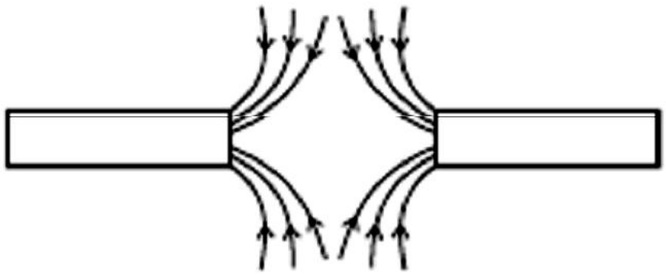
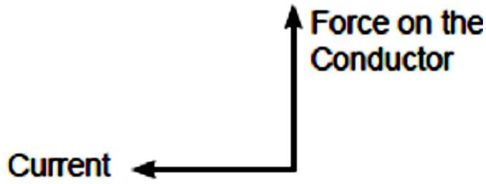
MAGNETIC EFFECTS OF ELECTRIC CURRENT

VERY SHORT ANSWER TYPE QUESTION [1 MARK]

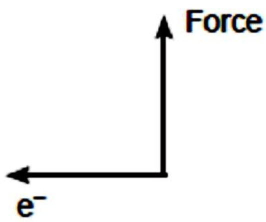
1. **Name the type of current: (a) used in household supply. (b) given by a cell.**
Answer. (a) Alternating current. (b) Direct current.
2. **State the observation made by Oersted on the basis of his experiment with current carrying conductors.**
Answer. The electric current passing through a conducting wire produces magnetic effect.
3. **Name the device which is used to draw magnetic field lines.**
Answer. Compass needle.
4. **Identify the poles of the magnet in the given figure.**



Answer. Both the poles facing each other represent south pole in nature as the magnetic field lines outside the magnet move from North to South Poles.
5. **State the direction of magnetic field in the following case.**

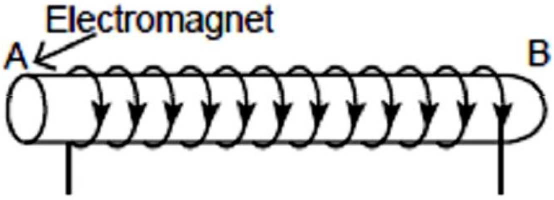


Answer. In given situation, according to Fleming's Left-Hand Rule Force is along y-axis. Current is along x-axis. Then magnetic field is along z-axis.
6. **State the direction of magnetic field in the following case.**



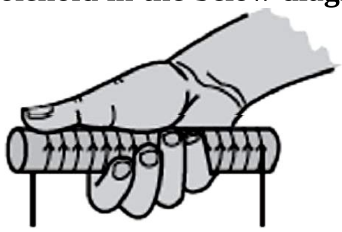
Answer. Perpendicular to the plane of paper in the outward direction by using Fleming's left hand rule.
7. **Give one application of electromagnetic induction.**
Answer. This phenomenon is used in electric generator.
8. **Name the physical quantities which are indicated by the direction of thumb and forefinger in the Fleming's right hand rule?**
Answer. In Fleming's right hand rule,
thumb indicates — direction of motion of the conductor; forefinger indicates — direction of magnetic field.
9. **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 north (b) towards east
(c) downward (d) upward
Answer. (d) Upward (Apply Fleming's left hand rule).

10. **The diagram shows a coil of wire wound on a soft iron core forming an electromagnet. A current is passed through the coil in the direction indicated by the arrows. Mark the N and S poles produced in the iron core.**



Answer. Using clock face rule
A is South pole. B is North pole.

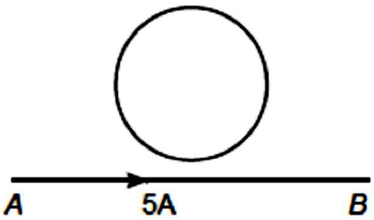
11. **How will you determine the direction of the magnetic field due to a current-carrying solenoid in the below diagram?**



Direction of magnetic field produced by anticlockwise current in a solenoid

Answer. Direction of magnetic field: Imagine the current carrying solenoid in your right hand such that the curled fingers are in the direction of current, then the extended thumb will indicate the direction of emerging magnetic field line, i.e. the face of solenoid which has North polarity.

12. **A steady current of 5 A is flowing through a conductor AB. Will the current be induced in the circular wire of radius lm?**

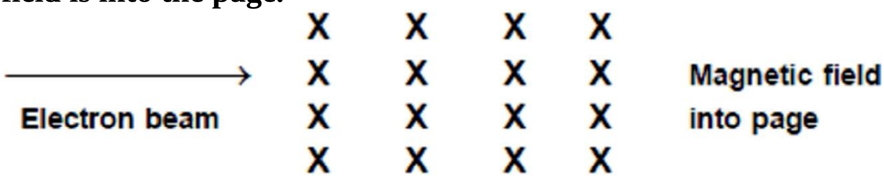


Answer. No, because circular coil is placed in a constant magnetic field produced by a steady current of 5A.

13. **Name the device used to prevent damage to the electrical appliances and the domestic circuit due to overloading.**
Answer. Electric fuse.

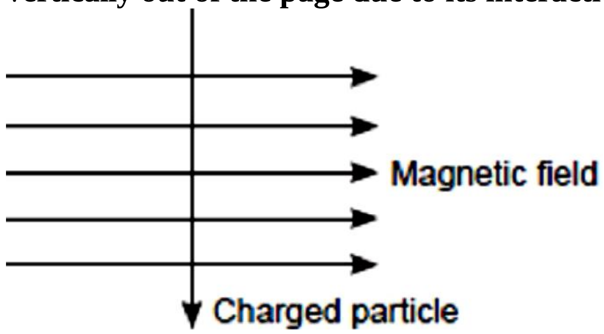
14. **Give one difference between the wires used in the element of an electric heater and in a fuse.**
Answer. Electric wire used in electric heater has a high melting point whereas fuse wire has a low melting point.

15. **The diagram shows a beam of electrons about to enter a magnetic field. The direction of the field is into the page.**



What will be the direction of deflection, if any, as the beam passes through the field?
Answer. Direction of current is from right to left as electron beam enters from left to right and magnetic field is into the page. So, according to Fleming's left hand rule, force is perpendicular to the flow of current and in its left side. So, electron beam deflects towards bottom of the page.

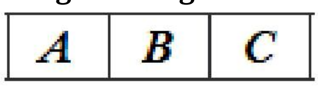
16. **How can you show that the magnetic field produced by a given electric current in the wire decreases as the distance from the wire increases?**
Answer. The decrease in deflection of the magnetic compass needle clearly shows that the magnetic field decreases as we move away from the current-carrying conductor.
17. **A current carrying straight wire held perpendicular to the plane of paper and current passes through this conductor in the vertically upward direction. What is the direction of magnetic field produced around it?**
Answer. According to right-hand thumb rule, the direction of magnetic field produced around the given conductor is anticlockwise.
18. **If the circular coil has n turns, the field produced is n times as large as that produced by a single turn. Justify it.**
Answer. This is because the current in each circular turn has the same direction, and the field due to each turn then just adds up along the axis of the coil
19. **Name any two appliances which are based on the application of heating effect of electric current.**
Answer. Room heater and geyser.
20. **An electron beam is moving vertically upwards. If it passes through a magnetic field which is directed from south to north in a horizontal plane, then in which direction will the beam deflect?**
Answer. Using Fleming's Left-Hand Rule, electron beam will be deflected towards the west.
21. **A charged particle enters at right angle into a uniform magnetic field as shown. What should be the nature of charge on the particle if it begins to move in a direction pointing vertically out of the page due to its interaction with the magnetic field?**



Answer. Using Fleming's left hand rule, the nature of charged particle is positive.

SHORT ANSWER TYPE QUESTIONS [I] [2 MARKS]

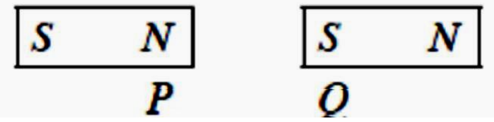
22. **The given magnet is divided into three parts A, B, and C.**



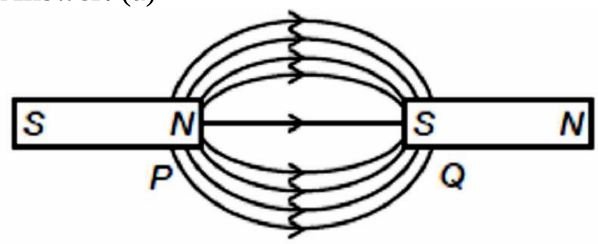
Name the parts where the strength of the magnetic field is: (i) maximum (ii) minimum. How will the density of magnetic field lines differ at these parts?
Answer.
(i) Maximum strength – at A and C
(ii) Minimum strength – at B
At A and C, magnetic field lines are crowded while at B, they are spread out.
23. **A compass needle is placed near a current-carrying wire. State your observation for the following cases, and give reason for the same in each case.**
(a) Magnitude of electric current in the wire is increased.
(b) The compass needle is displaced away from the wire.
Answer.
(a) Observation: The deflection of the needle increases.
Reason: Magnetic field strength due to current-carrying wire increases as current in the wire

increases, $B \propto I$.
(b) Observation: The deflection in the compass needle decreases as its displacement from the current-carrying wire increases.
Reason: The strength of magnetic field reduces with the increase in distance from the wire as $B \propto \frac{1}{r}$.

24. **(a) Two magnets are lying side by side as shown below.**
Draw magnetic field line between poles P and Q.

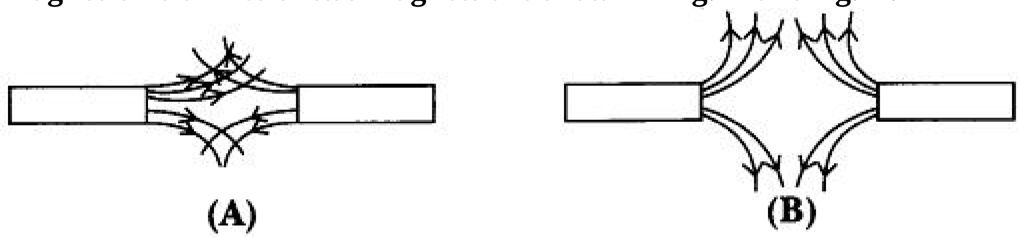


(b) What does the degree of closeness of magnetic field lines near the poles signify?
Answer. (a)



(b) The degree of closeness of magnetic field lines near the poles signify that the field is stronger there, i.e. the pole of another magnet when placed in the magnetic field experiences a greater force where the field lines are crowded.

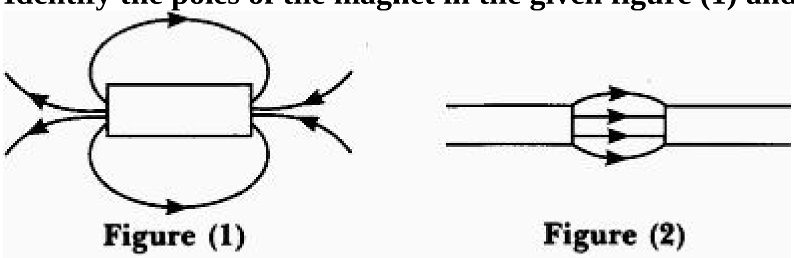
25. **Magnetic field lines of two magnets are shown in fig. A and fig. B.**



Select the figure that represents the correct pattern of field lines. Give reasons for your answer. Also name the poles of the magnets facing each other.
Answer. Figure B represents the correct pattern of field lines. In figure A, field lines cross each other which is not possible because if they cross each other, at the point of intersection, there would be two directions of field lines.
In figure B, field lines are emerging in nature, so poles of magnet facing each other are north poles while opposite faces will have south polarity.

26. **Insulation cover of which colour is conventionally used for earth wire? Why is an earth wire connected to metallic parts of appliances?**
Answer. For earth wire, green or yellow colour insulation is used. The earth wire provides the low resistance conducting path for the current and maintains the potential of appliances body with that of the earth. So, earth wire is used as a safety measure.

27. **Identify the poles of the magnet in the given figure (1) and (2).**



Answer. Field lines emerge from north pole (N) and merge at the south pole (S) as shown in both the figures

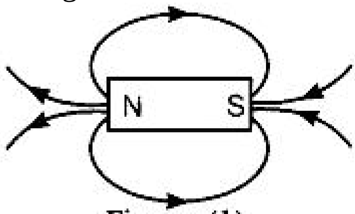


Figure (1)

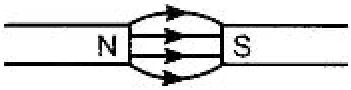


Figure (2)

28. **Explain the role of fuse in series with any electrical appliance in an electric circuit. Why should a fuse with defined rating for an electric circuit not be replaced by one with a larger rating?**
Answer. Fuse is a safety device connected in series with live wire or with any electrical appliance in an electric circuit. It stops the flow of unduly high electric current in the circuit by getting melted due to rise in temperature as per Joule's law of heating.
High rating fuse wire has the larger capacity. So, it will not stop the flow of any relatively high current. Therefore, electrical devices cannot be protected from the possible damage.
29. **The magnetic field associated with a current-carrying straight conductor is in anticlockwise direction. If the conductor was held along the east-west direction, what will be the direction of current through it? Name and state the rule applied to determine the direction of current.**
Answer. Direction of current – east to west as determined by Right-hand thumb rule. Ri'-lu-Uand Thumb Rule: If we hold a current-carrying conductor by right hand in such a way that the stretched thumb is along the direction of current, then the curly fingers around the conductor represents the direction of field lines of magnetic field.
30. **Two circular coils A and B are placed close to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.**
Answer. Yes, when a current in coil A changes, magnetic field lines linked with coil B also change. Hence, due to change in number of magnetic field lines, there is an induced current in coil B. ,
31. **A coil of insulated wire is connected to a galvanometer. What would be seen if a bar magnet with its north pole towards one face of the coil is**
(i) moved quickly towards it,
(ii) moved quickly away from the coil and
(iii) placed near its one face?
Name the phenomenon involved.
Answer.
(i) Deflection in the galvanometer needle will be more on right-side.
(ii) Larger deflection in opposite direction as compared to the case (i) will be seen. (Hi) No deflection.
The phenomenon involved is electromagnetic induction.
32. **Two coils A and B of insulated wires are kept close to each other. Coil A is connected to a galvanometer while coil B is connected to a battery through a key. What would happen if (i) a current is passed through coil B by plugging the key, and (ii) the current is stopped by removing the plug from the key?**
Explain your answer mentioning the name of the phenomenon involved.
Answer. In both the given cases, galvanometer shows momentary deflection but in opposite direction. In coil A, magnetic field lines [increased in case (i) and decreased in case (ii)] induce a potential difference across the coil A which sets up induced electric current in coil A. It is shown by the deflection in galvanometer. This is known as electromagnetic induction.
33. **An electric oven of 2 kW power rating is operated in a domestic electric circuit (220.V) that has a current rating of 5 A. What result do you expect? Explain.**
Answer. Current drawn by electric oven

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

Current rating of the circuit = 5 A
So, fuse will blow off and power supply will cut off

34. **When is the force experienced by a current-carrying conductor placed in a magnetic field largest?**
Answer. When the length of current-carrying conductor and direction of magnetic field are perpendicular to each other, the maximum force is experienced by the current-carrying conductor.

35. **Why and when does a current carrying conductor kept in a magnetic field experience force? List the factors on which direction of this force depends?**
Answer. The drifting of free electrons of a conductor in a definite direction causes the current to flow through it. When such conductor is placed in a uniform magnetic field, each drifted electron of a conductor experience a magnetic force. This force is collectively experience by a conductor as a whole. Hence a current carrying conductor kept in a magnetic field experience a force. The direction of magnetic force depends on
(i) direction of current through the conductor, and
(ii) direction of magnetic field.

36. **How is the strength of magnetic field near a straight current-conductor**
(i) related to the strength of current in the conductor?
(ii) is affected by changing the direction of flow of current in the conductor?
Answer.
(i) The strength of magnetic field around a straight current conductor increases on increasing the strength of current in the conductor or vice versa.
(ii)The direction of magnetic field around a straight current carrying conductor gets reversed if the direction of current through that conductor is reversed.

37. **List in tabular form two major differences between an electric motor and a generator.**
Answer.

Electric motor	Electric Generator
(i) It converts electrical energy into mechanical energy.	(i) It converts mechanical energy into electrical energy.
(ii) It works on the principle of magnetic effect of electric current, i.e. when a current carrying conductor is placed perpendicular to the direction of magnetic field, it experiences a force. The direction of force can be found by using the Fleming's Left-Hand Rule.	(ii) It is based on the electromagnetic induction, i.e. current can be induced in a coil by rotating it in a magnetic field. The direction of induced current can be found by using the Fleming's Right-Hand Rule.
(iii) Armature is rotated in the magnetic field by supplying electric current to it by some external source such as battery to get the mechanical work.	(iii) Armature is rotated in the magnetic field by some external mechanical force to produce electric current.
(iv) Split ring is used as a commutator to reverses the direction of flow of current and direction of force acting on the arms of the coil after every half of its rotation. This make the coil to continue rotate in the same direction.	(iv) The slip rings conduct the alternating current or split ring conduct the direct current to the external circuit through the carbon brushes.

38. **Explain any two situations that can cause electrical hazards in domestic circuits.**
Answer. (i) Connecting too many electrical devices to a single socket or in the extension cord for any length of time draws high current from the mains that will exceed the current rating of connecting wires. The wires cannot withstand such a high current and melt and may cause fire.
(ii) Most electrical hazards in domestic circuits are caused by the faulty electrical outlets, old and out-dated appliances. The chances of short circuit i.e., contact of live wire and neutral wires with

each other due to damage in their insulation or some fault in the appliances are very high. It may result spark at the contact point which may even cause fire,

39. **How does the power of electric motor be enhanced?**
Answer. The power of electric motor can be enhanced by
(i) using an electromagnet in place of permanent magnet.
(ii) increasing the number of turns in the coil and
(iii) using a soft iron core on which the coil is wound.

40. **What is meant by the term 'frequency of an alternating current'? What is its value in India? Why is an alternating current considered to be advantageous over direct current for long range transmission of electric energy?**
Answer.
- Frequency of Alternating current is equal to the number of cycles completed in one second.
- In India, frequency of AC is 50 Hz i.e. 50 cycles per second.
- An alternating current is considered to be advantageous over direct current for long range transmission of electric energy because it can be transmitted over long distances to distant places without much loss of electric power as compared to direct current.

SHORT ANSWER TYPE QUESTIONS [II] [3 MARKS]

41. **What is short circuiting? State one factor/condition that can lead to it. Name a device in the household that acts as a safety measure for it. State the principle of its working.**
Answer. Short circuiting: When electric circuit offers very low resistance to the flow of current through it, the current increases heavily and the circuit is said to be short circuited. It occurs when live wire touches the neutral wire. This happens due to the damage in insulation of the power lines.
Safety measure device: Fuse.
Working principle of fuse: It works on the heating effect of electric current or Joule's law of heating. According to this law, the heat produced in a resistor is directly proportional to the
(i) square of current for a given resistance.
(ii) resistance for a given current and
(iii) time for which the current flows through the resistor.
$H = I^2Rt$
So, when current in the circuit increases, the wire with low melting point in it melts to the heat generated. Hence, the circuit breaks and electrical devices and appliances are saved. _

42. **Write one application of each of the following:**
(a) Right-hand thumb rule (b) Fleming's left hand rule
(c) Fleming's right hand rule
Answer.
(a) Right-hand thumb rule is used to find the direction of magnetic field in a coil of wire and the electric current in a straight conductor.
(b) Fleming's left hand rule is used to find the direction of force exerted on a current-carrying conductor placed in a magnetic field as in electric motor.
(c) Fleming's right hand rule is used to find the direction of induced current in a closed circuit placed in changing magnetic field as in electric generator.

43. **State one main difference between A.C. and D.C. Why is A.C. preferred over D.C. for long range transmission of electric power? Name one source each of D.C. and A.C.**
Answer. Difference between A.C. and D.C.: The alternating current (A.C.) reverses its direction periodically whereas the direct current (D.C.) always flows in one direction.
A.C. is preferred over D.C. because it can be transmitted over long distance without much loss of energy.
D.C. source: Battery
A.C. source: A.C. generator

44. **How will the magnetic field produced at a point due to a current-carrying circular coil change if we:**
(i) increase the current flowing through the coil?
(ii) reverse direction of current through the coil?
(iii) increase the number of turns in the coil?
Answer. Magnetic field (B) at the centre of the circular coil
(i) increases if the current is increased as $B \propto I$
(ii) reverses on reversing the current. .
(iii) increases if the number of turns in the coil increases as field is directly proportional to the number of turns.

45. **(a) Mention the factors on which the direction of force experienced by a current-carrying conductor placed in a magnetic field depend.**
(b) Under what condition is the force experienced by a current-carrying conductor placed in a magnetic field maximum?
(c) A proton beam is moving along the direction of a magnetic field. What force is acting on proton beam?
Answer. (a) The direction of force experienced by the current-carrying conductor depends on:
(i) direction of current and
(ii)direction of magnetic field.
(b) When the direction of current is at right angle to the direction of magnetic field, the force is maximum.
(c) No force is experienced by the proton beam. As proton beam is moving along the direction of magnetic field.

46. **A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (a) pushed into the coil,**
(b) withdrawn from inside the coil,
(c) held stationary inside the coil?
Answer.
(a) When a bar magnet is pushed into the coil, magnetic field lines linked with the coil changes (increases). It causes the electric current to get induced in it. The needle of galvanometer will move momentarily in one direction.
(b) When a bar magnet is withdrawn from inside the coil, the magnetic field lines linked with the coil changes but in decreasing order. Current will be induced in the coil which will be indicated by deflection of needle in the galvanometer. The deflection is opposite to that in case (a). This indicates that the direction of induced current is now opposite to the direction of induced current in case (a).
(c) When bar magnet is held stationary inside the coil, there is no deflection in the galvanometer. This is because there is no change in magnetic field lines linked with the coil. Hence, no induced current will flow through the coil.

47. **State the rule to determine the direction of a**
(a) magnetic field produced around a straight conductor carrying current,
(b) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it.
Answer.
(a) Direction of magnetic field produced around a straight current-carrying conductor is given by right-hand thumb rule.
If we hold a current-carrying conductor in a right hand in such a way that the stretched thumb is along the direction of current, then the curly fingers around the conductor represent the direction of magnetic field lines.
(b) Direction of force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, is given by Fleming’s left hand rule.
Stretch the thumb, forefinger and middle finger of left hand in such a way that they are mutually perpendicular to each other. If the forefinger points to the direction of magnetic field and the

middle finger points to the direction of current, then the thumb will point to the direction of motion or the force acting on the conductor.

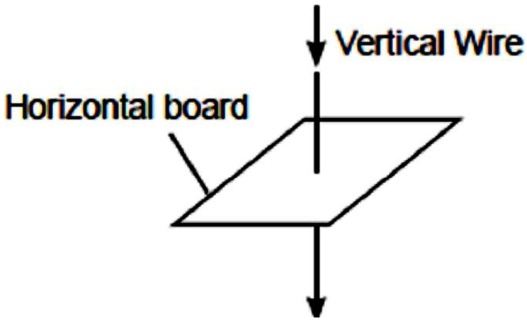
48. **State one main difference between A.C and D.C. Why A.C is preferred over D.C for long range transmission of electric power? Name one source each of D.C and A.C.**

Answer. Difference between A.C. and D.C. The alternating current (A.C.) reverses its direction periodically whereas the direct current (D.C.) always flows in one direction.

A.C. is preferred over D.C. because it can be transmitted over long distance without much loss of energy.

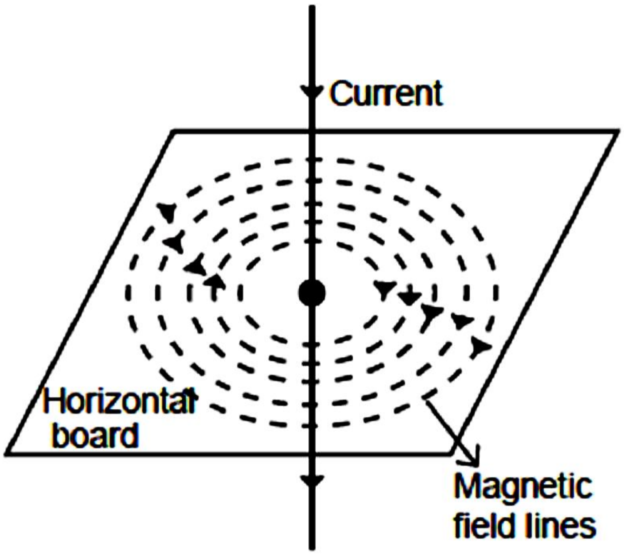
D.C. source : Battery, A.C. source : A.C. generator

49. **The direction of electric current passed through a vertical wire and through a horizontal card is shown below:**



Sketch the pattern of the magnetic field on the card around the wire. Indicate the direction of the magnetic field at any one point. How would you check this direction experimentally?

Answer. The pattern of magnetic field lines on the card around the current carrying conductor for the downward direction of current is shown. They are concentric in circle with their centre ties on the axis of wire.



Direction of magnetic field lines can be checked experimentally by placing a magnetic compass needle any where on the card board. Direction of its North pole indicating the direction of magnetic field.

50. **State the consequences that can lead to a short circuit. OR**

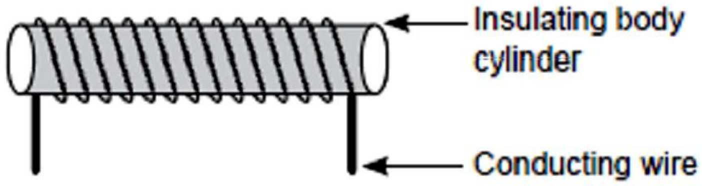
One of the major cause of fire in office building is short circuiting. List three factors which may lead to the short circuit.

Answer. It occurs as a consequence of

- failure of electrical insulation's due to which live wire comes in direct contact with neutral or earth wire.
- presence of external conducting material such as water which is introduced accidentally into the circuit.
- electrical appliances are forced to operate when its moving parts are jammed.

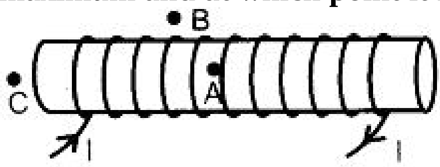
- connection of current carrying parts of electrical equipment's comes in contact to one another due to human or natural cause and
- use of less rating wires.
  When this happens, there is an excessive electric current which can damage the circuit and may also cause electrical fires.

51. **What is meant by solenoid? How does a current carrying solenoid behave? Give its main use.**
    Answer. Solenoid: A coil of many circular turns of insulated copper wire wound on a cylindrical insulating body (i.e., cardboard etc.) such that its length is greater than its diameter is called solenoid.

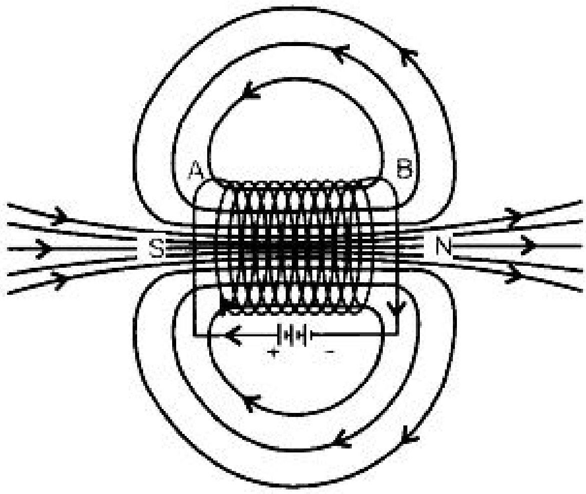


When current is flowing through the solenoid, the magnetic field line pattern resembles exactly with those of a bar magnet with the fixed polarity,
i.e. North and South pole at its ends and it acquires the directive and attractive properties similar to bar magnet. Hence, the current carrying solenoid behave as a bar magnet.
Use of current carrying solenoid: It is used to form a temporary magnet called electromagnet as well as permanent magnet.

52. **For the current carrying solenoid as shown below, draw magnetic field lines and giving reason 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.**



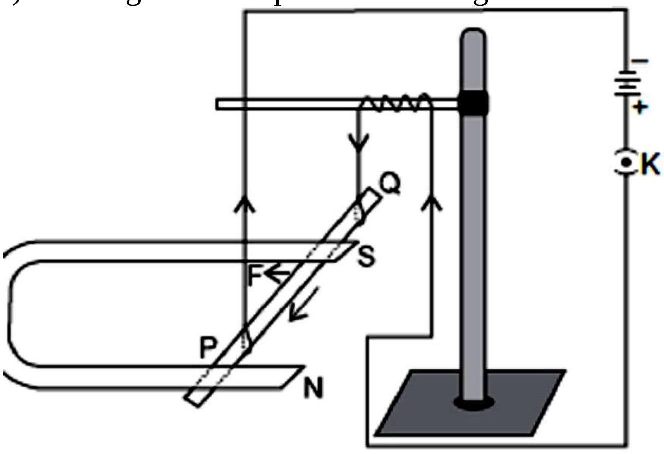
Answer. Outside the solenoid magnetic field is minimum. At the ends of solenoid, magnetic field strength is half to that inside it. So Minimum – at point B; Maximum – at point A



53. **With the help of a diagram of experimental setup describe an activity to show that the force acting on a current carrying conductor placed in a magnetic field increases with increase in field strength.**
    Answer.
    Aim : To show that force acting on a current carrying conductor placed in a magnetic field increases with the field strength.
    Apparatus Required : Aluminium rod, stand horse shoe magnet of different intensity, cell, key and connecting wires.

Procedure :

i) Arrange the set-up as shown in figure.



A current carrying rod, *PQ* is experiencing force *F*

ii) Plug the key, the current flowing through the rod from Q to P observe the displacement of rod.

iii) Now unplug the key and remove the first horse shoe magnet and place the second horse shoe magnet of higher magnetic field strength in a similar manner to that of first.

iv) Plug the key, the current again flow through the rod from Q to P. Again observe the deflection of rod.

v) Now bring both'the magnet closer together (to ensure greater magnetic field than that of previous case). Again observe the motion of rod.

Observations : Each time, the conductor moves faster than that of previous one. It is possible only when conductor gets accelerated more each time which required more force. (F = ma)
Thus, if the magnetic field strength is increased, the rod will experience a greater force and move faster.
Conclusion : The force acting on a current carrying conductor placed in a magnetic field increases with increase in field strength.

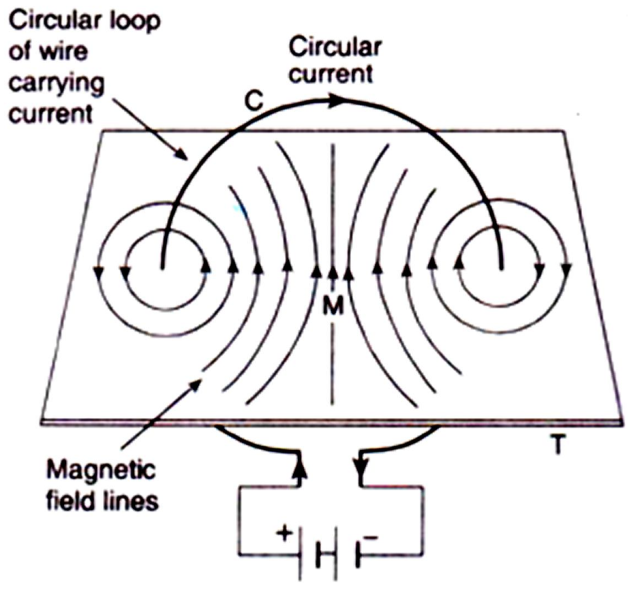
54. **What are magnetic field lines? Justify the following statements**
(a) Two magnetic field lines never intersect each other.
(b) Magnetic field lines are closed curves.
Answer.
Magnetic field lines: It is defined as the path along which the unit North pole (imaginary) tends to move in a magnetic field if free to do so.
(a) The magnetic lines of force do not intersect (or cross) one another. If they do so then at the point of intersection, two tangents can be drawn at that point which indicates that there will be two different directions of the same magnetic which field, i.e. the compass needle points in two different directions which is not possible.
(b) Magnetic field lines are closed continuous curves. They diverge from the north pole of a bar magnet and converge its south pole. Inside the magnet they move from south pole to north pole.

55. **What is overloading? State the causes of overloading.**
Answer. Overloading: If the current drawn by the many electrical appliances connected to a single socket exceeds the current rating of the wire, the entire circuit or part of circuit gets heated and can even cause fire. This is known as overloading.
It might be due to
(i) accidental hike in supply voltage or
(ii) connecting too many appliance to a single socket or
(iii) damage in the insulation of wires or
(iv) some fault in the appliances or
(v) direct contact between a live wire and a neutral wire.

56. **Give scientific reasons.**

(a) Wires carrying electricity should not be touched when bare-footed.
(b) We must not use many electrical appliances simultaneously.
(c) Electrical switches should not be operated with wet hand.
Answer. (a) When we touch the live wire bare-footed, our body is directly in contact with the earth. So, current passes through the body to the earth. As our body is good conductor of electricity, we get a severe shock. Hence, we should not handle live wires bare footed.
(b) When many high power rating appliances are switched on simultaneously, a large amount of current flows through the main circuit and current may exceed the bearing capacity of the connecting wires. This causes overloading, which may cause fire. Hence, we must not use many electrical simultaneously.
(c) Switches should not be operated with wet hand : Water is a good conductor of electricity as it contains salt and impurities. When we touch the switch with wet hand, it is possible that electric current will pass through our body and we get a severe shock.

57. **Describe an activity to show that the magnetic field lines produced when current is passed through the circular coil.**
Answer.
Aim : To study the characteristics of magnetic field produced by a current carrying circular coil at its centre.
Apparatus Required : Rectangular cardboard having two holes, Thick copper circular coils of different radii having known number of turns, key, battery, rheostat, stand, iron filings.
Procedure :
i) Pass the coil through the two holes of cardboard in such a way that half of the loop is above the cardboard and remaining part should be below it and normal to the plane of cardboard.
ii) Connect the circuit as shown.



Magnetic lines of force due to a circular wire carrying current

iii) Sprinkle iron filings uniformly on the cardboard.
iv) Allow the current to pass though the coil by inserting plug in the key.
v) Note the pattern of iron filings that emerges on the cardboard after tapping gently a few times. (Observation).
vi) Place the compass at any point over the pattern of field. Observe the direction of needle. (Observation 2).

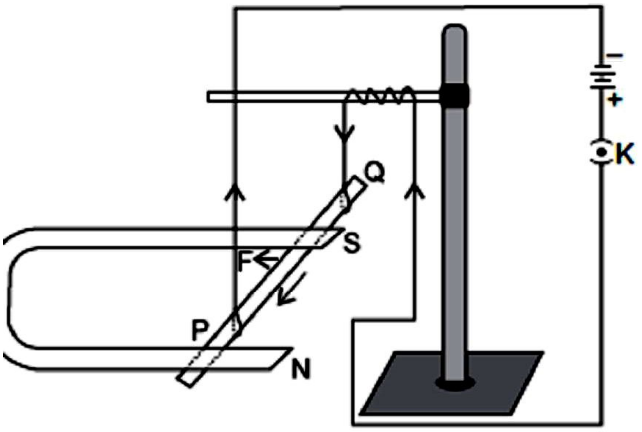
Observations :
(a) Iron filings are arranged in the form of concentric circles.
(b) The concentric circles become larger and larger as we move away from the wire.
(c) At the centre of loop, lines are almost straight and perpendicular to the plane of the loop.

Conclusion :

i) The concentric circles at every point of a current carrying circular loop represent the magnetic field around it.
ii) Magnetic field line close to the axis of loop is straight and is perpendicular to the plane of the coil.
iii) Field lines keep on diverging as we move away from the centre of loop.

LONG ANSWER TYPE QUESTION [5 MARKS]

58. **(a) Describe activity with labelled diagram to show that a current carrying conductor experience a force in a magnetic field.**
(b) State the rule to determine the direction of force.
Answer.
(a) Without using a magnet, magnetic field can be produced by flowing the current through a straight conductor or a solenoid.
Aim : To show that magnetic field exerts a force on a current carrying conductor.
Apparatus required : Aluminium rod, stand, strong horse shoe magnet, cell, key and connecting wires.



A current carrying rod, *PQ* is experiencing force *F*

Procedure :

i) Hang the aluminium rod with the help of clamp stand such that it passes between the North and South pole of the magnet with the magnetic field directed upwards and the rod being horizontal and perpendicular to the field.
ii) Connect the aluminium rod in series with a battery, a key as shown in figure.
iii) Plug the key, the current flows through the rod from Q to P and observe the direction of motion of the rod.
iv) Reverse the direction of current by reversing the battery connection. Again observe the direction of displacement of aluminium rod.
v) Restore the original direction of current and change the direction of field vertically downwards by interchanging the two poles of the magnet. Observe the deflection of rod again.
vi) Place the wire parallel to magnetic field and allow the current to pass through it. Check the deflection of rod again.

Observation :

i) On plugging the key in step 3, the aluminium rod moves towards left.
ii) In step 4, rod displaces towards right.
iii) In step 5, rod moves towards right again.
iv) In step 6, rod does not move in any direction.

Conclusion :

i) Magnetic field exerts a force on a current carrying conductor.

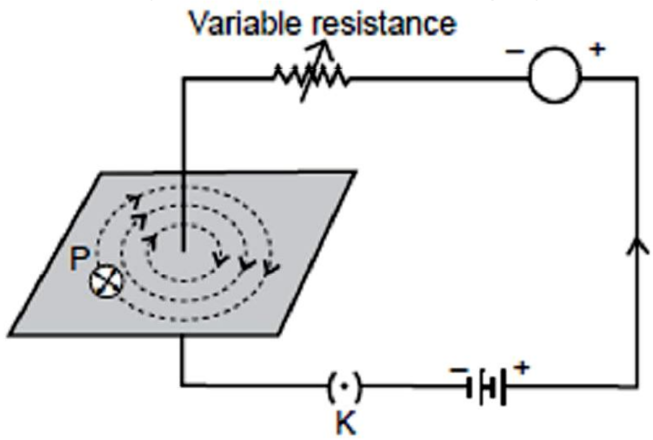
ii) The force exerted on the current carrying conductor depends upon the direction of current and direction of magnetic field acting on it.
iii) Displacement of the rod or the magnetic force on it is largest when the direction of current is at right angle to the direction of magnetic field.
iv) When current carrying conductor is placed parallel to the magnetic field, it experiences no force.
(b) Direction of force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it is given by Fleming's left hand rule.
Stretch the thumb, forefinger and middle finger 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 and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

59. **(a) Describe an activity to demonstrate the pattern of magnetic field lines around a straight conductor carrying current.**
(b) State the rule to find the direction of magnetic field associated with a current carrying conductor.
(c) What is the shape of a current carrying conductor whose magnetic field pattern resembles that of a bar-magnet ?

Answer.

(a) Aim : To study the magnetic field due to a straight current carrying conductor.
Apparatus Required : A thick conducting wire, battery, rheostat, magnetic needle, ammeter (0-5 A), key, a cardboard, a stand to hold the wire, iron filings and sprinkler of iron filings.

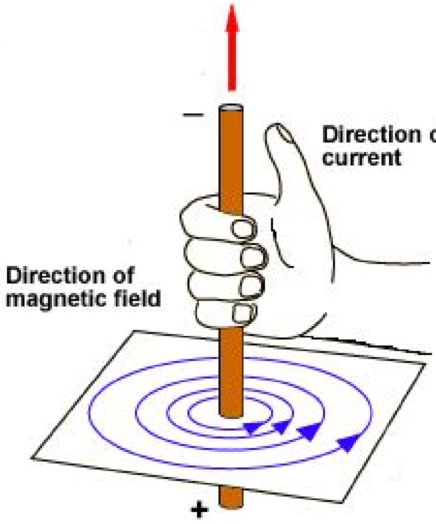
Procedure :
i) Attach the thick wire through a hole at the middle of the cardboard and clamp it in a stand.
ii) Attach the ends of the wire through a key, variable resistor and an ammeter on either side of a battery and hold it vertically and perpendicularly to the board.
iii) Spread the iron filings uniformly on the cardboard and place the magnetic needle on the board.
iv) Close the key and tap the cardboard slightly and observe the orientation of iron filings.



Magnetic field around a straight conducting wire.
Concentric circles indicate the field lines

Observation :
Just on closing the key, the iron filings are aligned in the pattern of concentric circles around the wire.

Conclusion :
i) Current carrying conductor is a source of magnetic field.
ii) The magnetic field is in the form of concentric circles whose centre lies on the wire.
(b) Right-Hand Thumb Rule. This rule is used to find the direction of magnetic field due to a straight current carrying wire.



It states that if we hold the current carrying-conductor in the right hand in such a way that the thumb is stretched along the direction of current, then the curly finger around the conductor represent the direction of magnetic field produced by it. This is known as right-hand thumb rule.

Direction of Field Lines due to current carrying straight conductor is as shown in figure.

(c) Solenoid.

60. **(a) Explain why there are two separate circuits one for high power rating appliances and other for low power rating appliances.**
(b) A domestic circuit has 5A fuse. How many bulbs of rating 100W, 220V can be safely used in this circuit? Justify your answer.
Answer.
(a) Two separate circuits are formed in the domestic wiring, one for high power rating appliances called power circuit and other for low power rating called lightning circuit.
Power circuit: The circuit which draw heavy current (15 A) from mains and used for high power rating devices such as microwave, oven, air conditioners, geysers, washing machine, etc., is known as power circuit. Lightning circuit: The circuit which draw small amount of current from the mains and used for low power rating devices such as bulb, tube light, fans, T.V., Computer, etc. having a current rating of 5 A is known as lightning circuit.
(b) In India, the correct voltage is 220 V.
Electric current flowing in the circuit is given by

$$I = \frac{P}{V}$$

Hence, $I = 5$ A, $V = 220$ V and $P = n \times 100$
Where, n = number of bulbs

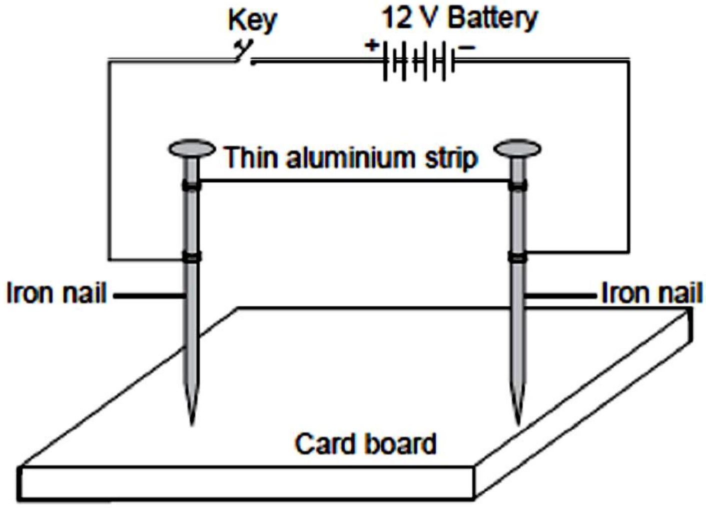
$$\therefore \quad 5 = \frac{n \times 100}{220}$$

$$\therefore \quad n = \frac{5 \times 220}{100} = \frac{1100}{100} = 11$$

So, 11 bulbs of 100 W can be used in the house at correct voltage.

61. **(i) Design an activity with the help of two nails, very thin aluminium strip, a 12 V Battery and a key to illustrates.**
(ii) Cable of a microwave oven has three wires inside it which have insulation of different colours black, green and red. Mention the significance of the three colours and potential difference between red and black one.
Answer.
(a) Aim: How electric fuse works?
Apparatus required : Two nails, card board, very thin aluminium strip, a 12 V battery, key and connecting wires.
Procedure:

Insert the two nails vertically on the card board.
Take very thin aluminium strip and tie it between the nails.
Make a circuit as shown in figure with 12 V battery and key with the help of connecting wires.



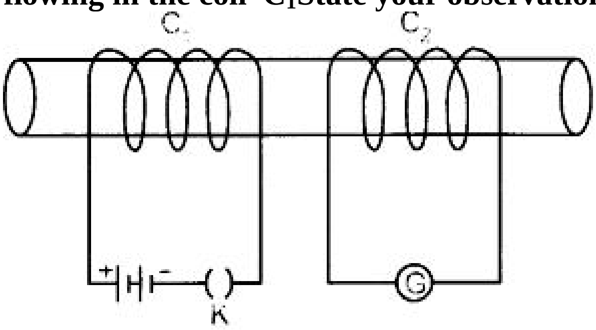
If there are any fans running in the room, switch them off.
Now switch on the current in the circuit by pressing the key or by moving the switch of the 'ON' position.
Now pass the current through the circuit for some time. Observe the strand of aluminium strip between the two nails carefully.
Observation: The strand of aluminum strip melt and break quickly on passing the large electric current through it.

Conclusion: When current flows through the circuit, exceed the rating of aluminium strip, i.e. safe limit, its temperature increases. This make it overheated. As a result, aluminium strip melts and breaks the circuit. Hence, very thin aluminium strip between the two nails acts as a fuse wire. This activity shows that how fuse works.

(b) Significance of insulation colour:
Red colour insulation wire – Live wire
Black colour insulation wire – Neutral wire
Green colour insulation wire – Earth wire

Live wire is at higher potential of 220 V while neutral wire is at zero potential. So, potential difference between red and black insulation wire is 220 V.

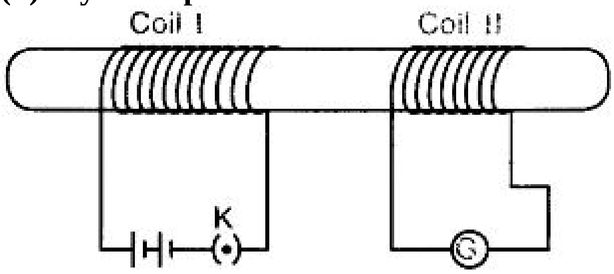
62. **Two coils C_1 and $C_2$are wrapped around a non conducting cylinder. Coil $C_1$is connected to a battery and key and C_2 with galvanometer G. On pressing the key (K), current starts flowing in the coil C_1State your observation in the galvanometer:**



(i) When key K is pressed on
(ii) When current in the coil C_1 is switched off.
(iii) When the current is passed continuously through coil C_1
(iv) Name and state the phenomenon responsible for the above observation. Write the name of the rule that is used to determine the direction of current produced in the phenomena.
Answer.
(i) When key is pressed on, the galvanometer needle deflects momentarily in one direction.
(ii) When the current in the coil C_1 is switched off, the galvanometer needle deflects again

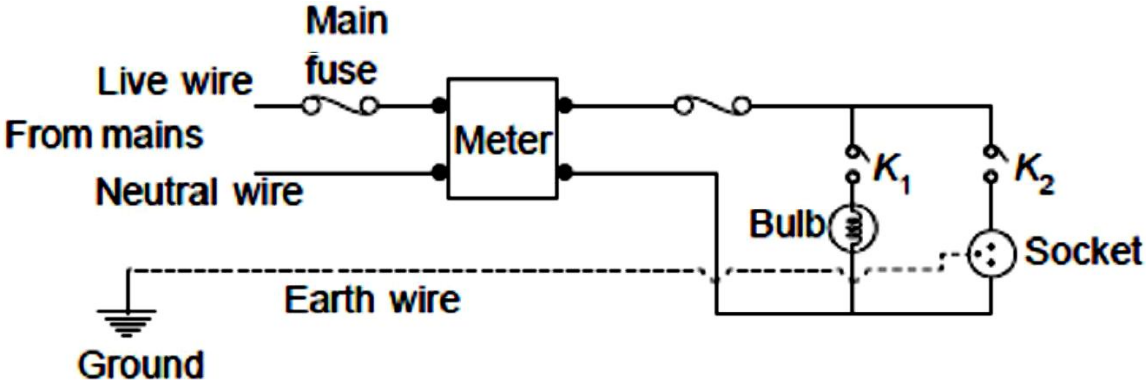
momentarily but in opposite direction to that in the previous case.
(iii) When current is passed continuously through coil C_1 , no deflection is observed in the galvanometer.
(iv) The phenomenon responsible for the above observations is electromagnetic induction.
Electromagnetic Induction: The process, by which a changing magnetic field in a conductor induces a current in another conductor placed nearby, is called electromagnetic induction.
• Fleming's right hand rule is used to determine the direction of current produced in the phenomena of electroynagnetic induction.

63. **Two coils of insulated copper wire are wound over a non -conducting cylinder as shown. Coil I has larger number of turns.**
(i) Write your observations when,
(a) key K is closed,
(b) key K is opened.



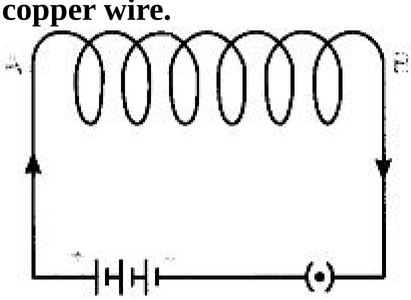
(ii)When the current is passed continuously through coil I.
Give reason for your observations.
(iii)Name and state the phenomenon responsible for the above observation.
(iv) Write the name of the rule that is used to determine the direction of current produced in the phenomenon.
(v) Name the two coils used in this experiment.
Answer.
(i) (a) When key is closed, the galvanometer needle deflects momentarily in one direction. ,
Reason: When key is closed, magnetic field lines around coil 2 increases momentarily. This causes an induced current to flow through it and hence deflection occurs in one direction.
(b) When key is opened, the galvanometer needle deflects again momentarily but in opposite direction.
Reason: When key is open, magnetic field lines around coil 2 decreases momentarily. This causes an induced current to flow in opposite direction. Hence, deflection occurs in opposite direction.
(ii) When current is passed continuously through coil I, no deflection is observed in the galvanometer.
Reason: There will be no change in magnetic field lines passing through the coil 2. Hence, no induced current will be set up in coil 2.
(iii) The phenomenon observed in above cases is electromagnetic induction. It is a process by which a changing magnetic field in a conductor induces a current in another conductor placed nearby.
(iv) Fleming's right hand rule
(v) Coil I – Primary coil Coil II – Secondary coil

64. **(a) Mention the effect of electric current on which the working of an electrical fuse is based.**
(b) Draw a schematic labelled diagram of a domestic circuit which has a provision of a main fuse, meter, one light bulb and a socket.
(c) Explain the term overloading of an electric circuit.
Answer.
(a) Heating effect of electric current.
(b) Domestic circuit wiring consists of a main fuse, meter, one light bulb and a socket.

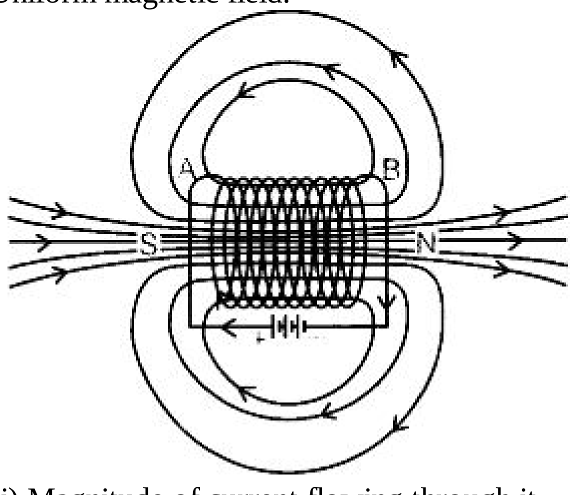


(c) The flow of large amount of current through the circuit beyond its bearing capacity due to use of many high power rating devices at the same time is called overloading.

65. **Observe the figure given below and answer the following questions:**
(a) Write the special name given to the coil AB which has many circular turns of insulated copper wire.



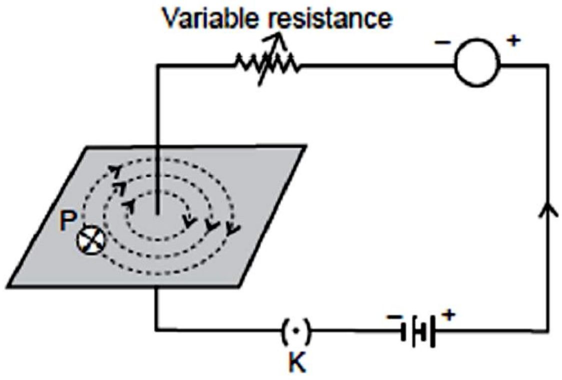
(b) State the nature of magnetic field inside AB when a current is passed through it.
(c) Redraw the diagram and sketch the pattern of magnetic field lines through and around AB.
(d) List two factors on which the strength of the magnetic field produced by AB depends.
(e) What is the effect of placing an iron core in the coil AB?
Answer.
(a) Solenoid.
(b) Uniform magnetic field.
(c)



(d) (i) Magnitude of current flowing through it.
(ii) Number of turns of a circular coil.
(e) It becomes an electromagnet.

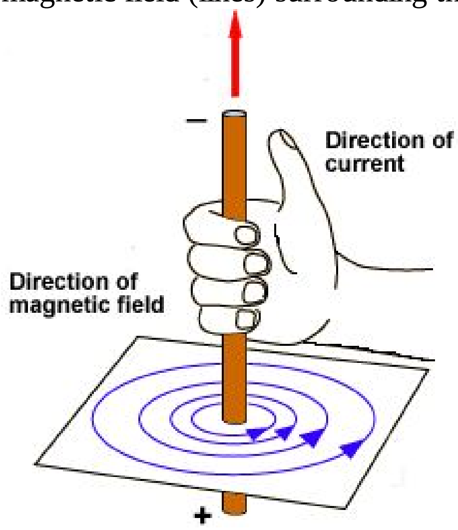
66. **(a) Describe an activity to demonstrate the pattern of magnetic field lines around a straight conductor carrying current.**
(b) State the rule to find the direction of magnetic field associated with a current-carrying conductor.
(c) What is the shape of a current-carrying conductor whose magnetic field pattern resembles that of a bar-magnet?

Answer.
(a) Aim: To study the magnetic field due to a straight current-carrying conductor.
Apparatus Required: A thick conducting wire, battery, rheostat, magnetic needle, ammeter (0-5 A), key, a cardboard, a stand to hold the wire, iron filings and sprinkler of iron filings.
Procedure:
Attach the thick wire through a hole at the middle of the cardboard and clamp it in a stand.
Attach the ends of the wire through a key, variable resistor and an ammeter. on either side of a battery and hold it vertically and perpendicularly to the board.
Spread the iron filings uniformly on the cardboard and place the magnetic needle on the board.
Close the key and tap the cardboard slightly and observe the orientation of iron filings.



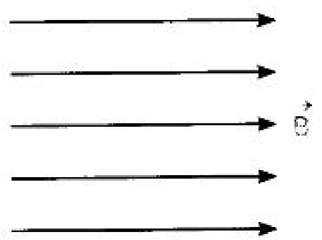
Magnetic field around a straight conducting wire.
Concentric circles indicate the field lines

Observation: Just on closing the key, the iron filings are aligned in the pattern of concentric circles around the wire.
Conclusion:
A current-carrying conductor is a source of magnetic field.
The magnetic field is in the form of concentric circles whose centre lies on the wire.
(b)Right – Hand thumb Rule: Hold the current-Carrying wire in your right hand, such that the thumb indicates the direction of current, then the folded fingers will indicate the direction of magnetic field (lines) surrounding the wire.



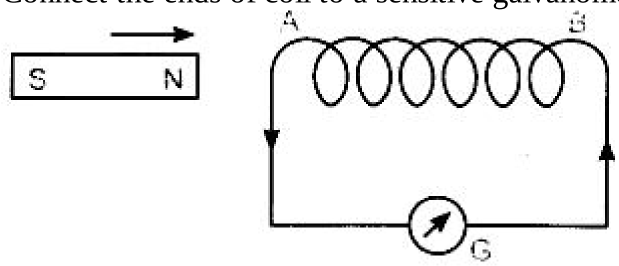
(c) Solenoid.

67. **(a) Draw a diagram to represent a uniform magnetic field in a given region.**
(b) List two properties of magnetic field lines.
Answer.
(a) Equidistant parallel line indicates a uniform magnetic field in a given region.



(b) Properties of magnetic field lines are:
The magnetic field lines of a magnet form continuous closed loops, i.e. outside the magnet, they emerge from north pole and merge at the south pole and inside the magnet, the direction of field lines is from its south pole to its north pole.
The degree of closeness of field lines indicates the strength of magnetic field.
Field lines never cross each other.

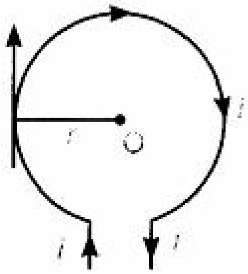
68. **(i)With the help of an activity, explain the method of inducing electric current in a coil with a moving magnet. State the rule used to find the direction of electric current thus generated in the coil.**
(ii) Two circular coils P and Q are kept close to each other, of which coil P carries a current. What will you observe in Q
(a) if current in the coil P is changed?
(b) if both the coils are moved in the same direction with the same speed? Give reason.
Answer.
(i) Take a coil AB of wire having a large number of turns.
Connect the ends of coil to a sensitive galvanometer as shown in figure.



Take a strong bar magnet and move its north pole towards the end 'A' of coil. The deflection in the needle of galvanometer indicates that the induced current flows in the circuit in anticlockwise direction. The end A of the coil behaves as a north pole.
When north pole of the magnet moves away from the coil, the deflection in the galvanometer occurs but in opposite direction.
Similar observations can be made when south pole of the magnet is moved towards the coil or away from it.
When magnet is kept at rest with respect to the coil, the deflection in the needle of galvanometer drops to zero.
Thus, the motion of a magnet, with respect to the coil, produces an induced potential difference which sets up an induced electric current in the circuit.
The direction of electric current thus generated in the coil can be found by using the Fleming's right-hand rule.
(ii)Fleming's right-hand rule: Stretch the thumb, forefinger and middle finger of right hand in such a way that they are mutually perpendicular to each other. If the forefinger indicates the direction of magnetic field and thumb shows the direction of motion of the conductor, then the middle finger will indicate the direction of induced current.
(a) If current in the coil P is changed, the magnetic field lines of forces linked with coil Q also change. So, induced potential difference is set up in the coil Q. This results in induced electric current in coil Q which opposes the change in current in coil P.
(b) If both the coils are moved in the same direction with the same speed, there will be no relative motion between them and hence, there will be no change in magnetic field lines of force associated with the secondary coil. Hence, no current will be induced in the coil.

69. **Consider a circular loop of wire lying in the plane of the paper. Let the current pass through the loop clockwise. With the help of a diagram, explain how the direction of the magnetic field can be determined inside and outside the loop. Name the law used to find the direction of magnetic field.**

Answer. Consider a circular loop of wire of radius r with centre O lying in the plane of the paper. Let the current i pass through the loop clockwise. According to right hand thumb rule, direction of magnetic field due to any portion of small current carrying length of the coil is:
Direction of magnetic field inside the loop — Perpendicular to the plane of paper inwards.
Direction of magnetic field outside the loop — Perpendicular to the plane of paper outwards.



So, the direction of magnetic field can be considered as the direction of total magnetic field due to circular coil as current through all the elements will contribute to the magnetic field in the same direction.

70. **Why is pure iron not used for making permanent magnets? Name one material used for making permanent magnets. Describe how permanent magnets are made electrically. State two examples of electrical instruments made by using permanent magnets.**

Answer.

- Pure iron cannot retain its magnetism for long time. Hence it cannot be used for making permanent magnet.
- Cobalt-steel or some alloys of iron such as ALNICO are used for making permanent magnet.
- Formation of permanent magnet electrically A current carrying solenoid is used to magnetise steel rod. Steel rod is kept inside the solenoid. A strong uniform magnetic field produced by the current carrying solenoid magnetise it. The magnet so formed retains the magnetism even after switching off the current in solenoid.
- Permanent magnets are used in (i) Galvanometer and (ii) loudspeaker