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PRACTICE PAPER 13 (2024-25)

CHAPTER 12 MAGNETIC EFFECTS OF ELECTRIC CURRENT

(ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : X **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

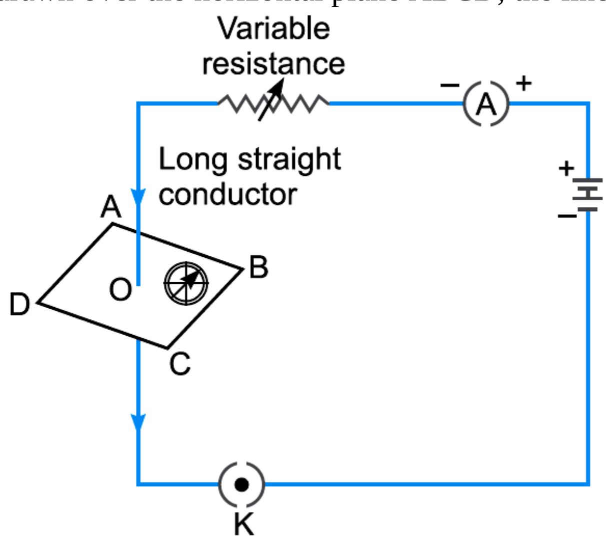
(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. If the key in the arrangement as shown below 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. (c) straight lines parallel to each other

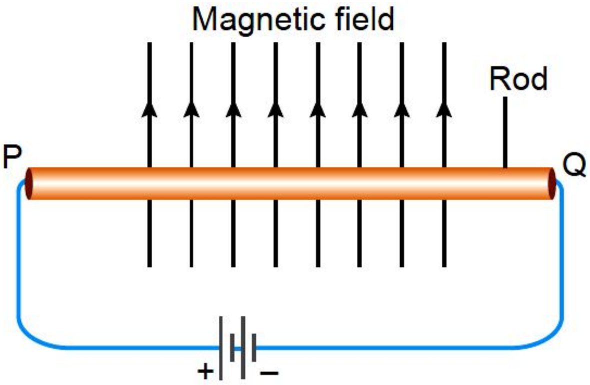
If the circuit connection breaks by taking the key out, then no current will flow through the wire and no magnetic field will exist due to the conductor. Therefore, at the point O, there will be only Earth's magnetic field and they are straight lines parallel to each other.

2. 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.

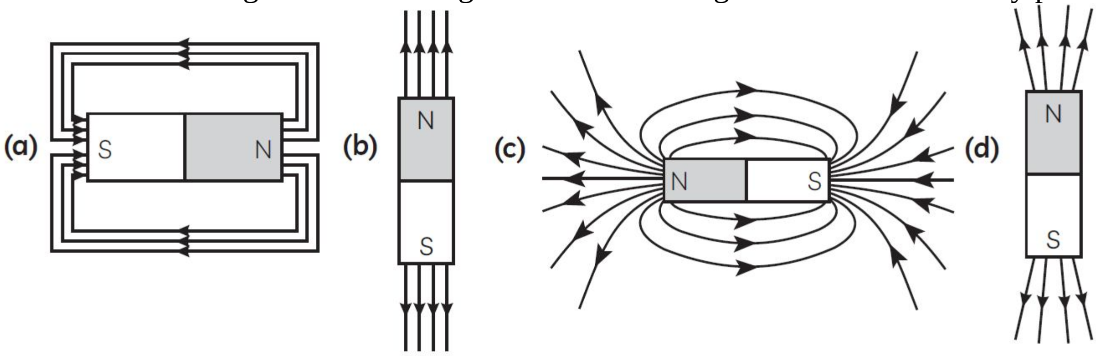
Ans. (c) The pattern of the magnetic field associated with the solenoid is different from the pattern of the magnetic field around a bar magnet.

3. A metal rod PQ is placed in the magnetic field. The ends of the rod are connected with a battery using wires. Where will the rod move?



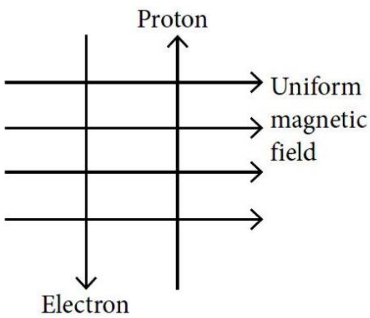
(a) Into the field. (b) Upward (c) Downwards (d) Out of the field.
Ans. (d) Out of the field.

4. A student learns that magnetic field strength around a bar magnet is different at every point.



Which diagram shows the correct magnetic field lines around a bar magnet?
Ans. (c)
The magnetic field of a bar magnet is stronger at either pole of the magnet. The poles have magnetic field closer to each other, so the magnetic field is strongest at the pole. Magnetic field is weak in the centre of the bar magnet. Magnetic field lines start from North pole and terminate at South pole outside the magnet.

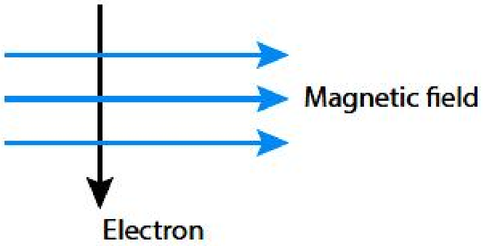
5. A uniform magnetic field exists in the plane of paper pointing from left to right as shown in the figure.



In the field, an electron and a proton move as shown. The electron and the proton experience:
(a) forces both pointing into the plane of paper
(b) forces both pointing out of the plane of paper
(c) forces pointing into the plane of paper and out of the plane of paper, respectively
(d) forces pointing opposite and along the direction of the uniform magnetic field respectively
Ans. (a) forces both pointing into the plane of paper

Apply Fleming's left hand rule and considering that the flow of current in the direction of the movement of proton and in the direction opposite to the flow of electron. So, the current due to both electron and proton will be in the same direction because of which, the forces acting on both will be in the same direction. By Fleming's left hand rule, the direction of force is pointing into the plane of paper.

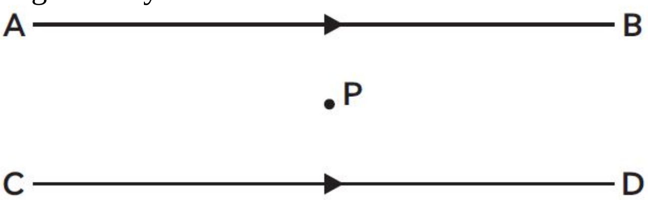
6. An electron enters a magnetic field at right angle to it, as shown in figure.



The direction of force acting on the electron will be:
(a) to the right (b) to the left (c) out of the page (d) into the page
Ans. (d) into the page
The direction of force is perpendicular to the magnetic field and current, according to Fleming's left hand rule. As a result, the force is directed in the opposite direction of electron travel into the page at a 90° angle.

7. Which of these statements is true for the lines of a magnetic field?
(I) Lines of a magnetic field can sometimes cross each other.
(II) Lines of a magnetic field emerge from the north pole and meet at the south pole.
(III) Lines of a magnetic field can sometimes change direction.
Options:
(a) Only (I) (b) Both (I) and (II) (c) Both (II) and (III) (d) Both (I) and (III)
Ans. (c) Both (II) and (III)
Magnetic field lines emerge from the north pole and merge at south pole. Lines of magnetic field can sometimes change direction since the forces that generate magnetic field, are changing the field itself, also changes. We can also see evidence of magnetic polarity reversals by examining the geological record. So options (II) and (III) are correct.

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



(a) in the same direction as the current in the wires.
(b) in the vertically upward direction.
(c) zero.
(d) in the vertically downward direction.
Ans. (c) zero.
The lower wire's contribution to the magnetic field at point P is directed out of the page, whereas the upper wire's contribution is directed into the page. Given that point P is equidistant from the two wires and that their current will be of the same magnitude, so these two oppositely directed magnetic field have equal magnitudes and cancel out each other.

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

9. **Assertion (A):** A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the magnitude of the current in the wire is increased.
Reason (R): The strength of a magnetic field at a point near the conductor increases on increasing the current.
Ans. (d) (A) is false but (R) is true.
A magnetic field is created around a wire as electricity flows through it. As one moves away from the wire, the intensity of the magnetic field weakens. As a result, when a compass needle is positioned near a current carrying wire, it deflects owing to the wire's magnetic field.
The distance between the compass needle and the wire grows as the needle moves away from the wire. As a result, the intensity of the magnetic field weakens, so does the deflection of the compass needle.

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

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. When is the force experienced by a current – carrying straight conductor placed in a uniform magnetic field:
(i) Maximum (ii) Minimum K
Ans. (i) The force experienced by a current carrying straight conductor placed in a uniform magnetic field is maximum when the conductor carrying current is perpendicular to the direction of a uniform magnetic field.
(ii) The force experienced by a current carrying straight conductor placed in a uniform magnetic field is minimum when the conductor carrying current is parallel or anti parallel to the direction of a uniform magnetic field.

12. (a) Name the poles P, Q, R and S of the magnets in the following figures 'a' and 'b':

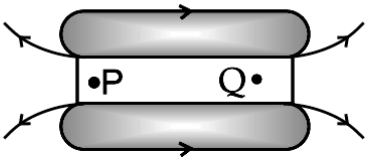


Figure 'a'

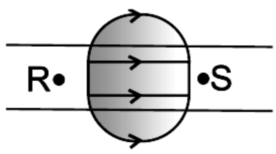


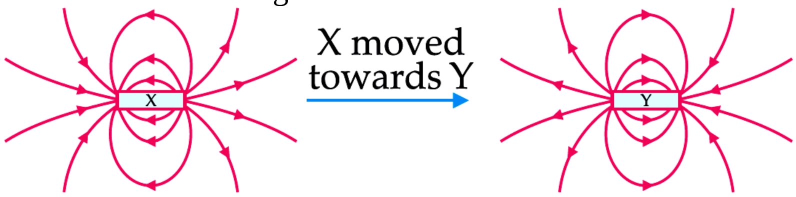
Figure 'b'

(b) State the inference drawn about the direction of the magnetic field lines on the basis of these diagrams.
Ans. (a) In figure (a)- P is north pole and Q is the south pole.
In figure (b)- R is the north pole and S is the south pole.
(b) In the given diagrams, the direction of magnetic field shows that outside the magnet, the magnetic field lines emerge from the North Pole of a magnet and merge at the south pole of the magnet.

OR

What is the function of an earth wire? Why is it necessary to earth the metallic appliances?
Ans. Sometimes, the insulation of live wire is torn and due to this the live wire touches the metallic body of the appliances. This causes the flow of current in metallic body. This current flows to the Earth through the earth wire and does not harm the user of the appliances. Therefore, to prevent the user getting an electric shock, due to leakage of current to metallic body, earth wire must always be used.

13. The figure shows two magnets X and Y kept near each other. Their poles are not marked, but the magnetic field lines are shown in the figure.



If magnet X is moved towards magnet Y as indicated by the arrow, will the two magnets attract or repel each other? Justify your answer by describing how you interpret the field lines.
Ans. They will repel each other.
The right end of magnet X and the left end of magnet Y are both north poles since field lines start from there.

14. 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.
Ans. Factors on which the magnetic field produced by a current carrying conductor depends:
(i) Strength of current passing through the conductor.
(ii) Distance of the point of measurement from the conductor.
Right Hand Thumb Rule gives the direction of magnetic field.

OR

A compass needle is placed near a current carrying wire. State your observations for the following cases and give reasons for the same in each case-
(a) Magnitude of electric current in wire is increased.
(b) The compass needle is displaced away from the wire.
Ans. (a) The deflection in the compass needle increases as magnetic field of the current carrying conductor is directly proportional to current flowing through it.
(b) The deflection in the needle decreases as the magnetic field is inversely proportional to the perpendicular distance from the wire.

SECTION – C

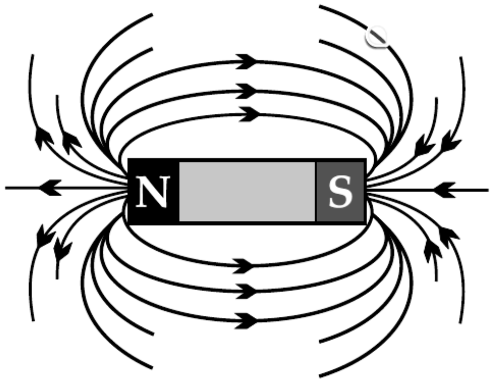
Questions 15 to 17 carry 3 marks each.

15. (a) A student wants to use an electric heater, an electric bulb and an electric fan simultaneously. How should these gadgets be connected with the mains? Justify your answer giving three reasons.
(b) What is an electric fuse? How is it connected in a circuit?
Ans. All these electrical gadgets can be connected in parallel. It is because:
(i) All appliances will get same potential difference in parallel so flow of any one appliance is not affected on switching on or off of other appliance.
(ii) In parallel arrangement if one appliance is switched off or fuses other can effectively work.
Electric fuse is a safety device that protects our electrical appliances in case of short circuit or overloading. It is made up of pure tin or alloy of copper and tin. It is always connected in series with live wire.

OR

"Magnetic field is a physical quantity that has both direction and magnitude." How can this statement be proved with the help of magnetic field lines of a bar magnet?
Ans. Magnetic field is a quantity that has both direction and magnitude. The direction of the magnetic field is taken to be the direction in which a north pole of the compass needle moves inside it. Therefore it is taken by convention that the field lines emerge from North Pole and merge at the South Pole. Inside the magnet, the direction of field lines is from its south pole to its north pole. Thus, the magnetic field lines are closed curves.

The relative strength of the magnetic field is shown by the degree of closeness of the field lines. The field is stronger, that is, the force acting on the pole of another magnet placed is greater where the field lines are crowded.



16. A student fixes a white sheet of paper on a drawing board. he places a bar magnet in the centre and sparkles some iron filings uniformly around the bar magnet. Then he taps gently and observes that iron filings arrange themselves in a certain pattern.
(a) Why do iron filings arrange themselves in a particular pattern?
(b) Which physical quantity is indicated by the pattern of field lines around the bar magnet?
(c) State any two properties of magnetic field lines.
Ans. (a) When iron filings are placed in a magnetic field around a bar magnet, they behave like tiny magnets. The magnetic force experienced by these tiny magnets make them rotate and align themselves along the direction of field lines.
(b) The physical property indicated by this arrangement is the magnetic field produced by the bar magnet.
(c) Magnetic field lines never intersect, magnetic field lines are closed curves.

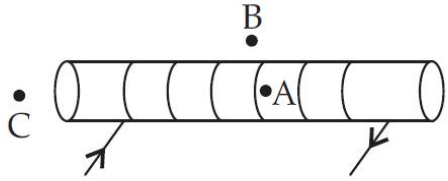
OR

List the four properties of magnetic field lines.
Ans. Properties of magnetic lines of force (also known as magnetic field lines) are listed below :
(i) Outside the magnet, the magnetic field lines are directed from N-pole of magnet towards S-pole. However, inside a magnet the field lines are directed from S-pole to N-pole. Thus, magnetic field lines form a closed loops.
(ii) The magnetic field line at any point gives the direction of magnetic field at that point.
(iii) The relative strength of magnetic fields at a point is given by degree of closeness of the field lines at that point. The magnetic field is strong in the region where the field lines are crowded.
(iv) No two magnetic field lines can ever intersect with each other.

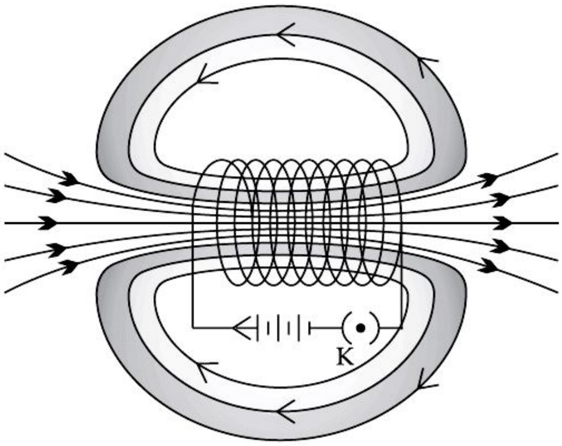
17. (i) Why is an alternating current (A.C.) considered to be advantageous over direct current (D.C.) for the long distance transmission of electric power?
(ii) How is the type of current used in household supply different from the one given by a battery of dry cells?
(iii) How does an electric fuse prevent the electric circuit and the appliances from a possible damage due to short circuiting or overloading?
Ans. (i) Alternating current can be transmitted over the long distances without the loss or energy. Also alternating voltage can be stepped up and stepped down using transformer.
(ii) Direct Current, or DC, is supplied by a dry cell (or battery of any kind). Alternating Current, or AC, is supplied by household outlets.
(iii) The fuse used in electrical circuits is a typical example of Joule's heating in action. It safeguards appliances and circuits by halting the flow of any excessively high electric current. The device and fuse are connected in series. It is composed of a wire made of a metal or alloy with an appropriate melting point, such as lead, copper, iron, or aluminium, The temperature of the fuse wire rises if a current greater than the allowed amount flows through the circuit. The fuse wire melts as a result, breaking the circuit. Typically, the fuse wire is enclosed in a porcelain or similar material cartridge with metal ends.

OR

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



Ans.

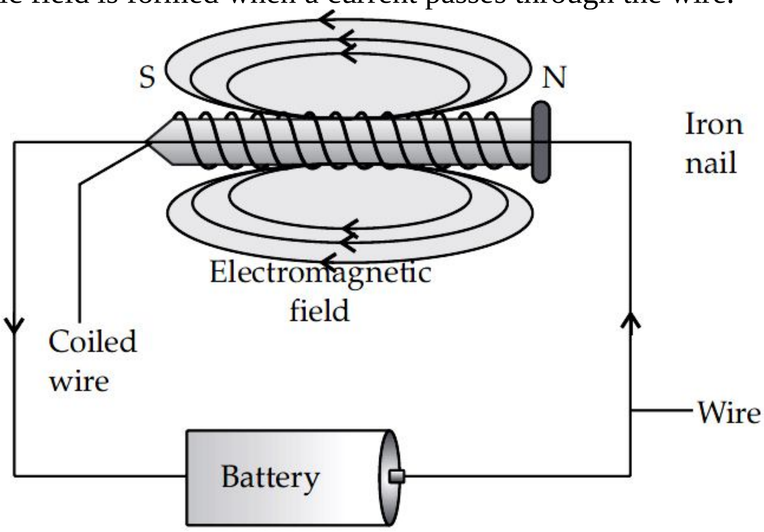


Magnetic field strength outside of the solenoid is minimal. The magnetic field strength at the ends of the solenoid is half that inside. Field strength is thus:
Minimum at point B; Maximum - at point A

SECTION – D

Questions 18 carry 5 marks.

18. What is an electromagnet? List any two uses.
(a) Draw a labelled diagram to show an electromagnet is made.
(b) State the purpose of soft iron core used in making an electromagnet.
(c) List two ways of increasing the strength of an electromagnet if the material of the electromagnet is fixed.
Ans. Electromagnet: Magnet formed by producing magnetic field inside a solenoid.
Uses of electromagnet: Inside TVs, sound speakers and radios.
(a) Labelled diagram to show how an electromagnet is made:
An electromagnetic field is formed when a current passes through the wire.

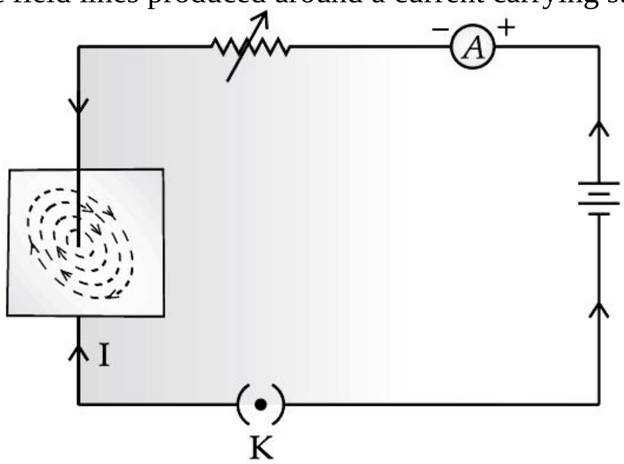


Am electromagnetic field is formed when a current passes through the wire.

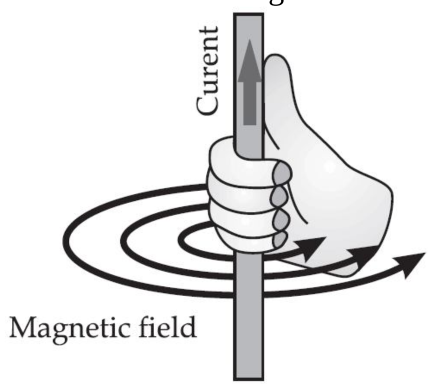
(b) Soft iron rod increases the magnetism of solenoid by a thousand fold. When the solenoid current is switched off, the magnetism is effectively switched off since the soft iron core has low retentivity.
(c) Ways to increase the strength of an electromagnet if the material of the electromagnet is fixed are:
(i) By increasing the amount of current flowing in the solenoid.
(ii) By increasing the number of turns in the solenoid.

OR

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.
Ans. 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

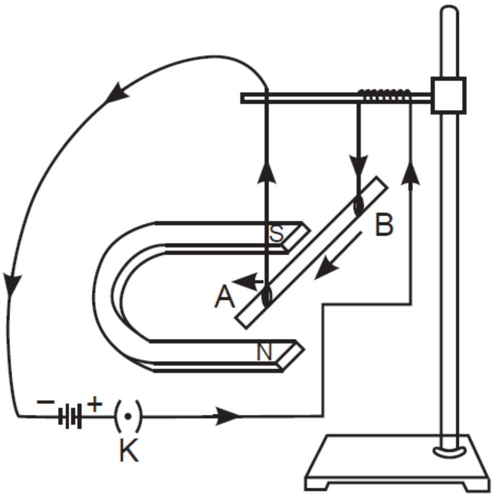


As the compass is placed farther, deflection in the needle decreases. Thus, the magnetic field produced by given current decreases as the distance from it increases. The concentric circles around the wire become larger as we move away from it.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

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



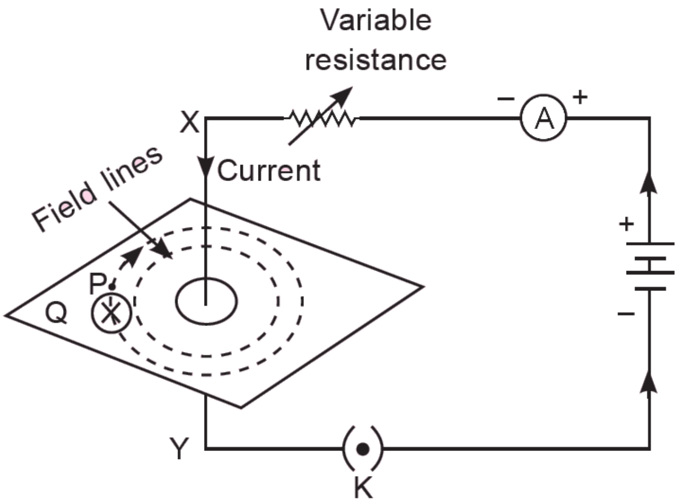
(a) Why does the rod get displaced on passing current through it ? (1)
(b) State the rule that determines the direction of the force on the conductor AB. (1)
(c) (i) In the above experimented set up, when current is passed through the rod, it gets displaced towards the left. What will happen to the displacement if the polarity of the magnet and the direction of current both are reversed ?
(ii) Name any two devices that use current carrying conductors and magnetic field. (2)

OR

(c) Draw the patten of magnetic field lines produced around a current carrying straight conductor held vertically on a horizontal cardboard. Indicate the direction of the field lines as well as the direction of current flowing through the conductor. (2)
Ans. (a) When a current carrying conductor is placed perpendicular to the magnetic field, it experiences a force.
(b) Fleming's left-hand rule: Stretch the thumb, forefinger and middle finger of your left-hand such that they are mutually perpendicular. If the first finger points to the direction of magnetic field and the second finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.
(c) (i) No change in the direction of displacement
(ii) Electric motor/ electric generator/ loudspeakers/ microphones/electrical measuring instruments

OR

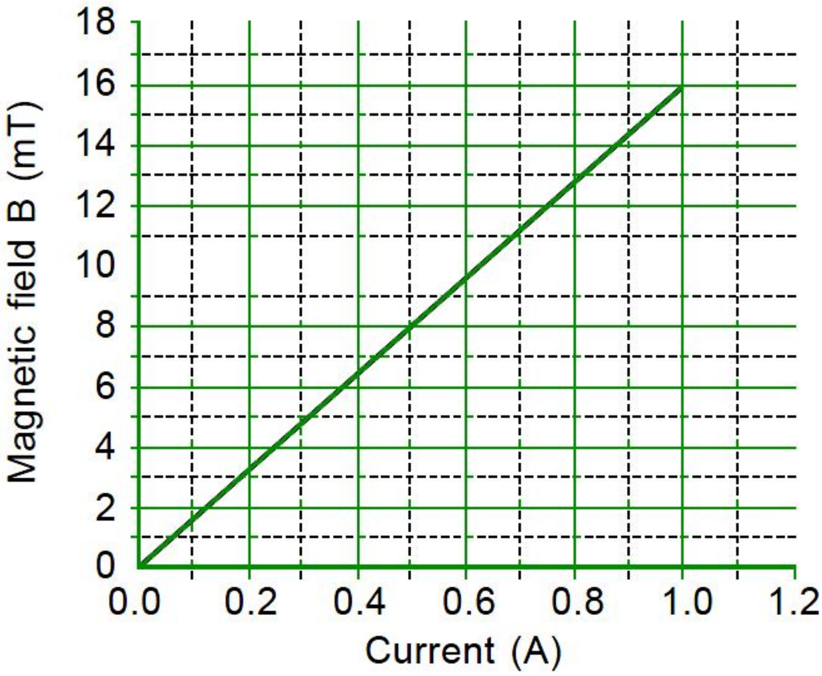
(c)



Direction of current-downward
Direction of field lines-clockwise.
Alternatively if the direction of current is marked upwards then direction of field lines will be anticlockwise.

20. 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 milli-Tesla (mT) and the current is given in Ampere.

(a) What will happen if a soft iron bar is placed insid the solenoid

(b) What conclusion would you like to draw after analysing the graph?

(c) (i) From the graph deduce the magnitude of magnetic field inside the solenoid if it carries a current of 0.8 A.

OR

(ii) List the two distinguishing features between the magnetic field of a current carryingsolenoid and a bar magnet.

Ans. (a) The soft iron bar will be magnetised as long as there is current in the circuit.

(b) The magnetic field produced by the current carrying solenoid is directly proportional to the current flowing through it.

(c) (i) From the graph, for a current of 0.8 A, the magnetic field is 13 mT.

OR

(ii) Distinguishing features are

• The magnetic field outside the solenoid is negligible as compared to the bar magnet.

• The magnetic field of a solenoid can be changed by changing the magnitude of current through it or by placing the core inside the solenoid but magnetic field around the bar magnet is fixed.