrying wire?

(a) The field consists of straight lines perpendicular to the wire.

(b) The field consists of straight lines parallel to the wire.

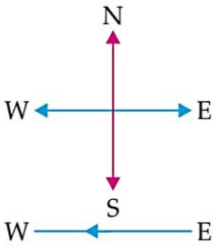
(c) The field consists of radial lines originating from the wire.

(d) The field consists of concentric circles centred on the wire. [NCERT Exemp]

Ans. Correct option : (d)

Explanation : The field consists of concentric circles centred on the wire. On applying right-hand thumb rule, we find the direction of magnetic field. The field is in the form of concentric circles centred on the wire carrying current.

Q. 3. A constant current flowing in a horizontal wire in the plane of the paper from East to West is shown in Figure. The direction of magnetic field at a point will be from North to South :



(a) directly above the wire.

(b) directly below the wire.

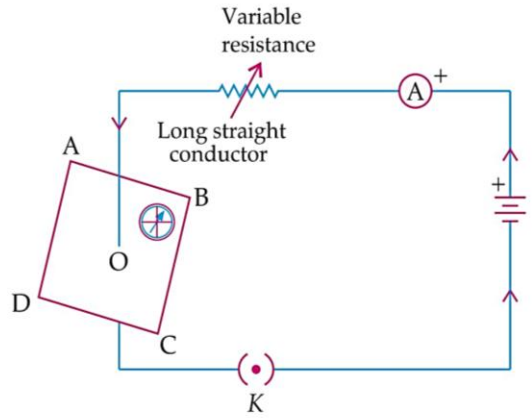
(c) at a point located in the plane of the paper, on the north side of the wire.

(d) at a point located in the plane of the paper, on the south side of the wire. [NCERT Exemp.]

Ans. Correct option : (b)

Explanation : Line WE shows a straight conductor through which current is moving from E to W. When seen from east, the magnetic field lines appear in clockwise direction, *i.e.* S to N above the wire and N to S below the wire. This is in accordance with right hand thumb rule.

Q. 4. If the key in the arrangement in the given Figure, is taken out (the circuit is made open) and magnetic field lines are drawn over the horizontal plane ABCD, the lines are :



(a) concentric circles.
(b) elliptical in shape.
(c) straight lines parallel to each other.
(d) concentric circles near the point O but of elliptical shapes as we go away from it. [NCERT Exemp.]

Ans. Correct option : (c)

Explanation : When the key is taken out, the circuit is open, no current flows and no magnetic field due to current carrying conductor. There exists only earth's magnetic field which will exhibit straight lines parallel to each other.

Q. 5. 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 field lines inside the solenoid are in the form of straight lines which indicates that the magnetic field is the same at all points inside the solenoid.
(b) The strong magnetic field produced inside the solenoid can be used to magnetise a piece of magnetic material like soft iron, when placed inside the coil.
(c) The pattern of the magnetic field associated with the solenoid is different from the pattern of the magnetic field around a bar magnet.
(d) The N and S-poles exchange position when the direction of current through the solenoid is reversed. [NCERT Exemp.]

Ans. Correct option : (c)

Explanation : A solenoid behaves like a bar magnet. Hence, the pattern of the magnetic field associated with the solenoid is same as the pattern of the magnetic field around a bar magnet.

Q. 6. The strength of magnetic field inside a long current carrying straight solenoid is :

(a) more at the ends than at the centre
(b) minimum in the middle
(c) same at all points
(d) found to increase from one end to the other [NCERT Exemp.]

Ans. Correct option : (c)

Explanation : Magnetic field lines are straight and parallel inside the solenoid. This indicates a same magnetic field. Hence, inside the solenoid, the magnetic field is same throughout.

B Assertions and Reasons Type Questions

Directions: In the following questions/a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(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.

Q. 1. Assertion (A): Two bar magnets attract when they are brought near to each other with the same pole.
Reason (R): Unlike poles will attract each other.

Ans. Correct option : (d)

Explanation: Two bar magnets repel when same poles face each other. Opposite poles attract each other.

Q. 2. Assertion (A): Magnetic field lines never intersect.
Reason (R): At a particular point magnetic field has only one direction.

Ans. Correct option : (a)

Explanation: Magnetic field lines never intersect each other as for two lines to intersect, there must be two north directions at a point, which is not possible.

Q. 3. Assertion (A): In Fleming's Left Hand Rule, the direction of magnetic field, force and current are mutually perpendicular.
Reason (R): Fleming's Left hand Rule is applied to measure the induced current.

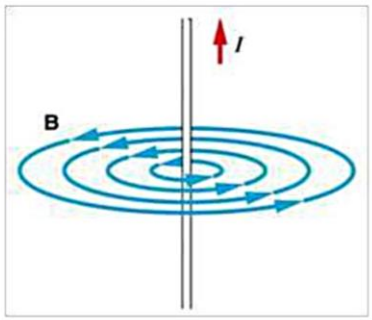
Ans. Correct option : (c)

Explanation: It is used to find the direction of force in a current carrying conductor in the presence of magnetic field.

C Very Short Answer Type Questions

Q. 1. Draw the magnetic field lines around a straight current carrying conductor. [SQP 2020]

Ans.



Q. 2. What is meant by magnetic field ?

R [Board Term-I, 2016] [DDE, 2017]

Ans. The region surrounding a magnet in which the force of the magnet can be detected is said to be its magnetic field. [CBSE Marking Scheme, 2016] 1

COMMONLY MADE ERROR

- Candidates generally get confused while indicating the direction of magnetic field.

ANSWERING TIP

- Carefully apply right hand thumb rule.

AI **Q. 3. Why are magnetic field lines more crowded towards the pole of a magnet ?**
AE [Board Term I, 2016]

Ans. The magnet is stronger at the poles so the magnetic field lines are crowded at the poles. **1**
[CBSE Marking Scheme, 2016]

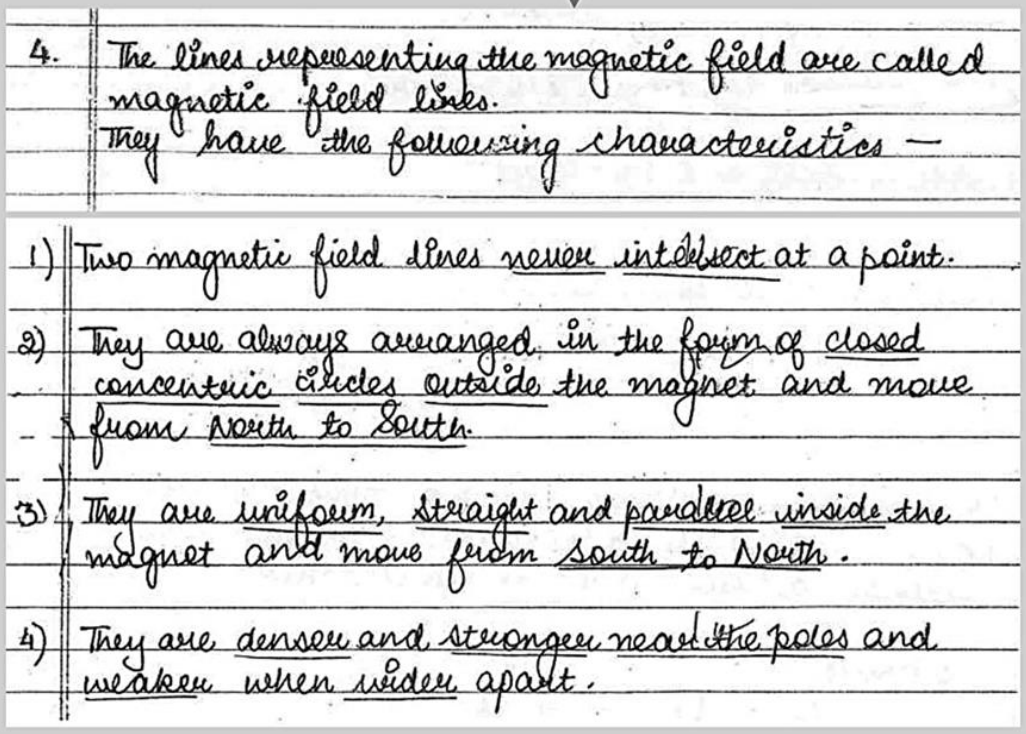
Q. 4. Why does a compass needle show deflection when brought near a current carrying conductor ?
U [Board Term I, 2016]

Ans. Due to production of magnetic field around the current carrying conductor. **1**
[CBSE Marking Scheme, 2016]

Short Answer Type Questions-I — 2 marks each

Q. 1. List four properties of magnetic field lines. R [CBSE Delhi, 2019]

Topper Answer, 2019


4. The lines representing the magnetic field are called magnetic field lines.
They have the following characteristics —

1) Two magnetic field lines never intersect at a point.

2) They are always arranged in the form of closed concentric circles outside the magnet and move from North to South.

3) They are uniform, straight and parallel inside the magnet and move from South to North.

4) They are denser and stronger near the poles and weaker when wider apart.

Q. 2. State any two factors on which the magnetic field produced by a current carrying straight conductor depends.
Mention the rule which helps to find the direction of its magnetic field. U

Ans. Factors on which the magnetic field produced by a current carrying conductor depends:
(i) Strength of current passing through the conductor. ½
(ii) Distance of the point of measurement from the conductor. ½
Right Hand Thumb Rule gives the direction of magnetic field. **1**

Q. 3. An alpha particle is placed in a magnetic field. Will it experience any force, if: C
(i) It moves in the magnetic field parallel to field lines.
(ii) It moves in the magnetic field perpendicular to field lines.

Ans. (i) No, because, the force is zero if current and field are in the same direction.
(ii) Yes, because, the force is maximum when current and magnetic field are perpendicular. **1+1**

Short Answer Type Questions-II — 3 marks each

AI **Q. 1. What is meant by solenoid ? How does a current carrying solenoid behave ? Give its main use.**
R [Board Term I, 2016]

Ans. Solenoid is a closely wound cylindrical coil of insulated metallic wire wrapped closely in the shape of a cylinder. A current carrying solenoid behaves as an electromagnet. The uniform magnetic field inside it may magnetise a steel rod permanently.
[CBSE Marking Scheme, 2016] **3**

Detailed Answer:

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

The field lines around a current-carrying solenoid is similar to that produced by a bar magnet. This means that a current carrying solenoid behaves as a magnet having north pole and south pole.

The strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material like soft iron when placed inside the coil.

COMMONLY MADE ERROR

- Students often forget to write "insulated" metallic wire.

ANSWERING TIP

- Metallic wire used for solenoid should be always "insulated".

Q. 2. Name, state and explain with an example the rule used to determine the direction of force experienced by a current carrying conductor placed in a uniform magnetic field. AE [Board Term I, 2016]

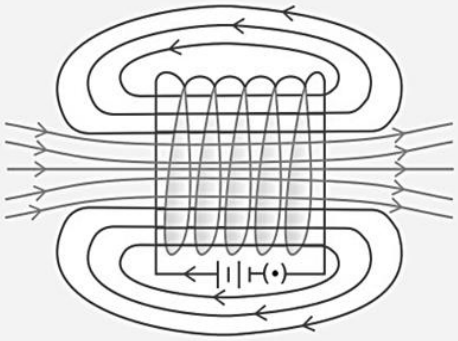
Ans. Fleming's Left Hand Rule: The direction of force which acts on the current carrying conductor placed in a magnetic field is given by Fleming's left hand rule. It states that if the forefinger, thumb and middle finger of left hand are stretched mutually perpendicular and if the forefinger point along the direction of external magnetic field, middle finger indicates the direction of current, then thumb points along the direction of force acting on the conductor.
Example: When an electron enters a magnetic field at right angles, the direction of force on electron is perpendicular to the direction of magnetic field and current according to this rule. **3**

Q. 3. Can a freely suspended current carrying solenoid stay in any direction ? Justify your answer. What will happen when the direction of current in the solenoid is reversed ? Explain.
C [Board Term- I, 2016]

Ans. A current carrying solenoid behaves like a magnet. When suspended freely, it will stay in north - south direction.
On reversing current its polarity will be reversed and so it will turn at 180°. **1 + 1 + 1**
[CBSE Marking Scheme, 2016]

Q. 4. What is solenoid? Draw the field lines of the magnetic field produced on passing current through and around a current carrying solenoid.
A [DDE 2017] [Board Term-I, 2015]

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



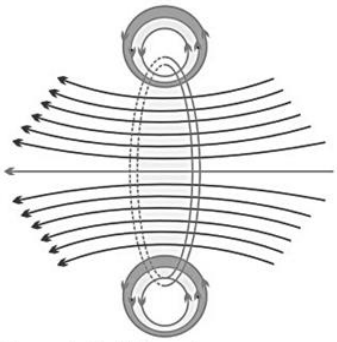
Magnetic field lines through and around a current carrying solenoid. **1½+1½**
[CBSE Marking Scheme,2015]

Long Answer Type Questions — 5 marks each

Q. 1. (i) Explain with the help of the pattern of magnetic field lines the distribution of magnetic field due to a current carrying a circular loop. C **3**

(ii) Why is it that the magnetic field of a current carrying coil having *n* turns, is '*n*' times as large as that produced by a single turn (loop) ? U **2**
[CBSE 2020 Delhi Set-3]

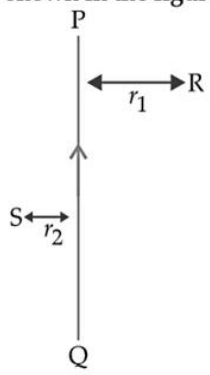
Ans. Magnetic field due to current through a circular Loop: It can be represented by concentric circle at every point. Circles become larger and larger as we move away. Every point on wire carrying current would rise to magnetic field appearing as straight line at centre of the loop. The direction of magnetic field inside the loop is same.



Magnetic field lines due to a current through a circular loop 3

Magnetic field is directly proportional to number of turns (n) in the coil. As the number of turns (n) in the coil increase, the magnetic strength at the centre increases, because the current in each circular turn is having the same direction, thus the field due to each turn adds up. 2

Q. 2. PQ is a current carrying conductor in the plane of the paper as shown in the figure below.



(i) Find the directions of the magnetic fields produced by it at points R and S? 1

Given $r_1 > r_2$, where will the strength of the magnetic field be larger? Give reasons.

(ii) Field strength are which point will be greater? 1

(iii) If the polarity of the battery connected to the wire is reversed, how would the direction of the magnetic field be changed? 1

(iv) Explain the rule that is used to find the direction of the magnetic field for a straight current carrying conductor. A [SQP 2020] **2**

Ans. (i) The magnetic field lines produced is into the plane of the paper at R and out of it at S. **1**

(ii) Field at S > Field at P. Magnetic field strength for a straight current carrying conductor is inversely proportional to the distance from the wire. **1**

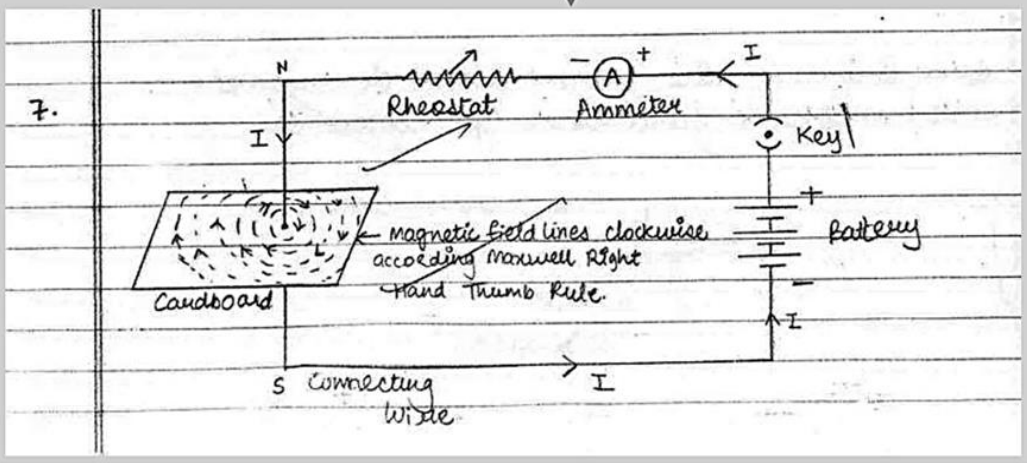
(iii) The current will be going from top to bottom in the wire shown and the magnetic field lines are now in the clockwise direction on the plane which is perpendicular to the wire carrying current. **1**

(iv) Right hand thumb rule. The thumb is aligned to the direction of the current and the direction in which the fingers are wrapped around the wire will give the direction of the magnetic field. **2**

Q. 3. Draw the pattern of the field lines of the magnetic field around a current carrying straight conductor passing through and held perpendicular to a horizontal cardboard. State right-hand thumb rule and explain how this rule is useful to determine the direction of the magnetic field in the above case, if the direction of current in the conductor is vertically downwards.

C [CBSE Delhi, 2019]

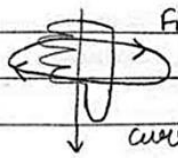
Topper Answer, 2019



Maxwell Right Hand Thumb Rule is used

It states that suppose you are holding a current carrying conductor in your right hand in such a way that ~~it points~~ your thumb points in the direction of the current.
Then the way or direction in which your fingers will encircle will give the direction of magnetic field lines.

As in this case, the current flows downwards, so the magnetic field lines go clockwise.

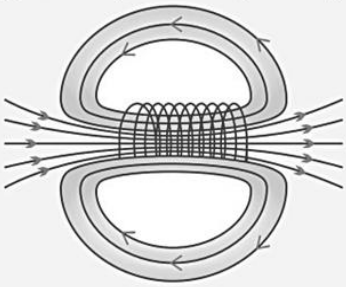


Q. 4. What is a solenoid ? Draw the pattern of magnetic field lines of (i) a current carrying solenoid and (ii) a bar magnet. List two distinguishing features between the two fields.

U [CBSE Board Delhi, Set- I, 2019]

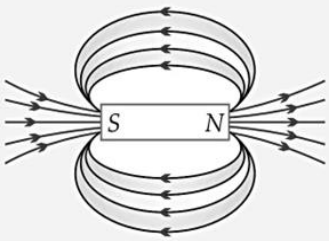
Ans. A coil of many turns of insulated copper wire wrapped closely in the shape of a cylinder. **1**

(i)



1

(ii)



1

Distinguishing features:

	Solenoid	Bar Magnet
1.	Field disappear on stopping the current.	No effect of current on field.
2.	Strength of the field can be changed by changing the current.	Strength cannot be changed.
3.	Direction can be reversed by changing the direction of current through it.	Direction is fixed and cannot be reversed.

(Any two features) 2

[CBSE Marking Scheme, 2019]

Q. 5. Draw the pattern of magnetic field lines produced around a current carrying straight conductor passing perpendicularly through a horizontal cardboard. State and apply right-hand thumb rule to mark the direction of the field lines. How will the strength of the magnetic field change when the point where magnetic field is to be determined is moved away from the straight conductor ? Give reason to justify your answer.

R [Board Outside Delhi, Set-I, 2019]

Ans.

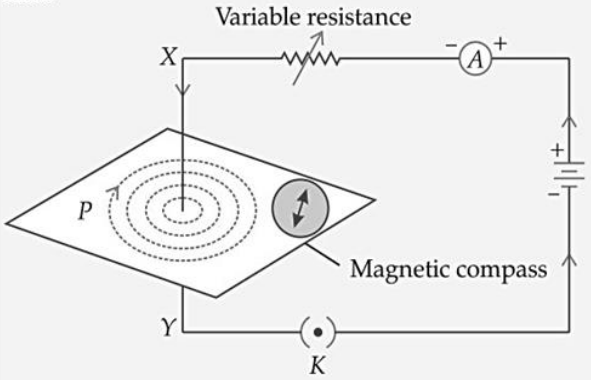


Diagram 1½ and direction ½

Statement of right hand thumb rule. **1 + 1**

The magnetic field strength decreases with increase of distance from the current carrying conductor.**1**

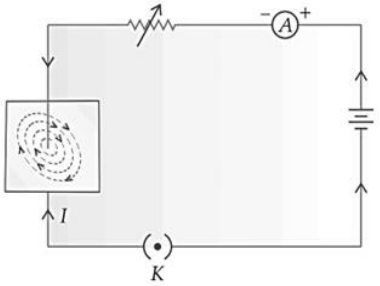
Reason: There is inverse relation between field strength and distance from current carrying conductor. **1**

Note: Direction of magnetic field should be in accordance with direction of current. **1**

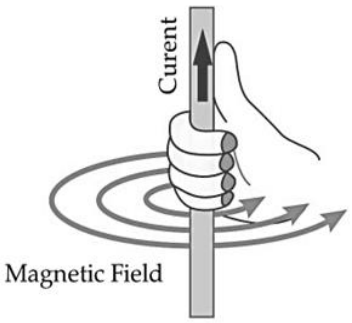
[CBSE Marking Scheme, 2019]

Detailed Answer:

Pattern of magnetic field lines produced around a current carrying straight conductor:



Right-hand thumb rule: If we are holding a current carrying straight conductor in right hand such that the thumb points towards the direction of current, then, the fingers will wrap around the conductor in the direction of the field lines of the magnetic field.



As the compass is placed farther, deflection in the needle decreases. Thus, the magnetic field produced by given current decreases as the distance from it increases. The concentric circles around the wire become larger as we move away from it.

Q. 6. (a) What are magnetic field lines ? How is the direction of magnetic field at a point in a magnetic field determined using field lines ?

(b) Two circular coils 'X' and 'Y' are placed close to each other. If the current in the coil 'X' is changed, will some current be induced in the coil 'Y' ? Give reason.

(c) State 'Fleming's right hand rule".

R [Delhi Comptt., 2018]

Ans. (a) Magnetic field line: Path along which a hypothetical free north pole would tend to move. **1**

Direction of magnetic field are a point is determined By drawing a tangent to the magnetic field line at that point **1**

(b) Yes. **1**

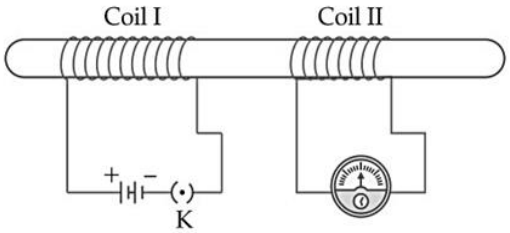
With change in current in the coil X, the magnetic field associated with it also changes around the coil Y placed near it. This change in magnetic field induces a current in the coil Y. **1**

(c) Fleming's right hand rule

Stretch the thumb, forefinger and middle finger of right hand so that they are perpendicular to each other. If the forefinger indicates the direction of the magnetic field and the thumb shows the direction of motion of the conductor, then the middle finger will show the direction of induced current in the conductor. **1**

Q. 7. (i) With the help of an activity, explain the method of inducing electric current in a coil with a moving magnet. State the rule used to find the direction of electric current thus generated in the coil.

(ii) Two circular coils-1 and coil-2 are kept close to each other as shown in the diagram. Coil-1 is connected to a battery and key and coil-2 with a galvanometer. State your observation in the galvanometer:



(a) When key *k* closed ;

(b) When key *k* is opened;

Give reason for you observations.

U [SQP, 2018]

Ans. (i)

(ii) (a) The galvanometer needle deflects momentarily in one direction because when the key is closed, magnetic field lines around coil-2 increases momentarily that causes induced current in coil-2.

(b) The galvanometer needle deflects momentarily but in opposite direction because when the key is opened, magnetic field lines around coil-2 decreases momentary that causes induced current in coil-2.

[CBSE Marking Scheme, 2018]

Detailed Answer:

(i)
- Take two different coils of copper wire having large number of turns (say 50 and 100 turn respectively). Insert them over a non-conducting cylindrical roll.
- Connect the coil-1, having larger number of turns, in series with a battery and a plug key. Also connect the other coil-2 with a galvanometer as shown.
- Plug in the key. Observe the galvanometer. There is a deflection in its needle. You will observe that the needle of the galvanometer instantly jumps to one side and just as quickly returns to zero, indicating a momentary current in coil-2.
- Disconnect coil-1 from the battery. You will observe that the needle momentarily moves, but to the opposite side. It means that now the current flows in the opposite direction in coil-2.

(ii) Same as CBSE Marking Scheme. **3 + 2**

AI **Q. 8. What are magnetic field lines ? List three characteristics of these lines. Describe in brief an activity to study the magnetic field lines due to a current flowing in a circular coil.**

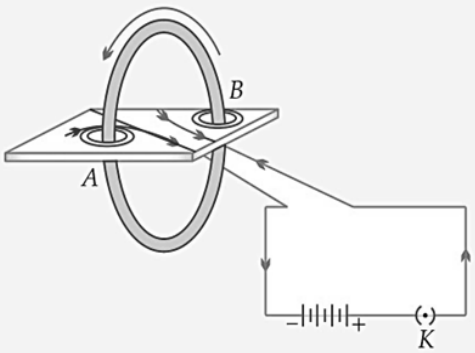
R [Board Term I, 2016]

Ans. Representation of the magnetic field path along which an imaginary free north pole would tend to move. The tangent at any point on the magnetic field line gives the direction of the magnetic field at that point.

(i) Emerge at north pole and merge at south pole. Inside the magnet, the direction of field lines is from south pole of magnet to its north pole and are closed curves.

(ii) At the points where the magnetic field is stronger, field lines are crowded and vice-versa.

(iii) No two magnetic field lines can intersect each other. **3**



2

[CBSE Marking Scheme, 2016]

(i) A rectangular cardboard having holes is used. A circular coil is passed through the holes. Coil is kept normal to the cardboard.

(ii) Ends of the coil is connected to a battery through a key.

(iii) Iron filings are sprinkled uniformly on the card board.

(iv) Key is plugged in.

(v) On tapping cardboard gently the iron filings get arranged in concentric circular loops around the holes on the cardboard indicating the magnetic field lines.

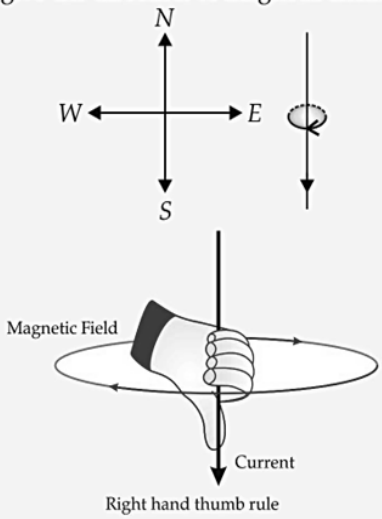
Q. 9. The magnetic field lines associated with current carrying straight conductor is in anti-clockwise direction. If the conductor was held horizontally along east-west direction, what is the direction of current through it ? Explain it with the help of diagram. Name and state the rule applied to determine the direction of magnetic field. If the conductor is held vertically and current flows from north to south, what will be the direction of magnetic field lines. Draw diagram.

U [Board Term I, 2016]

Ans. Direction of current will be from East to West direction.

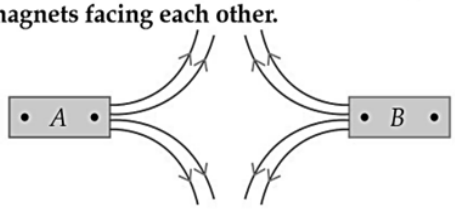
Maxwell's right hand thumb rule.

Statement: Imagine that you are holding the current carrying wire in your right hand so that your thumb points in the direction of current, then the direction of your fingers encircling the wire will give the direction of magnetic field.



[CBSE Marking Scheme, 2016] **5**

AI **Q. 10. (a) Magnetic field lines of two bar magnets A and B are as shown below. Name the poles of the magnets facing each other.** **1**



(b) Two magnetic field lines never intersect each other. Why ? **1**

(c) How does the strength of the magnetic field at the centre of a current carrying circular coil depend on the:

(i) Radius of the coil,
(ii) Number of turns in the coil, and
(iii) Strength of the current flowing in the coil ? 3

AE [Board Term I, 2016]

Ans. (a) North poles.

(b) Intersection of magnetic field lines at a point means two tangents can be drawn at that point and there will be two direction of a magnetic field which is not possible.

(c) (i) Inversely proportional; more radius, less strong magnetic field.

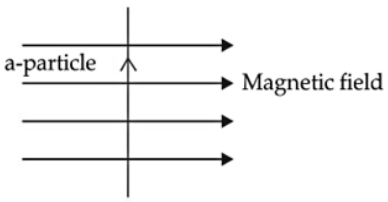
(ii) Directly proportional; more turns, more strong magnetic field.

(iii) Directly proportional; more strength of current, more strong magnetic field.

[CBSE Marking Scheme, 2016] **5**

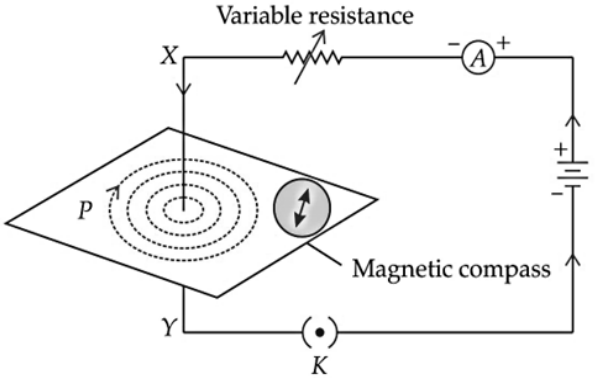
Q. 11. (i) Describe an activity to determine the direction of magnetic field produced by a current carrying straight conductor. Also show that the direction of the magnetic field is reversed on reversing the direction of current. 3

(ii) An α-particle, (which is a positively charged particle) enters a uniform magnetic field at right angles to it as shown below. Stating the relevant principle explain in which direction will this α-particle move ? U [Board Term I, 2016] **2**



Ans. (i) Take a battery (12 V), a variable resistance (or a rheostat), an ammeter (0 - 5A), a plug key and a long straight thick copper wire. Insert the thick wire through the centre, normal to the plane of a rectangular cardboard. Take care that the cardboard is fixed and does not slide up or down.

Connect the copper wire vertically between the points X and Y, in series with the battery, a plug and key. Sprinkle some iron filings uniformly on the cardboard. Keep the variable of the rheostat at a fixed position. Close the key, so that current flows through the wire. Ensure that the copper wire placed between the points X and Y remains vertically straight. Gently tap the cardboard for a few times. Observe the pattern of the iron filings. You would find that the iron filings align themselves showing a pattern of concentric circles around the copper wire. This represents the magnetic field around the current-carrying conductor. The direction of magnetic field changes on reversing the direction of current.



3

(ii) The alpha particle will move in a circular path. This is because a centripetal force acts on the particle due to the movement of particle in the magnetic field.

2

COMMONLY MADE ERROR

- Students often get confused about the motion of charged particle in magnetic field.

ANSWERING TIP

- Charged particles follow in circular path in magnetic field perpendicular point.

AI **Q. 12. (i) A coil of insulated copper wire is connected to a galvanometer. What happens if a bar magnet is:**
(a) Pushed into the coil ?
(b) Withdrawn from inside the coil ?
(c) Held stationary inside the coil ? Give reasons for your observation.
(ii) Mention one more method of inducing current in a coil. U [Board Term I, 2015]

Ans. (i) (a) When a bar magnet is pushed into the coil of insulated copper wire connected to a galvanometer, an induced current is set-up in the coil due to charge of magnetic field through it. As a result, galvanometer gives a deflection (say towards left) and returns to original position. **1½**

(b) When the bar magnet is withdrawn from inside the coil, again an induced current is set up in the coil due to charge of magnetic field through it. As a result galvanometer gives a deflection in the reverse direction (say towards right) and returns to original position. **1½**

(c) If the bar magnet is held stationary inside the coil, then there is no induced current in the coil, because there is no change in magnetic field through it. As a result, galvanometer does not show any deflection. **1**

(ii) By changing current in another coil placed near it. **1**

[CBSE Marking Scheme, 2015]

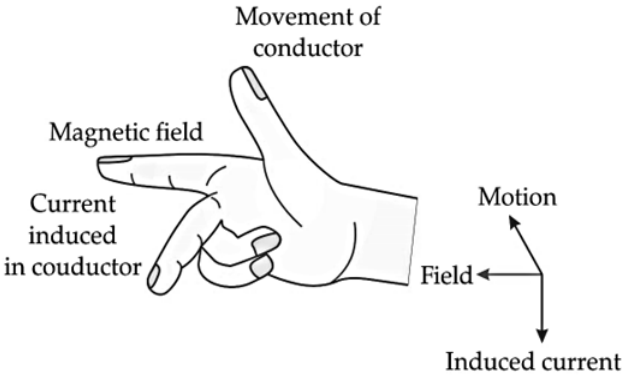
TOPIC - 2
Electric Generator and Electric Motor

Revision Notes

- **Electric motor:** It is a device used to convert electrical energy to mechanical energy. It works on the principle that force experienced by a current carrying conductor in a magnetic field.
- **Faraday's Law:** The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. More the rate, more the current and vice-versa.

$$I = \frac{Df}{R \times Dt} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

- **Fleming's Right Hand Rule:** Hold the thumb, the forefinger and the middle finger of right hand at right angles to each other. If the fore finger is in the direction of magnetic field and the thumb points in the direction of motion of conductor, then the direction of induced current is indicated by middle finger.



- **Electric Generator:** Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator produces unidirectional current.
- An electric circuit consists of three main wiring components:

  (i) Live wire (positive) with red insulation cover.

  (ii) Neutral wire (negative) with black insulation cover.

  (iii) Earth wire with green insulation cover.
- The potential difference between live and neutral wire in India is 220 V.
- Pole → Main supply → Fuse → Electricity meter → Distribution box → To separate circuits.

Mnemonics

Concept: **Electrical wiring**
Mnemonics: **R**are **L**awn **B**eautiful **N**ature **G**reen **E**arth
Interpretation: **R**ed: **L**ive **B**lack: **N**eutral **G**reen: **E**arth

How is it done on the GREENBOARD?

Q. It is necessary to connect an earth wire to electric appliance having metallic covers. Why?
How will you identify earth wire in household circuit?

Solution:

Step I: Earth wire is connected to a metalllic plate deep inside the earth so that its potential is equal to the earth's potential *i.e.* 0.

Step II: When the metallic cover of electric appliance is connected to the earth wire, the potential of the metal cover becomes 0. Hence if there is any leakage of current to the metallic cover it will go to the earth through the earth wire without passing through the user's body. Thus the user will be saved from getting electrical shock.

Step III: Identification of earth wire in household circuit is by its green insulation.

Objective Type Questions — 1 mark each

A Multiple Choice Questions

Q. 1. The phenomenon of electro-magnetic induction is :
(a) the process of charging a body.
(b) the process of generating magnetic field due to a current passing through a coil.
(c) producing induced current in a coil due to relative motion between a magnet and the coil.
(d) the process of rotating a coil of an electric motor. [NCERT Exemp.]

Ans. Correct option : (c)
Explanation : In electro-magnetic induction phenomenon, an induced current begins to flow in a coil whenever there is a change in magnetic field in and around a coil.

Q. 2. The device used for producing electric current is called a:
(a) generator **(b) galvanometer**
(c) ammeter **(d) motor** [NCERT Exemp.]

Ans. Correct option : (a)
Explanation : An A.C. generator is the device used for producing an electric current.

Q. 3. The essential difference between an AC generator and a DC generator is that:
(a) AC generator has an electro-magnet while a DC generator has permanent magnet.
(b) DC generator will generate a higher voltage.
(c) AC generator will generate a higher voltage.
(d) AC generator has slip rings while the DC generator has a commutator. [NCERT Exemp.]

Ans. Correct option : (d)
Explanation : AC generator has slip rings while the DC generator has a commutator.

Q. 4. Choose the correct option.
A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each:
(a) two revolutions.
(b) one revolution.
(c) half revolution.
(d) one-fourth revolution. [NCERT]

Ans. Correct option : (c)
Explanation : When a rectangular coil of copper wire is rotated in a magnetic field, the direction of the induced current changes once in each half revolution.

Q. 5. To convert an AC generator into DC generator :
(a) split-ring type commutator must be used.
(b) slip rings and brushes must be used.
(c) a stronger magnetic field has to be used.
(d) a rectangular wire loop has to be used. [NCERT Exemp.]

Ans. Correct option : (a)
Explanation : Split ring type commutator reverses the direction of current after each half turn of armature. This maintains a DC current.

Q. 6. Choose the incorrect statement :
(a) Fleming's right-hand rule is a simple rule to know the direction of induced current.
(b) The right-hand thumb rule is used to find the direction of magnetic fields due to current-carrying conductors.

(c) **The difference between the direct and alternating currents is that the direct current always flows in one direction, whereas the alternating current reverses its direction periodically.**

(d) **In India, the AC changes direction after every 1/50 second.** [NCERT Exemp.]

Ans. Correct option : (d)

Explanation : In India, the AC changes direction after every 1/100 second.

Q. 7. At the time of short circuit, the current in the circuit :

(a) **reduces substantially** (b) **does not change**

(c) **increases heavily** (d) **vary continuously**

[NCERT Exemp.]

Ans. Correct option : (c)

Explanation : At the time of short circuiting the live wire and the neutral wire come into direct contact. As a result, the current in the circuit increases abruptly..

Q. 8. The most important safety method used for protecting home appliances from short circuiting or overloading is :

(a) **Earthing** (b) **use of fuse**

(c) **use of stabilisers** (d) **use of electric meter**

[NCERT Exemp.]

Ans. Correct option : (b)

Explanation : A fuse is a short length of wire designed to melt in the event of excessive current flow.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(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.**

Q. 1. Assertion (A): Safety fuses are made up of materials having a low melting point.

Reason (R): Safety fuses should be resistant to electric current.

Ans. Correct option : (c)

Explanation: Safety fuses are made up of materials having a low melting point so that when excess current flow through the circuit, the fuse melts breaking the circuit and thus prevents appliances.

Q. 2. Assertion (A): Copper is used to make electric wires.

Reason (R): Copper has very low electrical resistance.

Ans. Correct option : (a)

Explanation: The low electrical resistance of copper makes it a good conductor for electricity.

Q. 3. Assertion (A): AC load line is used for long distance transmission.

Reason (R): It has very less loss of energy in long distance transmission.

Ans. Correct option : (a)

Explanation: It can be easily transmitted over long distance without much loss in energy.

Q. 4. Assertion (A): When two bulbs are operated on same voltage supply, having power 60 W and 100 W then 100 W bulb has less resistance than 60 W.

Reason (R): The power of the bulb is directly proportional to the square of the voltage.

Ans. Correct option : (b)

Explanation: Since, power (P) $= \frac{V^2}{R}$ or $R \propto \frac{1}{P}$

Hence, 100 W bulb has less resistance.

C Very Short Answer Type Questions

Q. 1. The change in magnetic field lines in a coil is the cause of induced electric current in it. Name the underlying phenomenon. C [CBSE 2020, Delhi]

Ans. Electromagnetic induction.

Q. 2. State an important advantage of using alternating current (a.c.) over direct current (d.c.).

U [CBSE 2020, Delhi]

Ans. Advantage of AC: It can be transmitted over long distance without much loss of energy.

Q. 3. Mention the colour convention for live, neutral and earth wires. R [Board Term-I, 2015]

Ans. Live wire — Red, Neutral Wire — Black, Earth wire — Green. [CBSE Marking Scheme, 2015] **1**

AI **Q. 4. What is the use of earth wire in domestic electric circuit?** R [Board Term I, 2012]

Ans. To ensure that any leakage of current to the metallic body of the appliance does not give shock to the user. [CBSE Marking Scheme, 2012] **1**

Short Answer Type Questions-I — 2 marks each

Q. 1. State any one point of difference in direct current and alternating current. Which current is most commonly produced at power stations in our country? R

Ans. Direct current does not change its direction with time whereas alternating current reverses its direction periodically. **1**

Most power stations produce AC in power station of India. **1**

Q. 2. State any one significance of the following devices in a domestic circuit: U
(i) Electric meter
(ii) Earthing

Ans. (i) Electric meter: It is used to record the consumption of electrical energy in kWh in the circuit. **1**

(ii) Earthing: It prevents electric shock. The earth-wire is joined to the metal case of the appliance and provides a low resistance conducting path for the current. **1**

Q. 3. An electric oven of power rating 2000W is used in an electric circuit of 220V. It has a fuse of 5A rating. What happens when the oven is switched on. Explain. C

Ans. Here, P = 2000 W, V = 220 V

Using P = VI

$$I = \frac{P}{V} = \frac{2000}{220} = \frac{100}{11} A = 9.09A$$

Since the current flowing through the oven is larger than the fuse rating (5 A), the fuse wire melts and breaks the circuit, thus protecting the circuit.

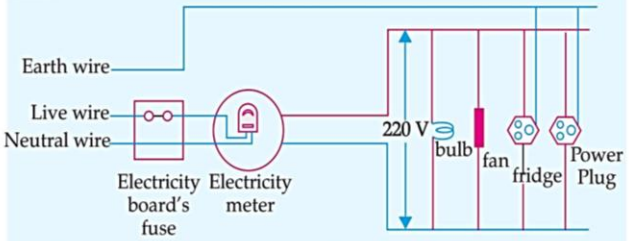
Q. 4. What are the three types of wires used in household circuits. Pick out the wire used as a safety measure for electrical appliance with metallic body? R

Ans. (i) Live wire ½
(ii) Neutral wire ½
(iii) Earth wire ½
Earth wire, colour of insulation – green ½

Short Answer Type Questions-II — 3 marks each

Q. 1. Suppose your parents have constructed a two room house and you want that in the living room there should be a provision of one electric bulb, one electric fan, a refrigerator and a plug point for appliances of power up to 2 kilowatt. Draw a circuit diagram showing electric fuse and earthing as safety devices. A **[Board SQP, 2020]**

Ans.



(i) Four components should be labelled. **1**

(ii) All of them should be in parallel and there should be a fuse for safety. ½ + ½

(iii) Live and earth wires should be there. **1**

(½ to be deducted if all parts of the diagram are not labelled)

[CBSE Marking Scheme, 2020] 3

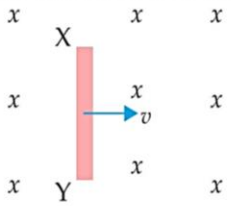
Q. 2. Give reasons for the following:
(i) There is either a convergence or a divergence of magnetic field lines near the ends of a current carrying straight solenoid. **1**
(ii) The current carrying solenoid when suspended freely rest along a particular direction. **1**
(iii) The burnt out fuse should be replaced by another fuse of identical rating. U **[CBSE 2020 OD] 2**

Ans. (i) Divergence or degree of closeness of magnetic field lines near the ends of a current carrying straight solenoid indicates a increase in the strength of the magnetic field near the ends of the solenoid. **1**

(ii) A current carrying solenoid acts as a bar magnet. We know that a freely suspended bar magnet aligns itself in the North-South direction. So, a freely suspended current carrying solenoid also aligns itself in the North-South direction. **1**

(iii) Burnt out fuse cannot be re-used. Also, a fuse wire works because of its lower melting point. If the fuse with larger rating is used with an appliance, the fuse wire shall not melt and hence would fail to serve the required purpose. So, new fuse of same rating should be used for electrical safety. **1**

Q. 3. Crosses ⊗ represent a uniform magnetic field directed into the paper. A conductor XY moves in the field toward right side. Find the direction of induced current in the conductor. Name the rule you applied. What will be the direction of current if the direction of field and the direction of motion of the conductor both are reversed ?



AE **[Board Term I, 2016]**

Ans. (i) Y to X

(ii) Fleming's right hand rule.

(iii) The direction of induced current will still be the same *i.e.*, Y to X. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

Long Answer Type Questions — 5 marks each

AI **Q. 1. What is an electromagnet ? List any two uses.**

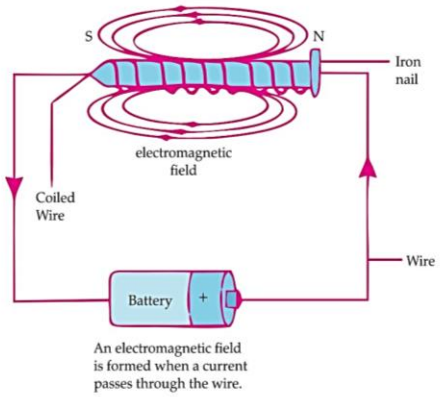
(i) Draw a labelled diagram to show an electromagnet is made.

(ii) State the purpose of soft iron core used in making an electromagnet.

(iii) List two ways of increasing the strength of an electromagnet if the material of the electromagnet is fixed. U **[CBSE 2020, Delhi]**

Ans. Electromagnet: Magnet formed by producing magnetic field inside a solenoid. Uses of electromagnet: Inside TVs, sound speakers and radios.

(i) Labelled diagram to show how an electromagnet is made:



An electromagnetic field is formed when a current passes through the wire.

(ii) Soft iron rod increases the magnetism of solenoid by a thousand fold. When the solenoid current is switched off, the magnetism is effectively switched off since the soft iron core has low retentivity.

(iii) Ways to increase the strength of an electromagnet if the material of the electromagnet is fixed are:

(a) By increasing the amount of current flowing in the solenoid

(b) By increasing the number of turns in the solenoid.

2+1+1+1

Q. 2. (a) State Fleming's left hand rule.

(b) Write the principle of working of an electric motor.

(c) Explain the function of the following parts of as electric motor.

(i) Armature (ii) Brushes (iii) Split ring

A **[CBSE Delhi/O.D., 2018]**

Ans. (a) Fleming's left-hand rule: Stretch the forefinger, middle finger and thumb of left hand in such a way that they are mutually perpendicular to each other. If the forefinger points in the direction of magnetic field, middle finger points in the direction of current then the thumb shows the direction of force or motion on the current carrying conductor.

(b) Principle of working of electric motor: A coil carrying electric current placed in an external magnetic field experiences a force.

(c) (i) It is a copper coil with iron cure. Current passes this coil. When it placed in a magnetic field it experiences a force and rotnts.

(ii) Function of brushes: Helps easy transfer of charge between the coil and the external circuit.

(iii) Function of split rings: Reverses the direction of current after each half rotation of the coil so that the coil can keep rotating continuously. **1 + 1 + 2**

Topper Answer, 2018

(a) Fleming's left Hand Rule states that if we stretch fore finger, middle finger & thumb of our left hand mutually perpendicular to each other such that our forefinger gives direction of magnetic field, middle finger gives the direction current & then our thumb will give the direction of force experienced by conductor.

(b) Principle of electric motor :-
When a current carrying conductor is placed inside a magnetic field, it experiences a force due to the interaction of 2 magnetic fields - one of conductor carrying current & the already existing magnetic field

(c) Armature is the combination of current carrying coil wound on soft iron core. This is attached to axle & rotates axle. 1

Brushes
Carbon brush provides conductivity. ½

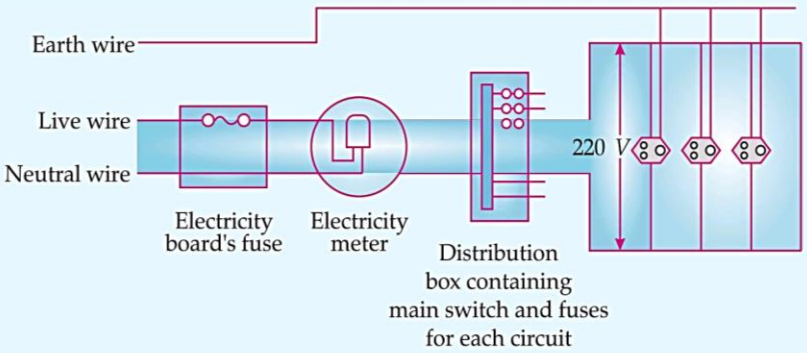
Split ring
It acts as commutator & reverses direction of current ½

AI Q. 3. (i) What is meant by the terms alternating current and direct current ?
(ii) Name a source of alternating current and a source of direct current.
(iii) Mention the frequency of AC supply in India.
(iv) State two important advantages of alternating current over direct current.
R [Board Term I, 2015]

Ans. (i) Refer to know the terms.
(ii) Source of AC current — electric generator.
Source of DC current — electric cell.
(iii) Frequency of alternating current in India is 50 Hz.
(iv) (a) AC can be easily converted to DC. Also AC can be easily stopped up or stopped down to any derived value.
(b) AC electric power can be transmitted over long distances without much loss of energy while DC cannot be Transmitted. 5

AI Q. 4. (a) Draw a schematic labelled diagram of domestic electric circuit.
(b) Why is it necessary to provide–
(i) A fuse in an electric circuit
(ii) An earth wire to electric application metallic body? Explain.
A [Board Term-I, 2015]

Ans. (a)



3

Fig. A schematic diagram of one of the common domestic circuits

(b) (i) It prevents damage to appliance due to overloading or short-circuiting.
(ii) Earth wire is connected to a metallic body buried deep inside earth. It is used as safety measure. It provides a low resistance conducting path for the current any leakage of current to a metallic body does not give shock to user. [CBSE Marking Scheme, 2015] 2

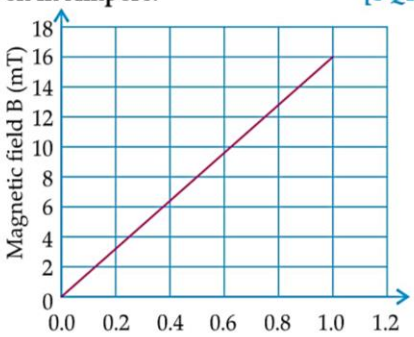
Visual Case-based Questions — 4 marks each

Q. 1. Read the following passage and answer any four questions from (a) to (e).

A solenoid is a long helical coil of wire through which a current is run in order to create a magnetic field. The magnetic field of the solenoid is the superposition of the fields due to the current through each coil. It is nearly uniform inside the solenoid and close to zero outside and is similar to the field of a bar magnet having a north pole at one end and a south pole at the other depending upon the direction of current flow. The magnetic field produced in the solenoid is dependent on a few factors such as, the current in the coil, number of turns per unit length etc.

The following graph is obtained by a researcher while doing an experiment to see the variation of the magnetic field with respect to the current in the solenoid.

The unit of magnetic field as given in the graph attached is in mili-Tesla (mT) and the current is given in Ampere. [SQP-2020-21]



(a) What type of energy conversion is observed in a linear solenoid? U

(i) Mechanical to Magnetic
(ii) Electrical to Magnetic
(iii) Electrical to Mechanical
(iv) Magnetic to Mechanical

(b) What will happen if a soft iron bar is placed inside the solenoid? C

(i) The bar will be electrocuted resulting in short-circuit.
(ii) The bar will be magnetised as long as there is current in the circuit.
(iii) The bar will be magnetised permanently.
(iv) The bar will not be affected by any means.

(c) The magnetic field lines produced inside the solenoid are similar to that of … A

(i) a bar magnet
(ii) a straight current carrying conductor
(iii) a circular current carrying loop
(iv) electromagnet of any shape

(d) After analysing the graph a student writes the following statements. AE

(I) The magnetic field produced by the solenoid is inversely proportional to the current.
(II) The magnetic field produced by the solenoid is directly proportional to the current.
(III) The magnetic field produced by the solenoid is directly proportional to square of the current.
(IV) The magnetic field produced by the solenoid is independent of the current.

Choose from the following which of the following would be the correct statement(s).

(i) Only IV **(ii) I and III and IV**
(iii) I and II **(iv) Only II**

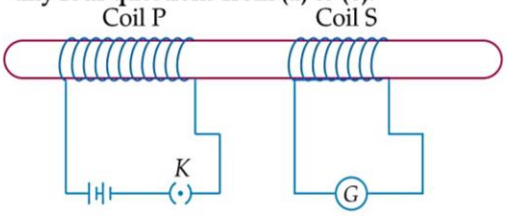
(e) From the graph deduce which of the following statements is correct. U

(i) For a current of 0.8A the magnetic field is 13 mT
(ii) For larger currents, the magnetic field increases non-linearly.
(iii) For a current of 0.8A the magnetic field is 1.3 mT
(iv) There is not enough information to find the magnetic field corresponding to 0.8A current.

Ans. (a) (ii) Electrical to Magnetic
(b) (ii) The bar will be magnetised as long as there is current in the circuit
(c) (i) A bar magnet
(d) (iv) Only II
(e) (i) For a current of 0.8A the magnetic field is 13 mT

1 + 1 + 1 + 1+1

Q. 2. In the given diagram, two coils of insulated copper wire are wound over a nonconducting cylinder as shown. Coil P has larger number of turns. Answer any four questions from (a) to (e).



(a) A momentary deflection is shown by the galvanometer , when: U

(i) Key K is open **(ii) Key K is closed**
(iii) In both the situations **(iv) In neither of the case.**

(b) When key K is opened or closed, which of the statement is false: U

(i) The current in the coil P changes.
(ii) Magnetic field linked with coil S changes.
(iii) The current is induced in the coil S.
(iv) None of the above

(c) In electromagnetic induction, current is induced in another conductor, AE

(i) By changing magnetic field
(ii) By increasing the strength of current
(iii) By decreasing the strength of the current
(iv) By using extra wire.

(d) State the rule which helps us to know direction of induced current: R

(i) Flemings right hand rule
(ii) Flemings left hand rule
(iii) Electro magnetic induction
(iv) Faraday's Law

(e) Flemings right hand rule explains: R

(i) Direction of magnetic field
(ii) Direction of motion of conductor
(iii) Only (a)
(iv) Both (a) and (b)

Ans. (a) (iii) In both the situations
(b) (iv) None of the above
(c) (i) By changing magnetic field
(d) (i) Fleming's right hand rule
(e) (iv) both (a) and (b) **1+1+1+1+1**

Q. 3. Read the following passage and answer any four questions from (a) to (e). 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 board gently and observes that the iron filings arrange themselves in a particular pattern.

(a) Why do the iron fillings arrange themselves in a particular pattern: AE

(i) Due to external force applied on the magnet.

(ii) Due to force exerted by the magnet outside the magnetic field.

(iii) Due to the force exerted by magnet within its magnetic field.

(iv) Due to pressure of magnetic field.

(b) What do the lines along which the iron fillings align represent: A

(i) North pole and south pole of the magnet

(ii) Strength of the magnet

(iii) Magnetic field lines

(iv) Gravitational force.

(c) What does the crowding of iron filings at the end of the magnet indicate? U

(i) magnetic field is strongest near the poles of the magnet.

(ii) magnetic field is weakest near the poles of the magnet.

(iii) There is no significant magnetic field at the poles of the magnet.

(iv) The significance of polarity

(d) The close field lines indicate: U

(i) Magnetic field in that region is weak

(ii) Magnetic field in that region is strong.

(iii) Magnetic field in that region is zero.

(iv) North and south poles are closer.

(e) What is SI unit of magnetic field: R

(i) Pascal (ii) Nm^2

(iii) Tesla (iv) No unit

Ans. (a) (iii) Due to the force exerted by magnet within its magnetic field.

(b) (iii) Magnetic field lines

(c) (i) magnetic field is strongest near the poles of the magnet.

(d) (ii) Magnetic field in that region is strong

(e) (iii) Tesla 1+1+1+1+1

Q. 4. Answer any four question from (a) - (e) on the basis of your understanding of the following paragraph and the related studied concepts.

Renewable energy sources such as wind energy are vital for the Indian economy, not only from the point of view of supply, but also from the perspective of environmental and social benefits. India is the world's fifth largest wind-power producer and the largest windmill facilities in India are installed in Tamil Nadu. Muppandal is a small village of Tamil Nadu and one of the most important sites of wind-farm in the state. It uses wind from the Arabian Sea to produce renewable energy. The suitability of Muppandal as a site for wind farms stems from its geographical location as it has access to the seasonal monsoon winds.

The electrical generators used on wind turbines in sites like Muppandal, produce an output AC of 240 V and a frequency of 50 Hz even when the wind speed is fluctuating. A transformer may be required to increase or decrease the voltage so it is compatible with the end usage, distribution or transmission voltage, depending on the type of interconnection.

(a) The output frequency of wind turbine is 50 Hz. Which of the following does not explain this statement? C

(i) The fan of turbine moves 50 times in one second

(ii) In one second the output AC completes 50 cycles

(iii) The polarity of the output alternating current changes every 1/100 seconds.

(iv) In one minute the output AC completes 50 cycles

(b) Which of the following device does not work on the principle of electro magnetic induction: A

(i) Electric fan (ii) Electric generator

(iii) Dynamo (iii) Electric bulb

(c) Which device is used to increase the AC voltage to make it compatible with end user?

(i) generator (ii) transformer

(iii) ammeter (iv) armature

(d) Which device produces the electric current? R

(i) galvanometer (ii) ammeter

(iii) motor (iv) generator

(e) Fleming's left hand and Right hand rules are used in

(i) Generator and electric motor respectively.

(ii) Electric motor and generator respectively.

(iii) any rule can be used for any device.

(iv) both are not applied for generator and motor.

Ans. (a) (ii) In one sound output AC completes 50 cycles

(b) (iv) Electric bulb

(c) (ii) Transformer

(d) (iv) Generator

(e) (ii) Electric motor and generator respectively

1 + 1 + 1 + 1+1

Know the Terms

- **Magnetic field lines:** Magnetic line of force are imaginary lines representing the direction of magnetic field such that the tangent at any point gives the direction of the field at that point.
- **Magnetic field:** The area around a magnet in which its effect can be experienced is called **magnetic field.**
- **Magnetic effects of current:** When electric current flows through a conductor, a magnetic field is produced around it. This is called **magnetic effects of current**.
- **Electromagnet:** An **electromagnet** is a solenoid coil that attains magnetism due to the flow of current. It works on the principle of magnetic effect of current.
- **Electromagnetic induction:** The production of electric current due to relative motion between a conductor and a magnetic field is called **electromagnetic induction.** Electric current produced due to this phenomenon is called **induced current.**
- **Self Induction:** When the current flowing through a coil changes, then the current is induced in the coil itself. This phenomena is called **self-induction**.
- **Magnetic flux:** It is defined as the product of the magnetic field and the area through which magnetic field passes perpendicularly. $\phi = n$BA, when field passes perpendicular to the plane of the coil. It is measured in weber. If B and A are at angle θ, $\phi = n$BA cos θ, where n is the number of turns.
- **Direct Current:** If the current always flows in the same direction, it is called **direct current**. DC can be obtained from a cell or a battery. The positive and negative polarities of DC are fixed.
- **Alternating Current:** If the current changes direction after equal intervals of time, it is called **alternating current**. The positive and negative polarities of AC are not fixed.
- **Earthing:** Connecting the outer frame of an appliance to earth to avoid any shock caused by fault or current leakage is called **earthing**.
- **Armature:** The coil having multiple turns used in electric motor or generator is called **armature**.
- **Fuse:** Fuse is a safety device commonly used in electric circuits. It is connected with the live wire.

❑❑❑

SELF ASSESSMENT TEST - 4

Maximum Time: 1 hour **MM: 25**

Q. 1. The magnetic field around a current-carrying solenoid is uniform in which region? **1**

Q. 2. How can you determine the direction of magnetic field at a given point? **1**

Q. 3. Find the direction of the magnetic field when an alpha particle which is projected towards West is deflected towards North by it. **1**

Q. 4. Directions : In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(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.

Assertion : An important application of electromagnetic induction is ac generator

Reason : The direction of current changes periodically and therefore the current is called alternating current

Q. 5. What are the constituent elements of alloy nipermag? Give an important use of this alloy. **2**

Q. 6. An insulated copper wire coil is connected to a galvanometer. Write your observation what happens when a bar magnet is :

(a) Held stationary inside the coil

(b) Pushed into the coil **2**

Q. 7. What is fuse used for in electric circuits ?What will happen if a fuse with defined rating not be replaced by one with larger rating? **2**

Q. 8. Name any two electrical appliance which make use of motor.

Also name and state the principle on which electric motor works. **3**

Q. 9. Define electromagnet. Suggest any two ways to determine north and south pole of an electromagnet with the help of magnetised iron bar ? **3**

Q. 10. Case Based Questions: **4**

Mahesh bought an electric iron and connected its wires into the two-pin plug. Obviously, the green wire was not connected anywhere. Few days later, his wife got a severe electric shock while ironing the clothes. The electrician told Mahesh that this situation could be averted had he connected the green wire also, using the three-pin plug. Mahesh learnt a lesson for a life-time.

Read the above passage and answer the following questions : **(Any four)**

(i) What are the colour convention for live , neutral and earth wire:

(a) Red, black, green **(b)** Red, green, black

(c) Green , black, red **(d)** Black, red , green

(ii) Which terminal was to be connected using green wire?

(a) Earthing **(b)** Live

(c) Neutral **(d)** Any of these

(iii) In domestic electric circuit, with which wire do we connect a fuse?

(a) Earthing **(b)** Live

(c) Neutral **(d)** Any of these

(iv) Electric fuse is an application of :

(a) Electromagnetic induction **(b)** Solenoid

(c) Joule's heating **(d)** Electro magnetic force

(v) Name the device used to record the consumption of electrical energy in the circuit:

(a) Electric meter **(b)** Ammeter

(c) Voltmeter **(d)** Earthing

Q. 11. Name a device which converts mechanical energy into electrical energy.

State the principle and explain the working of this device along with a well labelled diagram. **5**