10th Chapter-13 Magnetic Effects of Electric Current

1. Q. Electricity and magnetism are linked to each other. Justify?

Answer: Place a small magnetic compass near to current caring conducting wire. The position of its needle gets changed. This effect is called magnetic effect of current. Thus, Electricity and magnetism are related phenomena. This effect at first is observed by Hans Christian Oersted in 1820.

The branch of science in which we study about Electricity and magnetism is called Electrodynamics.

2. Q. What is magnetic compass?

Answer: A small bar magnet having two needles like end. The end pointing towards north is called North Pole [Red color]. The other end that points towards south is called South Pole.

3. Q. Why does a compass needle get deflected when brought near a bar magnet?

Answer: This is because of magnetic force which is exerted by a bar magnet.

4. Q. What do you mean by Magnetic Field and Magnetic field Line?

Answer: The region surrounding a magnet, in which the force of the magnet can be detected, is called its magnetic Field.

The imaginary lines which represent the magnetic field around the magnet are called magnetic field lines.

5. Q. Fix a card board on a table and place a bar magnet in the centre of it. Now sprinkle some iron fillings uniformly around the bar magnet. You observe that iron fillings arrange themselves in a pattern. Why?

Answer: The iron fillings experience a. magnetic force which makes iron filling to arrange in a pattern. The lines along which the iron fillings align themselves represent magnetic lines of force.

6. Q. List the properties of magnetic lines of force?

Answer: The properties of magnetic field lines are:

(i) Inside the magnet, the direction of magnetic field lines is from its South Pole to North Pole.

(ii) Outside the magnet, the direction of magnetic field lines is from its North Pole to South Pole.

(iii) The magnetic field lines are closed curves_

(iv) The magnetic field lines do not cross each other

7. Q. No two field-lines are found to cross each other. Why?

Answer: This is because the needle of magnetic compass always point in only one direction around a magnet.

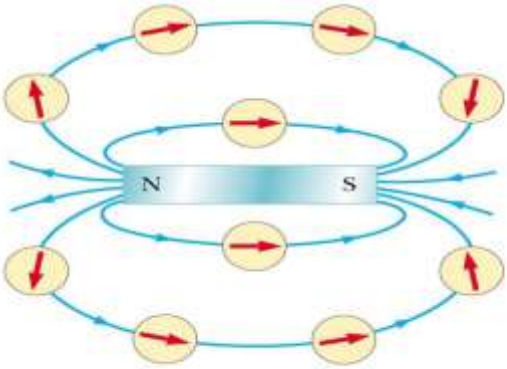
8. Q. What determines the pattern of the magnetic field generated by current through a conductor? Does the pattern depend on the shape of the conductor?

Answer: Yes. The pattern of the magnetic field generated by current through a conductor depends on the shape of the conductor.

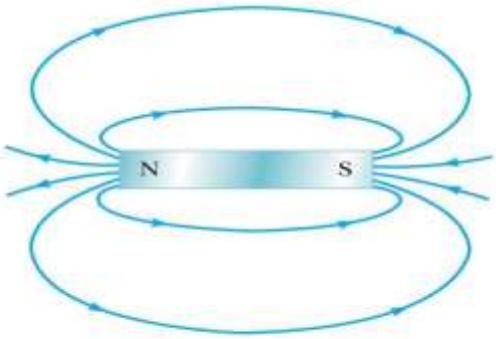
Oersted found that the magnetic field generated by straight current caring conductor form concentric circles. Ampere found that a current caring conductor of a circular loop form two concentric circles.

9. Q. Draw magnetic field lines with the help of a compass needle around bar magnet.

Answer:

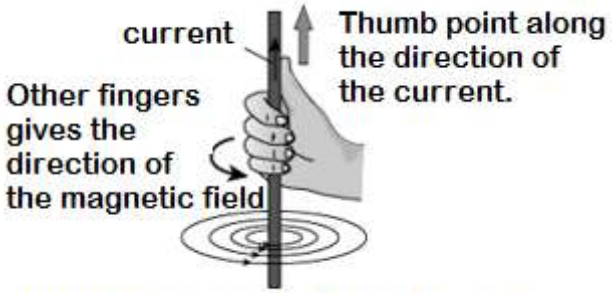


(a)



(b)

10. Q. How can you find the direction of the magnetic field line forming concentric circle around a straight current caring conductor?

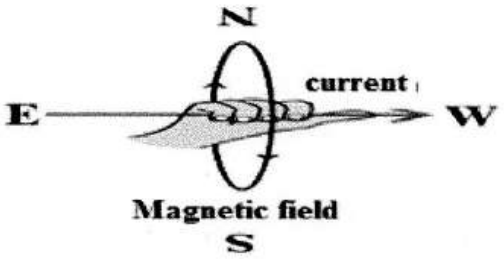


Maxwell the right-hand thumb rule

Answer : (a) Using a compass: Place a compass at any point over a circle. The direction of the north pole of the compass needle would give the direction of the field lines.

(b) Applying Right Hand Thumb Rule: Hold a current-carrying straight conductor in your right hand such a way that the thumb points towards the direction of current. Then your fingers will wrap around the conductor in the direction of the field lines of the magnetic field. This is known as Maxwell the right-hand thumb rule.

11. Q. A current through a horizontal power line flows in east to west direction. What is the direction of magnetic field at a point directly below it and at a point directly above it?



Answer: The current is in the east-west direction. Applying the right-hand thumb rule, we get that the direction of magnetic field at a point below the wire is from north to south. The direction of magnetic field at a point directly above the wire is from south to north.

12. Q. What are the properties of magnetic field line around a straight current caring conductor?

Answer: The properties of magnetic field tine around a straight current caring conductor are:

(a) The magnetic field tines form concentric circles.

(b) Direction of magnetic field lines get reversed by reversing the direction of current through the straight wire.

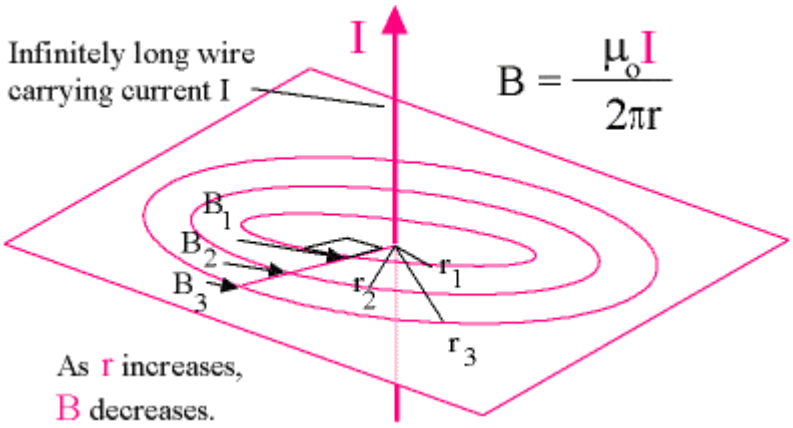
(c) Strength of magnetic field [SI unit Tesla] depends on Magnitude of current [$B \propto I$]

(d) Strength of magnetic field decreases as the distance from conductor increases. [$B \propto \frac{1}{r}$]

13.Q. What is the intensity of magnetic field (B) at a point near a long straight current caring conductor?

Answer: Let p is a point at a perpendicular distance of r from the straight wire then the intensity of magnetic field (B) at point P is given by formula B = $\frac{\mu_0 I}{2\pi r}$

Here μ_0 is a constant and its value in SI unit is $4\pi \times 10^{-7}$ m/A The direction of B at P is given by Right Hand Rule and here it is directed into the paper.



14. Q. What are the properties of magnetic field line around a current caring conductor of circular loop?

Answer: (a) The magnetic field lines near the coil are nearly circular and concentric

(b) The magnetic fields at the centre of the coil are uniform [straight and parallel]

(c) The direction of the magnetic field at the centre is perpendicular to the plane of the coil.

(d) Magnetic field is maximum at its centre.

(e) The face from which the line of force come out is N — Pole and other is S - pole.

15. Q. What are the factors on which strength of the magnetic field around a circular loop of conductor depends on?

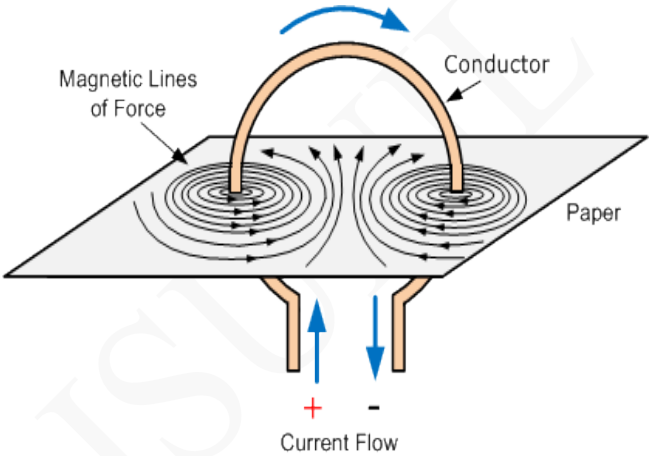
Answer: The strength of the magnetic field (B) at the centre of the coil is:

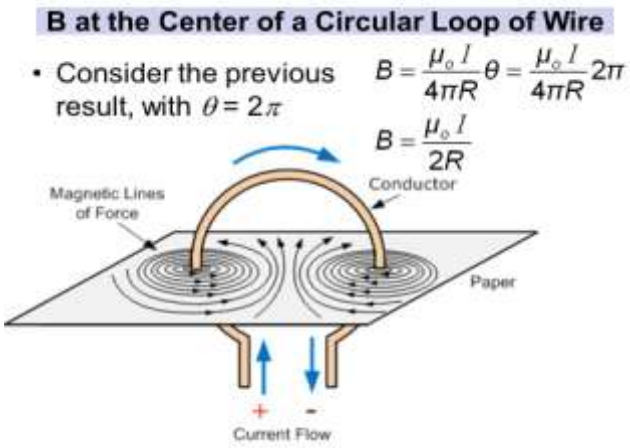
(i) Directly proportional to the current (I) flowing through it, i.e., B α I

(ii) Inversely proportional to the radius (r) of the coil, i.e. B α 1/r

(iii) Directly proportional to the total number of turns (N) in the coil, i.e., B α N

From (1), (2) and (3) B α $\frac{NI}{r}$ $\Rightarrow$ B = $\frac{\mu_0 n I}{2r}$; Here μ_0 is a constant.





16. Q. if there is a circular coil having n turns, the field produced is n times as large as that produced by a single turn. Give reason?

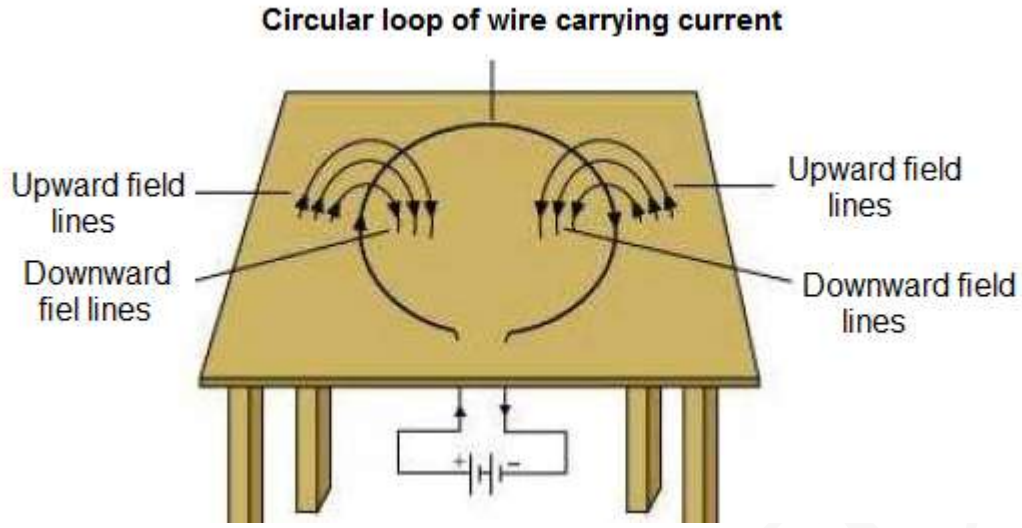
Answer: This is because the current in each circular turn has the same direction, and the field due to each turn then just adds up.

17. Q. State and define S.I unit of magnetic field?

Answer: The S.I unit of magnetic field is Tesla (T). The magnetic field strength is said to be one Tesla if 1 meter long conductor carrying 1 ampere current experiences 1 Newton force, when placed perpendicular to the direction of magnetic field.

18. Q. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

Answer: Magnetic field inside the loop is perpendicular to the plane of table and in the downward direction. However, outside the loop, magnetic field is perpendicular to the plane of the table and in the upward direction.



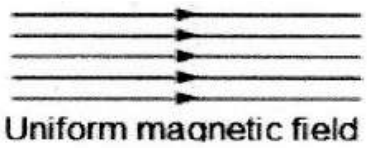
19. Q. Which of the following correctly describe the magnetic field near a long straight wire?

Answer: (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.

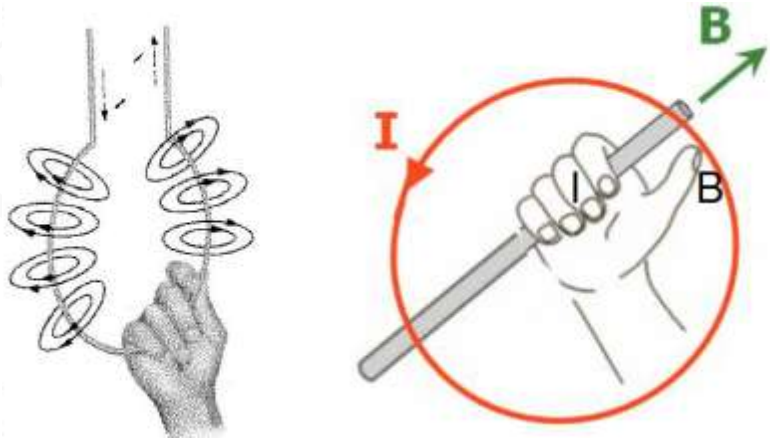


20. Q. The magnetic field in a given region is uniform.

Draw a diagram to represent it. Answer: Uniform magnetic field

21. Q. How can you use the Right Hand Thumb rule in the case of Circular loop and Solenoid?

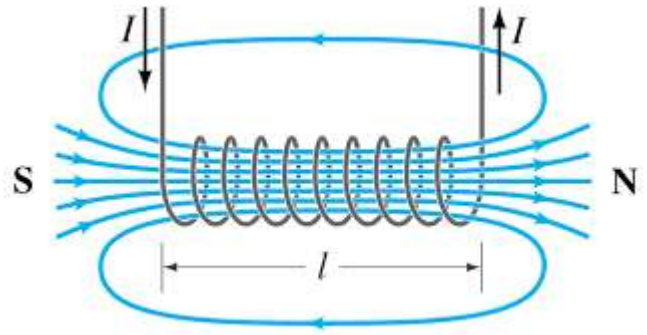
Answer: Curl the finger in the direction of the current in loop. Stretch the thumb normal to the fingers. The thumb will represent the direction of the magnetic field line of force.



22. Q. What is solenoid? Is the pattern of the magnetic field lines around a current-carrying solenoid similar to that of a bar magnet?

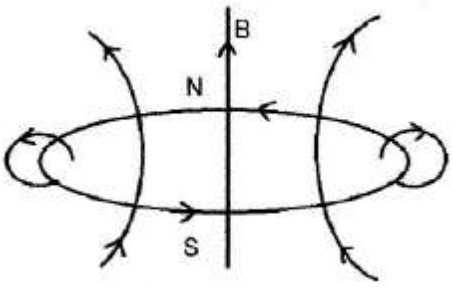
Answer: When a wire is looped several gt times it forms a coil we called this a solenoid.

Yes, If current allows to pass through solenoid it behave like a bar magnet.



23. Q. How can you determine N - pole and S - pole (polarity) around solenoid?

Answer: Clock rule helps us to determine the polarities of the faces of the current carrying coil. Rule:



Looking at the face of coil, If the current around that face is in clockwise direction the face is south pole.

While, if the current around the face is in anti-clockwise direction, the face is North Pole. The face from which the line of force come out is N - Pole and other is S -pole.

The magnetic field is the same at all points inside the solenoid.

24. Q. What is electromagnet?

Answer: A strong magnetic field produced inside a solenoid can magnetize a piece of magnetic material, like soft iron, when placed inside the coil. This magnet is called an electromagnet.

25. Q. What are the factors on which the strength of magnetic field produced by a current carrying solenoid depends upon?

Answer: (a) The number of turns in the solenoid: Larger the number of turns in the solenoid, greater will be the magnetic field produced.

(ii) The strength of current in the solenoid: Larger the current passed through solenoid, stronger will be the magnetic field produced.

(iii) The nature of "core material" used in making solenoid: The use of soft iron rod as core in a solenoid produced the strongest magnet. Magnetic field inside the solenoid

26. Q. A coil of insulated copper wire is connected to a galvanometer. What would happen if a bar magnet is (i) Pushed into the coil? (ii) Withdrawn from inside the coil? (iii) Held stationary inside the coil?

Answer: (i) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards right).

(ii) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards left opposite to that in case one).

(iii) As it is stationary no change in magnetic flux linked with coil, so galvanometer shows no deflection.

26. Q. Differentiate between electro magnet and permanent magnet .

Answer: Electro magnet

(a) An electro magnet is a temporary magnet as it can readily be demagnetized by stopping the current through solenoid.

(b) An electro magnet produces a magnetic field whose strength can be changed by changing the current through solenoid.

(c) The polarity of a electromagnet can easily be reversed by changing the direction of current through the solenoid.

Permanent magnet

(a) A permanent magnet cannot readily be demagnetized.

(b) The magnetic field of a permanent magnet is comparatively weak and its strength cannot be changed.

(c) The polarity of permanent magnet is fixed and cannot be easily be reversed.

27. Q. Electric currents producing magnetic fields and exerting forces on magnets. Can a magnet also exert an equal and opposite force on the current-carrying conductor?

Answer: Yes. French scientist Andre Marie Ampere suggested that a current-carrying rod experiences a force perpendicular to its length when rod is placed in a magnetic field.

28. Q. What are the factors on which force acting on a current carrying conductor placed in a magnetic field depends.

Answer: (i) The force F is directly proportional to t) the current flowing in the conductor, i.e. $F \alpha I$.

(ii) The force F is directly proportional to the intensity of magnetic field, i.e. $F \alpha B$.

(iii) The force F is directly proportional to the length of the conductor (inside the magnetic field), i.e. $F \alpha L$

(iv) Force is directly proportional to sin 0 where (the angle between current and the direction of magnetic is field. i.e. $F \alpha \sin \theta$

$\Rightarrow F \alpha L B I \sin\theta \Rightarrow F = K L B I \sin\theta$; if k =1 and using sin 90° = 1, F = L B I

Remember: Force experienced by the conductor is the maximum when placed perpendicular to magnetic field.

29.Q. Conductor carrying current will experience a force if placed in a magnetic field. Why?

Answer: A moving charge in a magnetic field (direction of motion not parallel to the field direction) experiences a force called Lorentz force. Since current is due to flow of charge, therefore a conductor carrying current will experience a force.

30. Q. Which of the following property of a proton can change while it moves freely in a magnetic field?

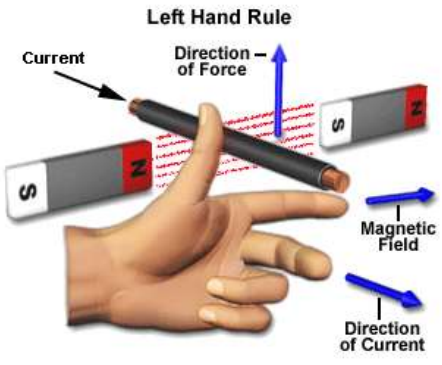
(a) Mass (b) speed (c) velocity (d) momentum

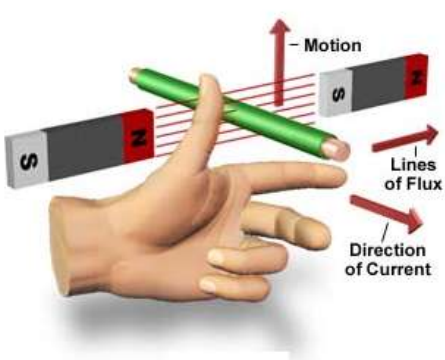
Answer: A force acts on a proton when it moves freely in a magnetic field. Hence its velocity and momentum can change.

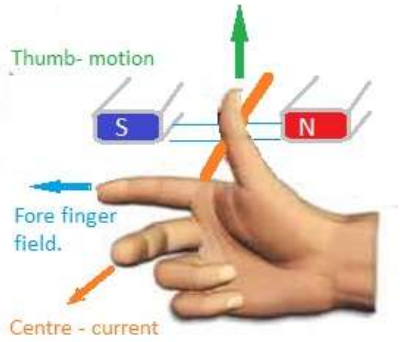
31. Q. How can you find the direction of the force on the conductor placed in a magnetic field?

Answer: Fleming's left hand rule helps us to predict the movement of a current carrying conductor (force) placed in a magnetic field.

If you stretch the thumb, middle finger and the forefinger of your right hand mutually perpendicular to each other as shown in figure.





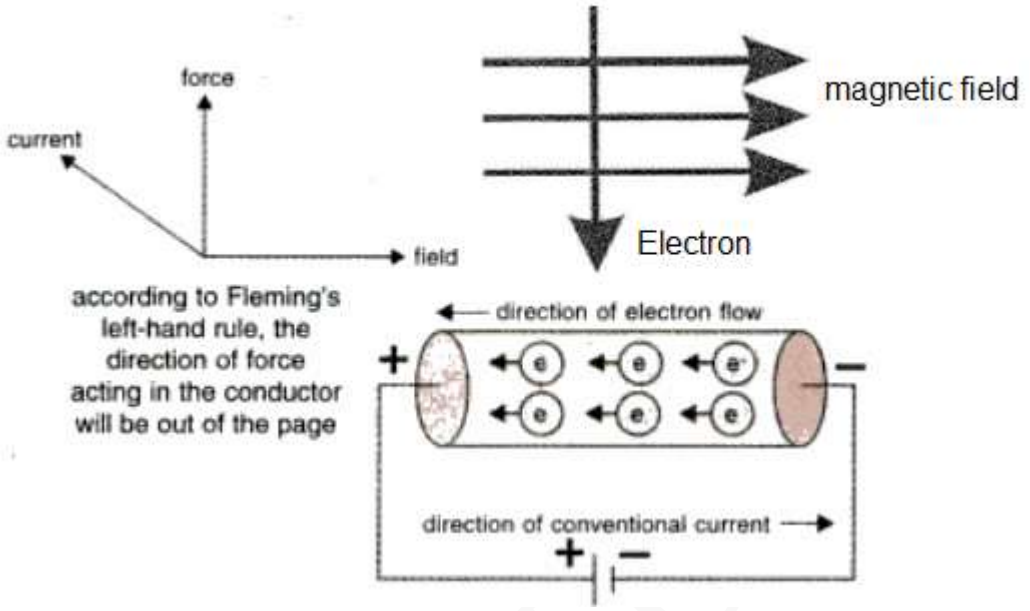


If the forefinger indicated the direction of the magnetic field and the thumb indicated the direction of motion of the conductor, the middle finger will indicate the direction of induced current.

Devices that use current carrying conductors and magnetic fields include electric motors, generators, loudspeakers and microphones.

32.Q. An electron enters a magnetic field at right angles to it, as shown in Fig. The direction of force acting on the electron will be (a) to the right (b) to the left (iii) out of the page (iv) into the page

Answer: (d). The direction of force is perpendicular to the direction of magnetic field and current as given by Fleming's left hand rule. Here, the direction of current is taken opposite to the direction of motion of electrons. The force is therefore directed into the page



33. Q. How do we think the displacement of rod will be affected if conductor placed in a magnetic field when

(i) Current in rod AB is increased (ii) A stronger horse shoe magnet is inserted (iii) Length of the rod AB is increased.

Answer. Force acting on a current carrying conductor of length I placed perpendicular to magnetic field B is given by

f = B I L

(i) When I increase, F also increases. Hence the displacement of the rod increases.

(ii) When a stronger horse shoe magnet is inserted, magnetic field at B increases. So force also increases. Hence, displacement increases.

(iii) When L increases, force increases and hence displacement increases

34. Q. A positively charged partial (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

Ans. (d) Since a positively charged particle (alpha particles) is projected towards west, so the direction of current is towards west. Now it is deflected towards north by magnetic field it means force is towards north.

Now hold the forefinger, center finger and thumb of our left hand at right angles to one another. Let us adjust the hand in such a way that our center finger points towards west and thumb points towards north. We see that, our forefinger will be pointing upward. This is the direction of magnetic field.

35. Q. What is the principle of electric motor?

Answer: An electric motor is a rotating device that converts electrical energy to mechanical energy. A motor works on the principle that when a rectangular coil is placed in a magnetic field and current is passed through it, a torque (rotational force) acts on the coil which rotates is continuously. When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.

36. Q. What is the role of the split ring in an electric motor?

Answer: Split rings (also called a commutator) are used to change the polarity of current after every half rotation so as to make the motor move continuously in same direction.

37. Q. What is electromagnetic induction? What are the different ways to induce current in a coil?

Answer: The phenomena of producing induced current in a coil due to relative motion between a magnet and the coil is called of electromagnetic induction.

The different ways to induce current in a coil are:

(i) By moving a bar magnet towards or away from the coil. (ii) By placing a coil near another coil connected across a battery.

38. Q. 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. Answer: (C)

39. Q. What is the essential difference between on AC generator and a DC generator?

Answer: AC generator has slip rings while the DC generator has a commutator.

40. Q. List three sources of magnetic fields.

Answer: (i) A permanent magnet. (ii) A current carrying conductor. (iii) A current carrying solenoid

41. Q. State the principle of the working of an electric motor.

Answer: An electric motor works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces acting are equal and opposite. Since they act in different lines the bring rotational motion.

42. Q. State the principle of a D.C generator.

Answer: D,C. Generator is based on the principle of electromagnetic induction.

43.Q. What is the frequency of AC (Alternating Current) in India?

Answer: 50Hz

44. Q. Does a neutron moving in a magnetic field experience a force? Why?

Answer: No. This is because a neutron is neutrally charged

45. Q. What are the functions of live and neutral wire in domestic circuit?

Answer: Live Wire - It is wire in which current flows from electric pole to our home. Its colour is Red Neutral Wire. It is a wire which is used to complete domestic circuit. Its colour is Black. As a potential difference is needed neutral wire is equally important.

46. Q. Electricians wear rubber shoes while working ? Why?

Answer: This is because a rubber is bad conductor and prevents flow of current into body.

47. Q. Why do we use power supply of two different current rating at our home?

Answer: The two different current rating circuits at our home are used. We use 15 A current rating for appliances with higher power ratings such as geysers, air coolers, etc. The other circuit is of 5 A current rating for bulbs, fans, etc.

48. Q. What is an electric fuse? What material is used for fuse wire?

Answer: A fuse is a safety device which prevents damage to the appliances and the circuit due to overloading. Fuse wires are made up of alloy.

49. Q. What is the importance of the earth wire?

Answer: The earth wire ensures that any leakage of current to the metallic body of the appliance keeps its potential to that of the earth, and the user may not get a severe electric shock.

50. Q. Should a copper wire be used as a fuse wire? If not, why?

Answer: a copper wire should not be used as a fuse wire because it does not have low melting point and high resistivity.

51.Q. Give four features of domestic electric wiring.

Answer: The electric power line enters our house through three wires- namely the red wire [the live wire] the black wire[neutral] and the earth wire[green] plastic insulation.

The live wire has a high potential of 220 volts whereas the neutral wire has zero potential.

There are two separate circuits in a house namely lighting circuit with a 5 A fuse and power circuit with a 15 A fuse.

The distribution circuits are always connected in parallel combination

52.Q. On what effect of an electric current does a fuse work?

Answer: Heating effect of electric current

53. Q. An Alternating Current has a frequency of 50 Hz. How many times it changes direction in one second?

Answer: Since Alternating Current changes its direction twice in a cycle, it will change its direction 100 times (50x2) in one second as its frequency is 50Hz.

54. Q. What is short circuiting in an electric circuit?

Answer: Short circuiting in an electric circuit is a situation in which the live wire touches the neutral wire.

55. Q. What kind of quantity is magnetic field?

Answer: It is a vector quantity as it has both direction & magnitude.

56. Q. How is Solenoid different from a circular coil?

Answer: Solenoid is different from a circular coil in the sense that the length of the solenoid is much greater than its diameter.

57. Q. A coil of insulated copper wire is connected to a galvanometer. What would happen if a bar magnet is (i) Pushed into the coil? (ii) Withdrawn from inside the coil? (iii) Held stationary inside the coil?

Answer: (i) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards right).

(ii) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards left opposite to that in case one).

(iii) As it is stationary no change in magnetic flux linked with coil, so galvanometer shows no deflection.

58. Q. Why are the earth pin thicker and longer than the live and the neutral pins?

Answer: It is thicker so that it does not enter into the live or neutral sockets. It is made longer so that it gets connected to the earth terminal earlier than the live and neutral pins. This ensures the safety of the user.