Magnetic Effects of Electric Current

(A) Objective Type Questions — 1 Mark Each

Stand Alone MCQs (1 Mark Each)

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. U

Ans. Option (C) is correct.

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.

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.

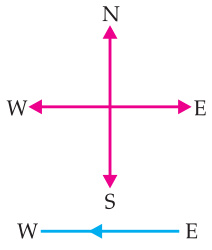
(C) The field consists of radial lines originating from the wire.

(D) The field consists of concentric circles centered on the wire. U

Ans. Option (D) is correct.

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

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.

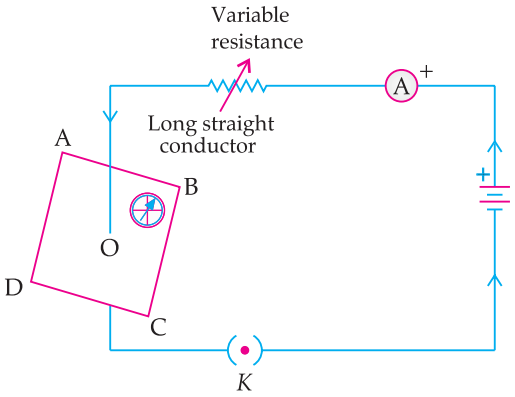
(C) At a point located in the plane of the paper, on the north side of the wire.

(D) At a point located in the plane of the paper, on the south side of the wire. AE

Ans. Option (B) is correct.

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.

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.

Ans. Option (C) is correct.

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.

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. U

Ans. Option (C) is correct.

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.

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 R

Ans. Option (C) is correct.

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.

7. Which of the following property of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer.)

(A) Mass **(B)** Speed

(C) Velocity **(D)** Momentum U

Ans. Option (C) and (D) is correct.

Explanation: When a proton enters a magnetic field, it starts moving on a circular path. Because of its movement along a circular path it attains angular momentum. We know that momentum is a product of mass and velocity. Therefore velocity and mass of a proton change when it enters a magnetic field.

8. A positively-charged particle (alpha - particle projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is

(A) Towards south. **(B)** Towards east.

(C) Downward. **(D)** Upward. U

Ans. Option (D) is correct.

Explanation: In accordance with Fleming's Left-Hand Rule, the direction of magnetic field is vertically upward.

9. The phenomenon of electromagnetic 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. A

Ans. Option (C) is correct.

Explanation: In electromagnetic induction phenomenon, an induced current begins to flow in a coil whenever there is a change in magnetic field in and around a coil.

10. 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. R

Ans. Option (C) is correct.

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.

Assertion and Reason Based MCQs
(1 Mark Each)

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 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 and R is true.

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. Option (D) is correct.

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

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

Ans. Option (A) is correct.

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.

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. Option (C) is correct.

Explanation: Fleming's Left Hand Rule is used to find the direction of force in a current carrying conductor in the presence of magnetic field.

4. **Assertion (A):** An alpha particle placed in a magnetic field will not experience any force, if it moves in the magnetic field parallel to field lines.
Reason (R): The force is zero if current and field are in the same direction.

Ans. Option (A) is correct.

> ***Explanation:*** An alpha particle placed in a magnetic field will not experience any force, if it moves in the magnetic field parallel to field lines. It is because, the force is zero if current and field is in the same direction. Where angle between the magnetic field and current is zero.

CASE-BASED MCQs (1 Mark Each)

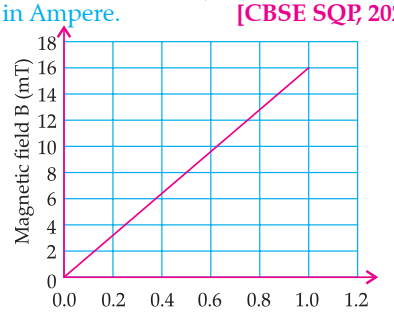
Case-based MCQs (1 Mark Each)

I. Read the following passage and answer the four questions given below :

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. **[CBSE SQP, 2020-21]**



1. **What type of energy conversion is observed in a linear solenoid?** U
   (A) Mechanical to Magnetic
   (B) Electrical to Magnetic
   (C) Electrical to Mechanical
   (D) Magnetic to Mechanical

Ans. Option (B) is correct.

> ***Explanation:*** In a solenoid, the current flowing through the circuit generates its own magnetic field. Hence the electrical energy of the circuit is converted to magnetic field.

2. **What will happen if a soft iron bar is placed inside the solenoid?** A
   (A) The bar will be electrocuted resulting in short-circuit.
   (B) The bar will be magnetised as long as there is current in the circuit.
   (C) The bar will be magnetised permanently.
   (D) The bar will not be affected by any means.

Ans. Option (B) is correct.

> ***Explanation:*** The magnetic field produced by the solenoid will be reinforced by the iron bar and it will be magnetised as long as there is current in the circuit.

3. **The magnetic field lines produced inside the solenoid are similar to that of …** A
   (A) A bar magnet
   (B) A straight current carrying conductor
   (C) A circular current carrying loop
   (D) Electromagnet of any shape

Ans. Option (A) is correct.

> ***Explanation:*** The magnetic field of a solenoid are similar to that of a bar magnet and just like a bar magnet a solenoid also has north and south poles.

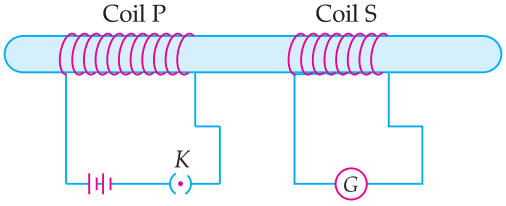
4. **After analysing the graph a student writes the following statements.** AE
   I The magnetic field produced by the solenoid is inversely proportional to the current.
   II The magnetic field produced by the solenoid is directly proportional to the current.
   III The magnetic field produced by the 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).
   (A) Only IV **(B)** I and III and IV
   (C) I and II **(D)** Only II

Ans. Option (D) is correct.

> ***Explanation:*** As can be seen from the graph the magnetic field is increasing linearly with current. Therefore, the current is directly proportional to the magnetic field.

AI II. Study the given diagram and answer the four questions given below :

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 than coil S.



1. **A momentary deflection is shown by the galvanometer , when:** U

(A) Key K is open
(B) Key K is closed
(C) In both the situations
(D) In neither of the case.

Ans. Option (C) is correct.

Explanation: Momentary deflection is seen in both the cases. When the key K is closed, magnetic field around the coil S increase momentarily. This induces current in the coils and deflection is shown by the galvanometer. And when it is opened, a momentary deflection is seen in opposite direction as induced current flow in the opposite direction because of decrease in magnetic field in coil S.

2. Which phenomenon is involved in it ? U

(A) Electromagnetic induction
(B) Magnetism
(C) Electromagnetism
(D) None of these

Ans. Option (A) is correct.

Explanation: Electromagnetic induction is the process by which a changing magnetic field in a conductor induces current in another conductor.

3. In above phenomenon, the current is induced in another conductor, AE

(A) By changing magnetic field
(B) By increasing the strength of current
(C) By decreasing the strength of the current
(D) By using extra wire.

Ans. Option (A) is correct.

Explanation: Electromagnetic current is induced in another conductor by changing the magnetic field because electromotive force is induced by the movement of charges that flow by the effect of force applied by magnetic field lines.

4. The rule which helps us to know direction of induced current: R

(A) Fleming's right hand rule
(B) Fleming's left hand rule
(C) Electro magnetic induction
(D) Faraday's Law

Ans. Option (A) is correct.

Explanation: **Fleming's right hand** rule helps us to know the direction of induced current. In this rule, the first three fingers of the right hand are mutually perpendicular to each other such that the forefinger gives the direction of magnetic field and the thumb points in the direction of the motion of a conductor then, the middle finger will give the direction of the induced current.

III. Read the following passage and answer the questions given below :

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.

1. Why do the iron fillings arrange themselves in a particular pattern ? AE

(A) Due to external force applied on the magnet.
(B) Due to force exerted by the magnet outside the magnetic field.
(C) Due to the force exerted by magnet within its magnetic field.
(D) Due to pressure of magnetic field.

Ans. Option (C) is correct.

Explanation: It is due to the force exerted by the magnet within its magnetic field that forces particles to move and make a concentric circular pattern.

2. What do the lines along which the iron fillings align represent ? A

(A) North pole and south pole of the magnet
(B) Strength of the magnet
(C) Magnetic field lines
(D) Gravitational force.

Ans. Option (C) is correct.

Explanation: The lines represent magnetic field lines because magnetic field induces each particle as a bar magnet (tiny), where south pole of each particle attracts north pole of its neighbour repeatedly to create a pattern similar to magnetic field lines.

3. What does the crowding of iron filings at the end of the magnet indicate? U

(A) Magnetic field is strongest near the poles of the magnet.
(B) Magnetic field is weakest near the poles of the magnet.
(C) There is no significant magnetic field at the poles of the magnet.
(D) The significance of polarity

Ans. Option (A) is correct.

Explanation: Crowding of iron filings at the ends of the magnet indicates that the magnetic field is strongest near the poles of the magnet.

4. What is SI unit of magnetic field: R

(A) Pascal **(B)** Nm^2
(C) Tesla **(D)** No unit

Ans. Option (C) is correct.

Explanation: Tesla is the SI unit of magnetic field.

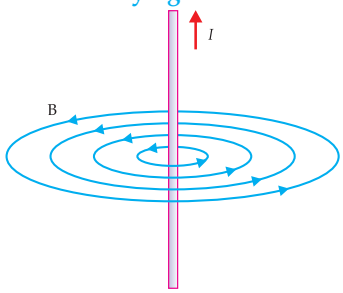
(B) Subjective Questions

Very Short Answer Type Questions

(1 Mark Each)

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

Ans.



1

2. What is meant by magnetic field ?

R [CBSE 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 3. Why are magnetic field lines more crowded towards the pole of a magnet ? R

AE [CBSE 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]

4. Why does a compass needle show deflection when brought near a current carrying conductor ?

U [CBSE Term I, 2016]

Ans. Due to production of magnetic field around the current carrying conductor. **1**

[CBSE Marking Scheme, 2016]

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

Ans. Electromagnetic induction.

Short Answer Type Questions-I

(2 Marks Each)

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 weaken when wider apart.

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. [O.E.B.] 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**

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? [O.E.B.]

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 **1.What is meant by solenoid ? How does a current carrying solenoid behave ? Give its main use.**

R [CBSE 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

➲ Keep in Mind, Metallic wire used for solenoid should be always "insulated".

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 [CBSE 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**

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.

A [CBSE Term- I, 2016]

Ans. A current carrying solenoid behaves like a magnet. When suspended freely, it will stay in north - south direction.

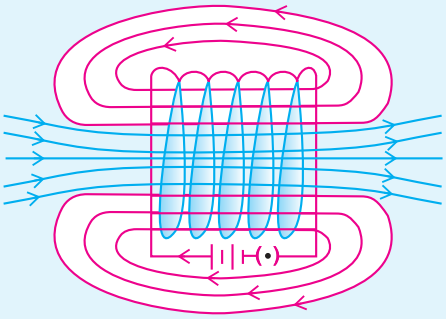
On reversing current its polarity will be reversed and so it will turn at 180°. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

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] [CBSE 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]

5. 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.

(ii) The current carrying solenoid when suspended freely along a particular direction.

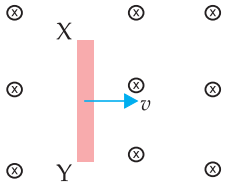
(iii) The burnt out fuse should be replaced by another fuse of identical rating. A [CBSE O.D., 2020]

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**

7. 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

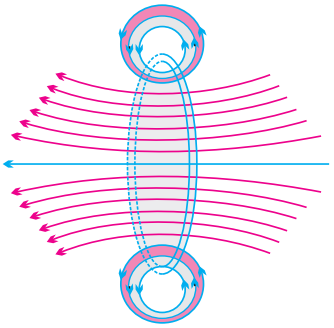
(5 Marks Each)

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.

(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) ?

A [CBSE Delhi Set-III, 2020]

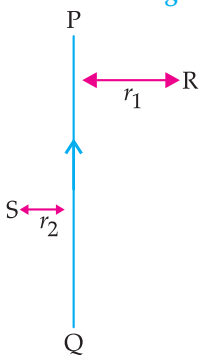
Ans. Magnetic field due to current through a circular Loop: It can be represented by concentric circle at every point. Circles become larger and larger as we move away. Every point on wire carrying current would rise to magnetic field appearing as straight line at centre of the loop. The direction of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



Magnetic field lines due to a current through a circular loop

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. **3 + 2**

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

(ii) Field strength at which point will be greater?

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

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

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

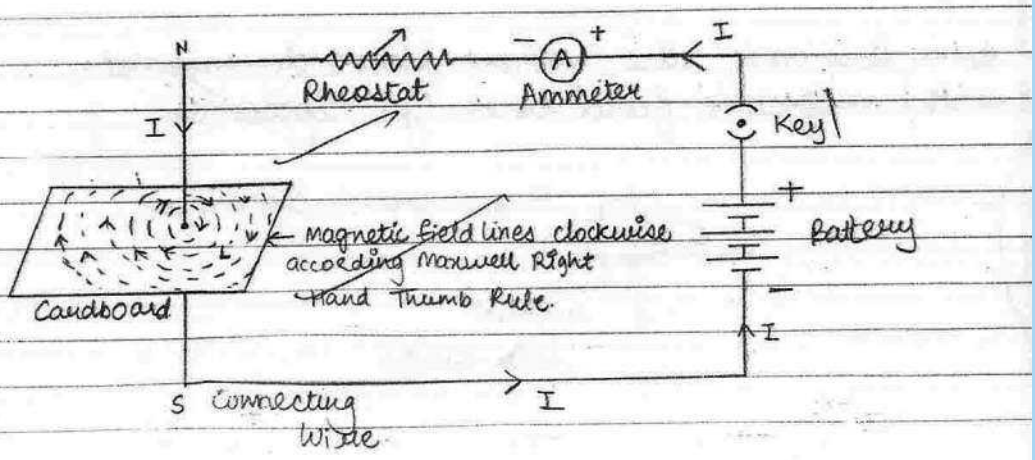
(iii) The current will be going from top to bottom in the wire shown and the magnetic field lines are now in the clockwise direction on the plane which is perpendicular to the wire carrying current. **1**

(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**

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. A **[CBSE Delhi, 2019]**

Topper Answer, 2019

7.

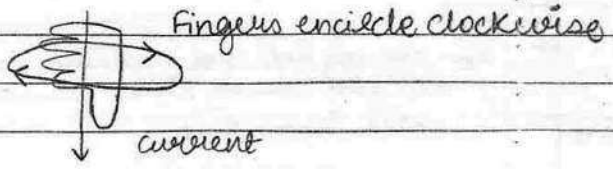


Maxwell Right Hand Thumb Rule is used

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.

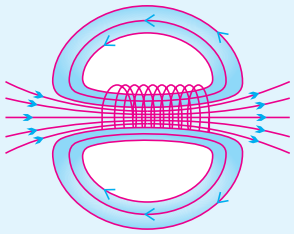


4. What is a solenoid ? Draw the pattern of magnetic field lines of (i) a current carrying solenoid and (ii) a bar magnet. List two distinguishing features between the two fields.

U [CBSE Delhi, Set-I, 2019]

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

(i)



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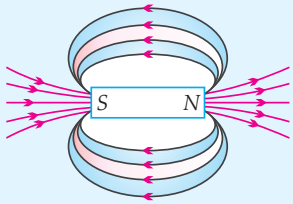
(ii)



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Distinguishing features:

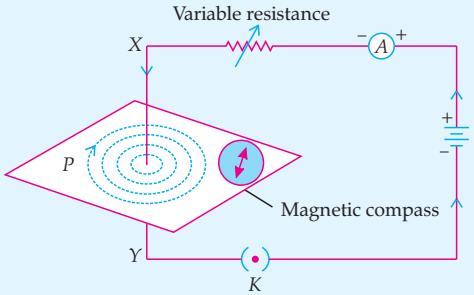
	Solenoid	Bar Magnet
1.	Field disappear on stopping the current.	No effect of current on field.
2.	Strength of the field can be changed by changing the current.	Strength cannot be changed.

[CBSE Marking Scheme, 2019] **2**

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 [CBSE Outside Delhi, Set-I, 2019]

Ans.



2

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

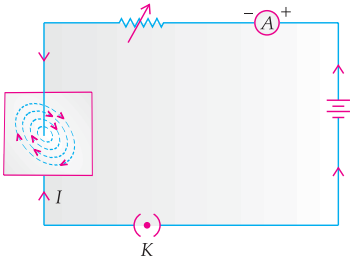
Reason: There is inverse relation between field strength and distance from current carrying conductor. **1**

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

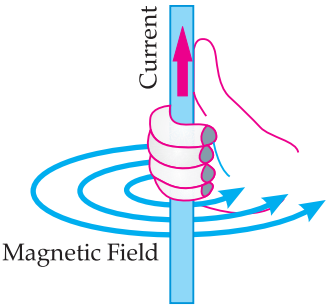
[CBSE Marking Scheme, 2019]

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.

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 [CBSE 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**

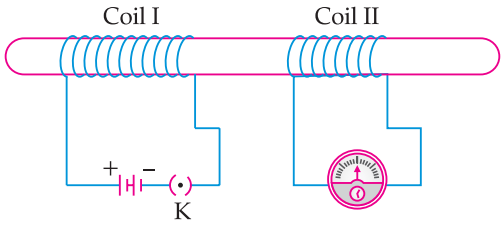
With change in current in the coil X, the magnetic field associated with it also changes around the coil Y placed near it. This change in magnetic field induces a current in the coil Y. **1**

(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**

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-I and coil-II are kept close to each other as shown in the diagram. Coil-I is connected to a battery and key and coil-II 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 **[CBSE SQP, 2018]**

Ans. (i) Refer NCERT Page 235, Activity 13.9

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

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

[CBSE Marking Scheme, 2018]

Detailed Answer:

(i) Activity

- 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-II.
- Disconnect coil-I 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-II.

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

AI **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 **[CBSE Term I, 2016]**

Ans. Magnetic field lines : 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.

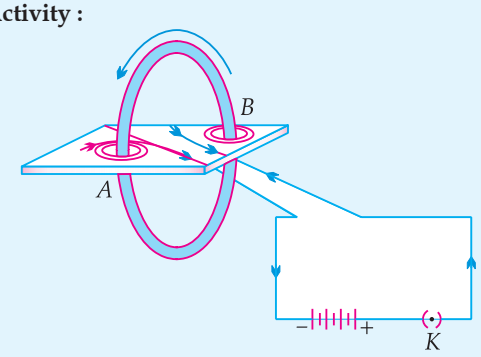
Characteristics of Magnetic field lines are :

(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**

Activity :



2

[CBSE Marking Scheme, 2016]

Detailed Answer :

Activity :

(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.

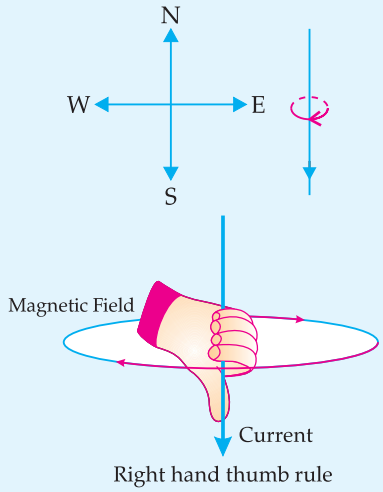
9. The magnetic field lines associated with current carrying straight conductor is in anti-clockwise direction. If the conductor was held horizontally along east-west direction, what is the direction of current through it ? Explain it with the help of diagram. Name and state the rule applied to determine 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 **[CBSE Term I, 2016]**

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

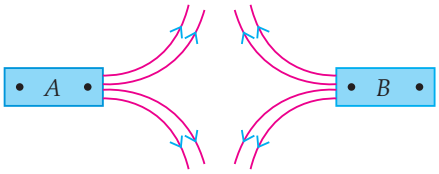
Maxwell's right hand thumb rule.

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 **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.**



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

(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 ?

AE **[CBSE 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.

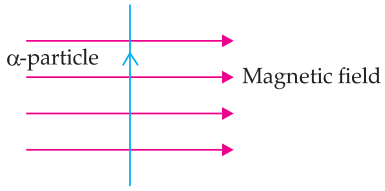
(ii) Directly proportional; more turns, more strong magnetic field.

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

[CBSE Marking Scheme, 2016] 5

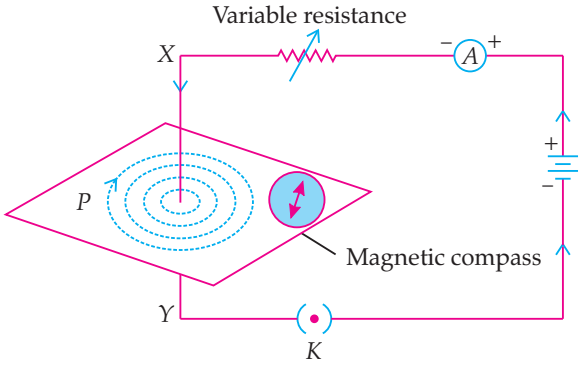
11. (i) Describe an activity to determine the direction of magnetic field produced by a current carrying straight conductor. Also show that the direction of the magnetic field is reversed on reversing the direction of current.

(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 **[CBSE Term I, 2016]**



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 **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 **[CBSE 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]

AI **13. What is an electromagnet ? List any two uses.**

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

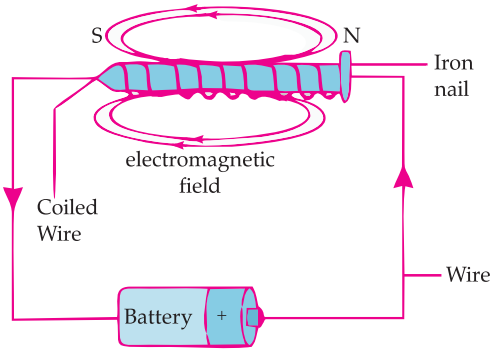
(ii) State the purpose of soft iron core used in making an electromagnet.

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

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

14. (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.

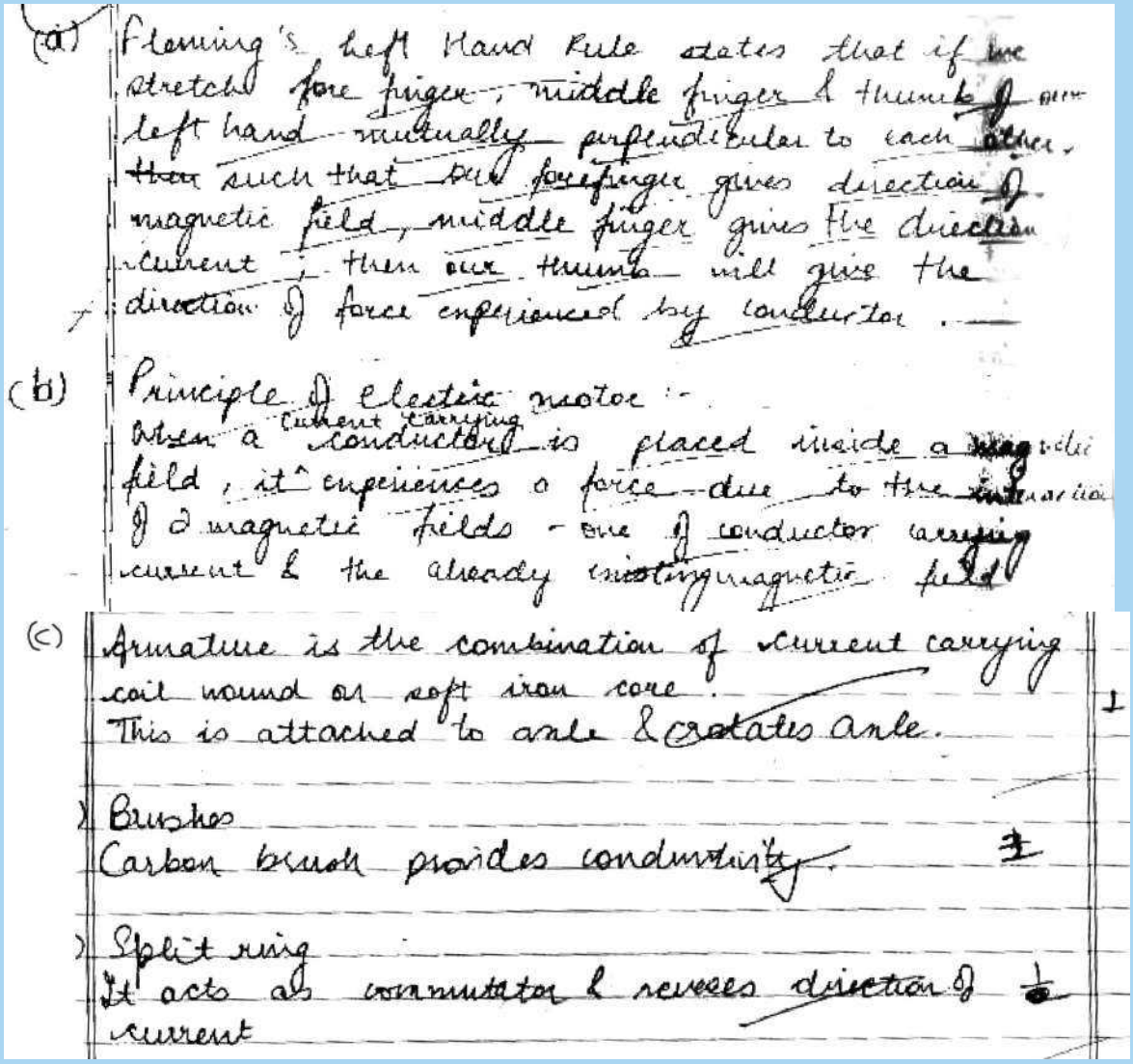
(c) (i) Function of armature : It is a rectangular iron core wrapped by the copper coil through which

electricity passes and due to magnetic field it experiences a force and rotates.

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

(iii) Function of split rings: It 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) Flemming's left Hand Rule states that if the stretched 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. 1
This is attached to axle & rotates axle.

Brushes
Carbon brush provides conductivity. ½

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

SELF ASSESSMENT TEST

Maximum Time: 1 hour **MM: 30**

(A) Objective Type Questions — 1 Mark Each

Stand Alone MCQs (1 Mark Each)

Q. 1. Priyanka connected two devices between two points say A and B in parallel. The physical quantity that will remain the same between the two points is

(A) current. **(B)** voltage.

(C) resistance. **(D)** None of these. **1**

Q. 2. When two resistors are connected in series, it gives an equivalent resistance of 10 Ω. When it is connected in parallel, it gives 2.4 Ω. Then the individual resistance are

(A) each of 5 Ω **(B)** 6 Ω and 4 Ω

(C) 7 Ω and 4 Ω **(D)** 8 Ω and 2 Ω **1**

Q. 3. Seema pointed the index finger towards the north and the middle finger towards the east while using Fleming's left-hand rule. Find the direction of the force acting on the conductor.

(A) South **(B)** West

(C) Upward **(D)** Downward **1**

Q. 4. Choose the correct statement about electromagnetic induction.

(A) It is the process of charging a body.

(B) It is the process of generating magnetic field due to a current passing through a coil.

(C) It is the process of producing induced current in a coil due to relative motion between a magnet and the coil.

(D) It is the process of rotating a coil of an electric motor. **1**

Assertion and Reason Based MCQs (1 Mark Each)

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 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 and R is true.

Q. 5. Assertion (A): Copper wire is used to make electric wires.

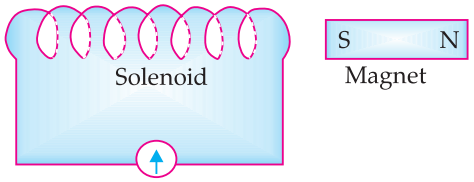
Reason (R): Copper has low electric resistance. **1**

Q. 6. Assertion (A): A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the compass needle is displaced away from the wire.

Reason (R): Strength of a magnetic field decreases as one moves away from a current carrying conductor. **1**

Case-based MCQs (1 Mark Each)

In the given diagram, when the magnet is pushed into the solenoid, the pointer of the galvanometer deflects slightly to the left.



Q. 7. The changes that would cause the pointer to deflect through a larger angle is

(A) Move the magnet faster into the solenoid.

(B) Move the magnet away from the solenoid.

(C) Unwind some of the turns of the solenoid.

(D) Keep the magnet stationary. **1**

Q. 8. How you can produce a deflection of the pointer towards the right?

(A) Move the solenoid towards the magnet.

(B) Move the solenoid away from the magnet.

(C) Move the magnet faster into the solenoid.

(D) By placing the magnet above the coil. **1**

Q. 9. Sonia wants to find the direction of magnetic field at any point. She can use a

(A) current carrying wire.

(B) compass needle.

(C) scale and a ruler.

(D) bar magnet. **1**

Q. 10. A magnet is inserted into the centre of a coil and an e.m.f. is induced across the coil. The magnitude of the induced current depends on

I. the number of turns of the coil.

II. the strength of a magnet.

III. the thickness of the wire with which the coil is made.

(A) I only **(B)** III only

(C) II and III only **(D)** All of these **1**

(B) Subjective Questions

Very Short Answer Type Questions
(1 Mark Each)

Q. 11. State Joule's law of heating. **1**

Q. 12. What is Ohm's law? **1**

Q. 13. What do you understand by the term magnetic field ? **1**

Short Answer Type Questions-I
(2 Marks Each)

Q. 14. Define electric power. How electric power, potential difference and resistance are related to each other? **2**

Q. 15. Write two properties of magnetic field lines. **2**

Q. 16. Why element of electrical heating devices are made up of alloys? **2**

Short Answer Type Questions-II
(3 Marks Each)

Q. 17. Establish a relationship to determine the equivalent resistance R of a combination of three resistors having resistances R_1, R_2 and R_3 connected in parallel. **3**

Q. 18. Explain the effect on the magnetic field produced at a point in a current carrying circular coil due to

(i) increase in the amount of current flowing through it.

(ii) increase in the distance of point from the coil.

(iii) increase in the number of turns of the coil. **3**

Long Answer Type Questions
(5 Marks Each)

Q. 19. What is meant by resistance of a conductor? Name and define its SI unit. List the factors on which the resistance of a conductor depends. How is the resistance of a wire affected if – (i) its length is doubled, (ii) its radius is doubled? **5**

■■