# Magnetic Effects of Electric Current

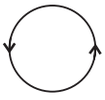
## OBJECTIVE TYPE QUESTIONS

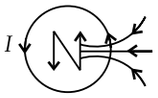
### Multiple Choice Questions (MCQs)

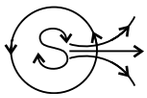
**1.** A magnetic field exerts no force on
(a) a stationary electric charge
(b) a magnet
(c) an electric charge moving perpendicular to its direction
(d) an unmagnetised iron bar.

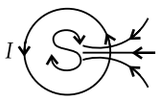
**2.** At the centre of a magnet, the magnetism is
(a) zero (b) same as at the poles
(c) maximum (d) minimum.

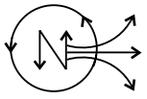
**3.** If a circular loop carries current $I$ then the direction of the magnetic field at the centre with the help of magnetic lines of force will be



(a) 


(b) 


(c) 

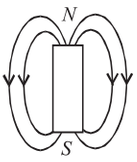

(d) 

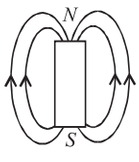

**4.** Induced current flows through a coil
(a) for more than the period during which flux changes through it.
(b) for less than the period during which flux changes through it.
(c) only for the period during which flux changes through it.
(d) none of the above.

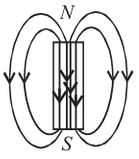
**5.** Which of the following instruments works by electromagnetic induction?
(a) Dynamo.
(b) Moving coil galvanometer.
(c) Telephone receiver.
(d) Simple motor.

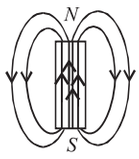
**6.** An electric charge in uniform motion produces
(a) an electric field only
(b) a magnetic field only
(c) both electric and magnetic fields
(d) no such field at all

**7.** The magnetic field lines due to a bar magnet are correctly shown in figure.

(a) 


(b) 


(c) 


(d) 


**8.** When is the force experienced by a current-carrying conductor placed in a magnetic field largest?
(a) At 30° (b) at 60°
(c) At 45° (d) at 90°

**9.** Which of the following properties of a proton can change while it moves freely in a magnetic field?
(a) Mass (b) Speed
(c) Momentum (d) Kinetic energy.

**10.** Choose the correct alternative which matches second and third column with first column

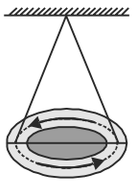
| Column I | | Column II | | Column III | |
|---|---|---|---|---|---|
| I. | Magnetic field is produced near current carrying conductor | 1. | Right hand thumb rule | (i) | Micheal Faraday |
| II. | Electric current is generated in a conductor moving in a magnetic field | 2. | Fleming's right hand rule | (ii) | Hans Oersted |

(a) I – (2) – (i), II – (2) – (ii)
(b) I – (1) – (ii), II – (2) – (ii)
(c) I – (2) – (ii), II – (1) – (i)
(d) I – (1) – (ii), II – (2) – (i)

**11.** A soft iron bar is introduced inside a current carrying solenoid. The magnetic field inside the solenoid
(a) will increase
(b) will remain unaffected
(c) will become zero
(d) will decrease.

**12.** A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current change once in each
(a) two revolutions
(b) one revolution
(c) half revolution
(d) one-fourth revolution.

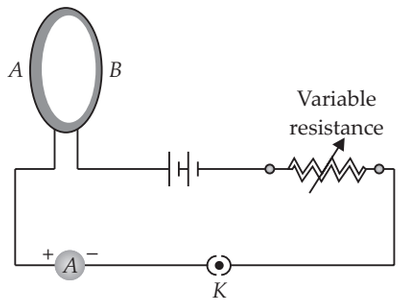
**13.** A circular loop is suspended in air as shown in figure. When the loop is seen from above, current flows anticlockwise and when seen from below, current flows clockwise. This loop behaves as a magnet. The N-pole of this magnet is on



(a) the upper face
(b) lower face
(c) the lower face if current is large
(d) upper face if current is large.

**14.** Choose the incorrect statement from the following regarding magnetic lines of field:
(a) The direction of magnetic field at a point is taken to be the direction in which the north pole of a magnetic compass needle points.
(b) Magnetic field lines are closed curves.
(c) If magnetic field lines are parallel and equidistant, they represent zero field strength.
(d) Relative strength of magnetic field is shown by the degree of closeness of the field lines.

**15.** A circular loop placed in a plane perpendicular to the plane of paper carries a current when the key is ON. The current as seen from points $A$ and $B$ (in the plane of paper and on the axis of the coil) is anticlockwise and clockwise respectively. The magnetic field lines point from $B$ to $A$. The N-pole of the resultant magnet is on the face close to

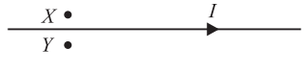



(a) $A$ (b) $B$
(c) $A$ if the current is small, and $B$ if the current is large
(d) $B$ if the current is small, and $A$ if the current is large

**16.** For a current in a long straight solenoid, N- and S-pole 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 indicate 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 positions when the direction of current through the solenoid is reversed.

**17.** On which of the following does not exert any force when kept in uniform magnetic field?
(a) Moving magnet (b) Moving charge
(c) Stationary magnet (d) Stationary charge

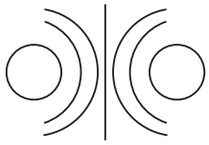
**18.** An electric current passes through a straight wire. Magnetic compasses are placed at the points $X$ and $Y$. Then,



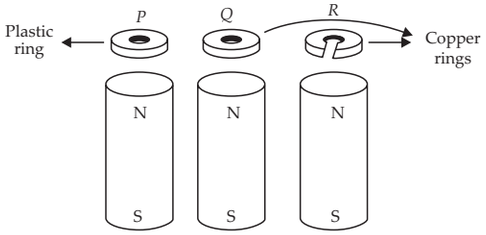

(a) their needles will not deflect
(b) only one of the needles will deflect
(c) the needles will deflect in the same direction
(d) the needles will deflect in the opposite directions.

**19.** An ionized gas contains both positive and negative ions. It is projected towards east to a region having uniform magnetic field directed into the plane of paper, then
(a) positive ions deflect towards north and negative ions deflect towards south
(b) positive ions deflect towards south and negative ions deflect towards north
(c) all ions deflect towards south
(d) all ions deflect towards north.

**20.** The diagram given below represents magnetic field caused by a current carrying conductor which is
(a) a long straight wire
(b) a circular coil
(c) a solenoid
(d) a short straight wire.



**21.** Three rings $P$, $Q$ and $R$ are dropped at the same time over identical hollow magnets as shown here.




Which of the following describes the order in which the ring $P$, $Q$ and $R$ reach the bottom of the magnet?
(a) They arrive in the order, $P$, $Q$, $R$.
(b) They arrive in the order $P$, $R$, $Q$
(c) Rings $P$ and $R$ arrive simultaneously, followed by $Q$
(d) Rings $Q$ and $R$ arrive simultaneously, followed by $P$.

**22.** The direction of magnetic field around a straight conductor carrying current can be determined by
(a) Fleming's left hand rule
(b) Lenz's law
(c) Right hand thumb rule
(d) Fleming's right hand rule.

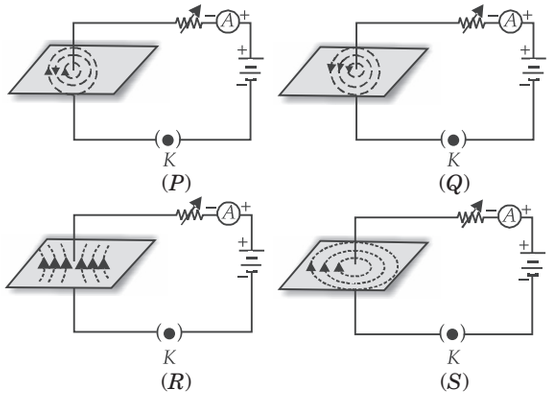
**23.** Magnetic field is produced by the flow of current in a straight wire. This phenomenon was discovered by
(a) Coulomb (b) Oersted
(c) Faraday (d) Maxwell.

**24.** An electric motor is a device which transform :
(a) mechanical anergy to electrical energy
(b) heat energy to electrical energy
(c) electrical energy to heat energy
(d) electrical energy to mechanical energy.

**25.** For making a strong electromagnet, the material of the core should be
(a) brass
(b) laminated steel strips
(c) soft iron
(d) steel.

**26.** The magnetic field produced due to a circular wire at its centre is
(a) at 45° to the plane of the wire
(b) at 60° to the plane of the wire
(c) in the plane of the wire
(d) perpendicular to the plane of the wire.

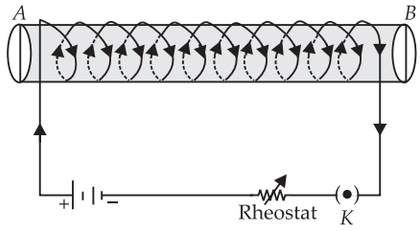
**27.** Four students plotted the sketch of the patterns of magnetic field lines representing the magnetic field around a current carrying straight wire as shown in figures $P$, $Q$, $R$ and $S$. Which one of the following sketches is correct?




(a) $P$ (b) $Q$
(c) $R$ (d) $S$

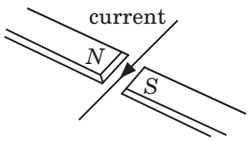
**28.** A positively-charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is
(a) towards south (b) towards east
(c) downward (d) upward

**29.** A soft iron bar is enclosed by a coil of insulated copper wire as shown in figure. When the plug of the key is closed, the face $B$ of the iron bar marked as



(a) N–pole
(b) S–pole
(c) N–pole if current is large
(d) S–pole if current is small.

**30.** A horizontal wire carrying a current as shown in figure below between magnetic poles N and S. The direction of the force on the wire due to the magnet is




(a) in the direction of the current
(b) vertically downwards
(c) opposite to the current direction
(d) vertically upwards.

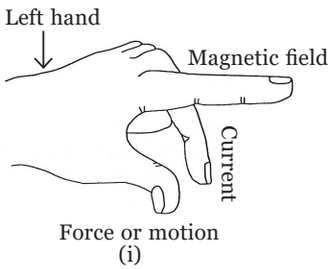
**31.** The phenomena of electromagnetic induction is
(a) the process of charging a body
(b) the process of generating magnetic field due to a current passing through a coil
(c) producing induced current in a coil due to relative motion between a magnet and the coil
(d) the process of rotating a coil of an electric motor.

**32.** If the force exerted on a current carrying wire placed in a magnetic field is zero, then the angle between wire and the direction of magnetic field is
(a) 45° (b) 60°
(c) 90° (d) 180°

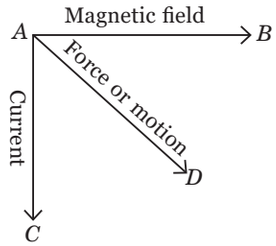
## Case Based MCQs

**Case I :** Read the passage given below and answer the following questions from 33 to 36.

Electric Charges moving in a magnetic field experience a force, while there is no such force on static charges. This fact was first recognized by Hendrik Antoon Lorentz, a great Dutch physicist, nearly a century ago. Thus, a charge moving in a magnetic field experience a force, except when it is moving in a direction parallel to it. The magnitude of force experienced depends on the charge, velocity ($v$), strength of magnetic field ($B$), and sine of the angle between $v$ and $B$. If the direction of velocity is perpendicular to the direction of magnetic field, direction of magnetic force is given by Fleming's left hand rule.



(i)

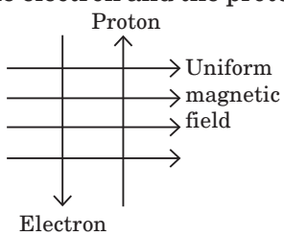


Vertically downward (ii)

**33.** If an electron is travelling horizontally towards east. A magnetic field in vertically downward direction exerts a force on the electron along
(a) east (b) west
(c) north (d) south.

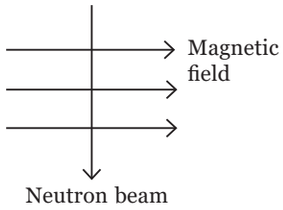
**34.** If a charged particle is moving along a magnetic field line. The magnetic force on the particle is
(a) along its velocity
(b) opposite to its velocity
(c) perpendicular to its velocity
(d) zero.

**35.** A uniform magnetic field exists in the plane of paper pointing from left to right as shown in figure. In the field an electron and a proton move as shown. The electron and the proton experience



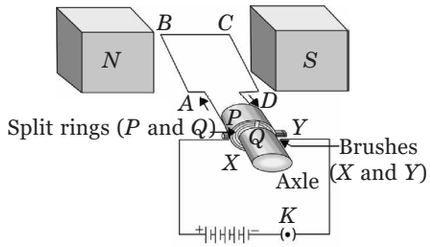

(a) forces both pointing into the plane of paper
(b) forces both pointing out of the plane of paper
(c) forces pointing into the plane of paper and out of the plane of paper, respectively
(d) force pointing opposite and along the direction of the uniform magnetic field respectively.

**36.** An neutron beam enters a magnetic field at right angles to it as shown in the figure. Due to magnetic field, neutron beam will deflect




(a) to the left (b) to the right
(c) into the page (d) no deflection.

**Case II :** Read the passage given below and answer the following questions from 37 to 40.
An electric motor is a rotating device that converts electrical energy into mechanical energy. Electric motor is used as an important component in electric fans, refrigerators, mixers, washing machines, computers, MP3 players, etc.




An electric motor consists of a rectangular coil *ABCD* of insulated copper wire. The coil is placed between the two poles of a magnetic field such that the arm *AB* and *CD* are perpendicular to the direction of the magnetic field. The ends of the coil are connected to the two halves *P* and *Q* of a split ring. The inner sides of these halves are insulated and attached to an axle. The external conducting edges of *P* and *Q* touch two conducting stationary brushes *X* and *Y*, respectively, as shown in the figure.
Commercial motors use an electromagnet in place of a permanent magnet.

**37.** Choose incorrect statement from the following regarding split rings.
(a) Split rings are used to reverse the direction of current in coil.
(b) Split rings are also known as commutator.
(c) Split ring is a discontinuous or a broken ring.
(d) Both (a) and (b)

**38.** Which of the following has no effect on the size of the turning effect on the coil of an electric motor?
(a) The amount of the current in the coil.
(b) The direction of the current in the coil.
(c) The number of turns in the coil.
(d) The strength of the magnetic field.

**39.** When current is switched ON, an electric fan converts
(a) mechanical energy to chemical energy
(b) electrical energy to mechanical energy
(c) chemical energy to mechanical energy
(d) mechanical energy to electrical energy.

**40.** In an electric motor, device that makes contact with the rotating rings and through them current is supplied to coil is
(a) axle (b) brushes
(c) coil (d) split rings.

## Assertion & Reasoning Based MCQs

**For question numbers 41-50,** a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
*(a) Both assertion and reason are true, and reason is correct explanation of the assertion.*
*(b) Both assertion and reason are true, but reason is not the correct explanation of the assertion.*
*(c) Assertion is true, but reason is false.*
*(d) Assertion is false, but reason is true.*

**41. Assertion :** Magnetic field lines show the direction (at every point) along which a small magnetised needle aligns (at the point).
**Reason :** Magnetic field lines certainly represent the direction of magnetic field, but not the direction of force, this is because force is always perpendicular to magnetic field *B*.

**42. Assertion :** Magnetic field interacts with a moving charge and not with a stationary charge.
**Reason :** A moving charge produces a magnetic field.

**43. Assertion :** No net force acts on a rectangular coil carrying a steady current when suspended freely in a uniform magnetic field.
**Reason :** Forces acting on each pair of the opposite sides of the coil are equal and opposite.

**44. Assertion :** In a conductor, free electrons keep on moving but no magnetic force acts on a conductor in a magnetic field.
**Reason :** Force on free electron due to magnetic field always acts parallel to its direction of motion.

**45. Assertion :** The magnetic field produced by a current carrying solenoid is independent of its length and cross sectional area.
**Reason :** The magnetic field inside the solenoid is uniform.

**46. Assertion :** In electric circuits, wires carrying currents in opposite directions are often twisted together.
**Reason :** If the wire are not twisted together, the combination of the wires forms a current loop. The magnetic field generated by the loop might affect adjacent circuits or components.

**47. Assertion :** The magnetic field intensity at the centre of a circular coil carrying current changes, if the current through the coil is doubled.
**Reason :** The magnetic field intensity is dependent on current in conductor.

**48. Assertion :** For a point on the axis of a circular coil carrying current, magnetic field is maximum at the centre of the coil.
**Reason :** Magnetic field is proportional to the distance of point from the circular coil.

**49. Assertion :** When two long parallel wires, hanging freely are connected in parallel to a battery, they come closer to each other.
**Reason :** Wires carrying current in opposite directions repel each other.

**50. Assertion :** The direction of force is given by Fleming's left hand rule.
**Reason :** A magnetic field exert a force on a moving charge in the same direction as the direction of field itself.

## SUBJECTIVE TYPE QUESTIONS

### Very Short Answer Type Questions (VSA)

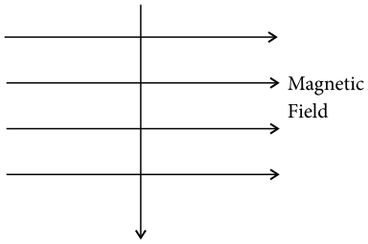
**1.** State the effect of a magnetic field on the path of a moving charged particle.

**2.** What is the function of a galvanometer in a circuit?

**3.** What is meant by magnetic field?

**4.** State the direction of magnetic field in the following case.


**5.** 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?




**6.** State two ways by which the speed of rotation of an electric motor can be increased.

**7.** Which sources produce alternating current?

**8.** Why does a compass needle get deflected when brought near a bar magnet ?

**9.** Name the factors on which strength of an electromagnet depend.

**10.** What is the role of the split ring in an electric motor ?

## Short Answer Type Questions (SA-I)

**11.** State how the magnetic field produced by a straight current carrying conductor at a point depends on (a) current through the conductor (b) distance of point from conductor.

**12.** What is a solenoid? Draw the pattern of magnetic field lines of a solenoid through which a steady current flows. What does the pattern of field lines inside the solenoid indicate?

**13.** Write any one method to induce current in a coil.

**14.** It is established that an electric current through a metallic conductor produces a magnetic field around it. Is there a similar magnetic field produced around a thin beam of moving (i) alpha particles, (ii) neutrons? Justify your answer.

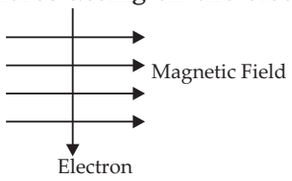
**15.** What does the divergence of magnetic field lines near the ends of a current carrying straight solenoid indicate?

**16.** In what respect does a wire carrying a current differ from a wire, which carries no current?

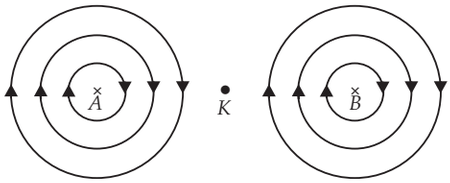
17. What is the direction of the force that a vertical magnetic field, directed upward, will exert on an electron travelling eastward in it?

**18.** Why does a current-carrying wire move when placed in magnetic field ?

**19.** An electron enters a magnetic field at right angle to it as shown in the figure. What is the direction of force acting on the electron?




**20.** In the diagram, $A$ and $B$ represent two straight wires carrying equal currents in a direction at right angle to the paper and downward into the paper. Sketch separately the magnetic lines of force produced by each current carrying conductor. Give reason why the magnetic field at $K$ will be zero.



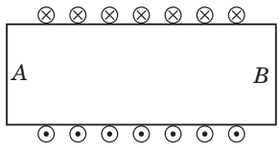

## Short Answer Type Questions (SA-II)

**21.** 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) placed near its one face?

**22.** In Faraday's experiment if instead of moving the magnet towards the coil we move the coil towards the magnet. Will there be any induced current? Justify your answer. Compare the two cases.

**23.** (a) State Right Hand Thumb rule to find the direction of the magnetic field around a current carrying straight conductor.
(b) How will the magnetic field be affected on:
(i) increasing the current through the conductor
(ii) reversing the direction of flow of current in the conductor?

**24.** Diagram shows the lengthwise section of a current carrying solenoid. ⊗ indicates current entering into the page, ⊙ indicates current emerging out of the page. Decide which end of the solenoid $A$ or $B$, will behave as north pole. Give reason for your answer. Also draw field lines inside the solenoid.




**25.** Find the direction of magnetic field at centre of current carrying circular coil held:
(i) vertically in North - South plane and an observer looking it from east sees the current to flow in anticlockwise direction,
(ii) in East - West plane and an observer looking it from south sees the current to flow in anticlockwise direction,
(iii) horizontally and an observer looking at it from below sees current to flow in clockwise direction.

**26.** Two circular coils $P$ and $Q$ are kept close to each other, of which coil $P$ carries a current. What will you observe in the galvanometer connected across the coil $Q$

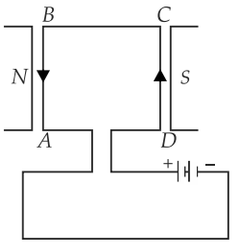
(a) if current in the coil $P$ is changed?

(b) if both the coils are moved in the same direction with the same speed?

Give reason to justify your answer in each case.

**27.** Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of the magnetic field?

**28.** A rectangular coil $ABCD$ is placed between the pole pieces of a horse-shoe magnet as shown in figure.




(i) What is the direction of force on each arm?

(ii) What is the effect of the forces on the coil?

(iii) How is the effect of force on the coil changed if the terminals of the battery are interchanged ?

**Direction :** Read the passage and answer the following questions given below:

The strength of the magnetic field produced by a current-carrying circular coil (or circular wire) depends on (i) Current flowing through the coil. (ii) Radius of the circular coil. (iii) Number of turns of wire in the circular coil.

**29.** A circular coil is carrying a current of 100 A in the anti clockwise when seen from upward direction. Find the pole of magnetic field when seen from 1.0 m below.

**30.** What type of curves we get, between magnetic field and distance along the axis of a current carrying circular coil ?

**31.** If a current carrying straight conductor is placed is east-west direction, then find the direction of the force experienced by the conductor due to earth's magnetic field.

## Long Answer Type Questions (LA)

**32.** What is a solenoid? Draw a diagram to show field lines of the magnetic field through and around a current carrying solenoid. State the use of magnetic field produced inside a solenoid. List two properties of magnetic lines of force.

**33.** (a) A coil of insulated copper wire is connected to a galvanometer. With the help of a labelled diagram state what would be seen if a bar magnet with its south pole towards one face of this coil is

(i) moved quickly towards it,

(ii) moved quickly away from it,

(iii) placed near its one face?

(b) Name the phenomena involved in the above cases.

(c) State Fleming's right hand rule.

**34.** A current carrying conductor is placed in a magnetic field now answer the following.

(i) List the factors on which the magnitude of force experienced by conductor depends.

(ii) When is the magnitude of this force maximum?

(iii) State the rule which helps in finding the direction of motion of conductor.

(iv) If initially this force was acting from right to left, how will the direction of force change if:

(a) direction of magnetic field is reversed?

(b) direction of current is reversed?

**35.** Describe an activity with labelled diagram to show that a force acts on current carrying conductor placed in a magnetic field and its direction of current through conductor. Name the rule which determines the direction of this force.

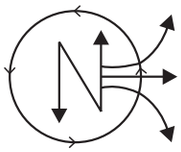
## ANSWERS

### OBJECTIVE TYPE QUESTIONS

**1.** **(a) :** A magnetic field exerts no force on a stationary electric charge.

**2.** **(a) :** Magnetism is zero at centre of magnet.

**3.** **(d) :** Direction of magnetic field at the centre will be outward.



**4. (c) :** By Faraday's laws of electromagnetic induction, the induced current flows through a coil only for the period where there is a change in the magnetic flux linked with the coil.

**5. (a) :** Dynamo works on the principle of electromagnetic induction.

**6. (c) :** An electric charge in uniform motion produces both electric and magnetic fields.

**7. (d) :** The magnetic field lines due to a bar magnet are closed continuous curves directed from *N* to *S* outside the magnet and directed from *S* to *N* inside the magnet. Hence option (d) is correct.

**8. (d) :** The force experienced by a current-carrying conductor placed in a magnetic field is largest when the direction of the current carrying conductor is at right angles to the direction of the magnetic field.

**9. (c) :** Whenever a charged particle (in this case a proton) moves in a magnetic field, its velocity and as a result of this its momentum change.

**10. (d) :** Magnetic field around conductor is given by right hand thumb rule and it is associated with Hans Oersted while generation of current is given by Fleming's right hand rule and was stated by Michael Faraday.

**11. (a) :** Magnetic field inside the solenoid will increase, if soft iron bar is introduced inside a current carrying solenoid.

**12. (c)**

**13. (a) :** N-pole of given magnet is on upper face.

**14. (c) :** If the magnetic field lies are parallel and equidistant, they represent a uniform magnetic field.

**15. (a) :** Since the magnetic field lines point from *B* to *A*, it implies that they enter into *B* and emerge out of *A*. Clearly, the face close to *A* is the N-pole as field lines emerge out of north pole and enter into south pole.

**16. (c) :** A current-carrying solenoid behaves like a bar magnet with fixed polarities at its ends.

**17. (d) :** $F = qvB\sin\theta$ is the force on a charged particle in a magnetic field.

If $v = 0$, then $F = 0$.

**18. (d) :** According to right hand thumb rule, magnetic field due to the current carrying wire at point *X* is out of the plane of paper and that at point *Y* is in the plane of paper. Therefore, the needles will deflect in the opposite directions.

**19. (a) :** By applying Fleming's left hand rule positive ions deflect towards north and negative ions deflect towards south.

**20. (b) :** Diagram shows magnetic field due to circular current carrying coil.

**21. (b)**

**22. (c)**

**23. (b) :** Hans Christian Oersted in 1820 discovered that around every conductor carrying an electric current produces magnetic field around it.

**24. (d) :** Electric motor converts electrical energy into mechanical energy.

**25. (c)**

**26. (d) :** By clock rule, we can find the direction of magnetic field.

**27. (d) :** From right hand thumb rule option (d) is correct.

**28. (d) :** From Fleming's left hand rule, we can infer that the direction of magnetic field is upwards.

**29. (a) :** Face *B* is north pole.

**30. (d)**

**31. (c) :** The correct option is (c).

**32. (d) :** The current carrying wire will not experience a magnetic force in the case of lying parallel or antiparallel to the direction of magnetic field.

**33. (d) :** Fleming's left hand rule is used to determine the direction of force on electron *i.e.*, in south direction.

**34. (d) :** The angle between velocity and magnetic field is zero. Therefore, magnetic force on the particle is zero.

**35. (a) :** As the direction of current is taken opposite to the direction of motion of electrons, therefore, current from the motion of electron and proton is in the same direction, i.e., from bottom to top. Now, according to Fleming's left hand rule, the electron and the proton experience forces both pointing into the plane of paper.

**36. (d) :** Neutron is uncharged particle so no magnetic force will act on it.

**37. (d)**

**38. (b) :** The direction of the current has no effect on the size of the turning effect on the coil.

**39. (b) :** Electric fan works on the principle of electric motor. It converts electrical energy to mechanical energy.

**40. (b)** **41. (b)**

**42. (a) :** An electric current is equivalent to the charges (or electrons) in motion. Such charges produce magnetic interaction. The magnetic field produced by current interacts with magnetic needle and deflects it.

**43. (a) :** In a rectangular coil carrying a steady current, the direction of current in opposite sides of coil is opposite to each other, therefore, forces acting on each pair of the opposite

sides of the coil are equal and opposite, i.e., net force on the coil is equal to zero.

**44. (c) :** In a conductor, the average velocity of electrons is zero. Hence no current flows through the conductor. Hence, no force acts on this conductor.

**45. (b) :** Magnetic field inside solenoid is uniform and independent of length and cross-sectional area of solenoid.

**46. (a) :** If the wires are twisted together, they can be modelled as a single wire carrying current in the opposite directions. In this model, no magnetic field is induced in the wires which does not affect adjacent circuits.

**47. (a) :** The magnetic field at the centre of circular coil is directly proportional to the current flowing through it. So if current through coil is doubled then magnetic field becomes double.

**48. (c) :** The magnitude of magnetic field produced by a current carrying circular coil is maximum at the centre and is not proportional to the distance of a point from the circular coil.

**49. (b) :** The wires are parallel to each other but the direction of current in it is in same direction so they attract each other. If the current in the wires is in opposite directions then wires repel each other.

**50. (c) :** According to Fleming's left hand rule, the direction of the magnetic force on a moving charge is always perpendicular to the magnetic field.

## SUBJECTIVE TYPE QUESTIONS

**1.** A charged particle moving in a magnetic field may experience a force in the direction perpendicular to direction of magnetic field and direction of motion of particle. This force deflects the charged particle from its path.

**2.** Galvanometer is an instrument that can detect the presence of electric current in a circuit.

**3.** Magnetic field **:** It is defined as the space surrounding the magnet in which magnetic force can be experienced.

**4.** Using Fleming's left hand rule, the direction of magnetic field is into the plane of paper.

**5.** By using Fleming's left hand rule if the direction of motion of charged particle is vertically out of the page, then the charged particle must be positive in nature.

**6.** The speed of rotation of an electric motor can be increased by

(i) increasing the strength of the current

(ii) increasing the number of turns in the coil.

**7.** AC generator, Thermal power station, Hydro-electric station.

**8.** A compass needle gets deflected when brought near a bar magnet because magnetic force is exerted by the bar magnet on the compass needle, which is itself a tiny pivoted magnet.

**9.** The strength of an electromagnet depends on the following factors :

(a) Number of the turns in the coil

(b) Strength of the current

(c) Nature of the core material.

**10.** Split ring facilitates the contacts with the ends of the rectangular coil to keep the rotation continuous and not a reversal after every 180°.

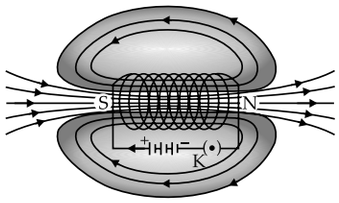
**11.** Strength of magnetic field produced by a straight current-carrying wire at a given point is

(a) directly proportional to the current passing through it.

(b) inversely proportional to the distance of that point from the wire.

$$i.e.,\ B \propto \frac{I}{r}\begin{cases} B \rightarrow \text{magnetic field} \\ I \rightarrow \text{current} \\ r \rightarrow \text{distance between wire and point of observation} \end{cases}$$

**12.** Solenoid : A coil of many circular turns of insulated copper wire wrapped in the shape of cylinder is called solenoid.




Field lines of the magnetic field through and around a current-carrying solenoid

The pattern of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid.

**13.** By keeping the magnet in a fixed position and moving the coil towards and away from the magnet, we can induce current in the coil.

**14.** (i) Yes, alpha particles being positively charged constitutes a current in the direction of motion.

(ii) No, the neutrons being electrically neutral constitute no current.

**15.** The divergence, that is, the falling degree of closeness of magnetic field lines indicated the fall in strength of magnetic field near and beyond the ends of the solenoid.

**16.** A current carrying wire produces a magnetic field. When current is flowing through a wire, the electrons move inside it along a definite direction. On the other hand, if no current is flowing through a wire, the electrons inside this wire are in random motion, their average thermal velocity is zero. Such a wire does not produce any magnetic field.

**17.** Applying Fleming's left hand rule point your fore finger upward. Since you are dealing with a negative charge, rotate your hand until the middle finger points east. Your thumb will point northward, and that is the direction of the force.

**18.** A current-carrying wire produces a magnetic field around it. When placed in a magnetic field, the two magnetic fields interact with each other and the wire moves.

**19.** The direction of force is at right angle to the direction of magnetic field and current (opposite to the direction of motion of electrons). Applying Fleming's left-hand rule, the force is at right angle into the page.

**20.**

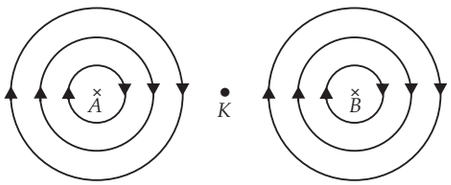
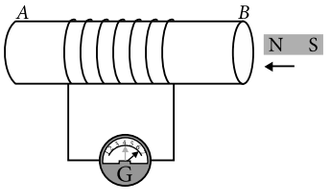


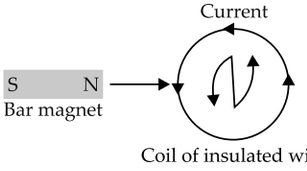

Figure shows the sketch of magnetic lines of force produced by current in wires *A* and *B*.

The point *K* is equidistant from the wires *A* and *B*, the wires *A* and *B* carry equal current, so the magnetic fields at *K* due to wires *A* and *B* are equal in magnitude but opposite in direction. Magnetic field due to the wire *A* is downward to the plane of paper, while due to the wire *B* it is upward to the plane of paper. So the net magnetic field at *K* is zero.

**21.** If a coil of insulated wire is connected to a galvanometer and a bar magnet with north pole is moved towards one face of the coil then, given situation is shown in the figure.




(i) Moved quickly towards the coil : A current is induced in anti-clockwise direction in the coil with respect to the side facing the south pole of the magnet and needle of galvanometer will deflect in one direction from zero position.




(ii) Placed near its one face : No deflection of the needle of galvanometer is observed.

**22.** Yes, these will be an induced current in both the cases as there is a change in the number of magnetic field lines associated with the coil or we can say that there is a motion of a magnet with respect to the coil.

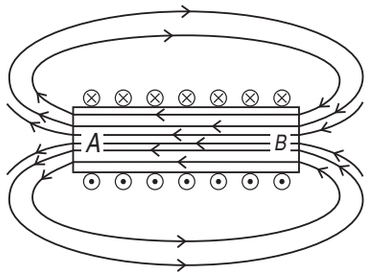
Same current will be induced and the direction of flow of current will also be the same in the two cases.

**23.** (a) It states that you are holding a current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then your finger will wrap around the conductor in the direction of the field lines of the magnetic field.

(b) (i) If the current is increased, the magnetic field strength also increases.

(ii) If the direction of current is reversed, the direction of magnetic field also get reversed.

**24.**




Using right hand thumb rube we can draw the magnetic field lines around the conductor as shown.

From figure, end *A* of solenoid act as north pole and end *B* will act as south pole. Inside the solenoid field lines are in the form of parallel straight lines.

**25.** According to right hand rule, the direction of magnetic field is

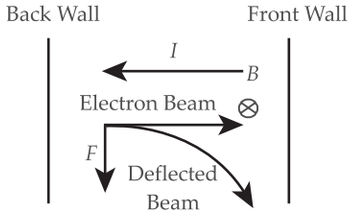
(i) west to east (ii) north to south

(iii) vertically upwards.

**26.** (a) When the amount of current in the coil *P* is changed, an induced current will induce in the coil *Q* due to change in magnetic field lines *i.e.*, magnetic flux.

(b) If both the coils are moved in the same direction with the same speed, then there is no net change in magnetic flux. Hence there will be no deflection in the galvanometer.

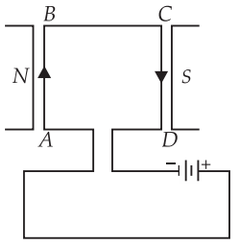
**27.** The direction of current *I* is opposite to the direction electron beam as shown in figure. Since the beam is deflected to the right side, the force, *F* acting on the beam is as shown. Applying Fleming's left hand rule, it is found that magnetic field, *B* is acting vertically downwards (i.e., perpendicular to the plane of the paper and directed inwards) as shown by ⊗.



**28.** (i) In figure, the current in the coil is in direction *DCBA*. By Fleming's left hand rule, in the arm *AB*, the force is outward at right angle to the plane of the coil. On the arm *BC* no force acts. On the arm *CD*, the force is inwards perpendicular to the plane of the coil. On the arm *DA*, no force acts.

(ii) The force on the arms *AB* and *CD* are equal in magnitude, but opposite in direction. They form a clockwise couple. So the coil will rotate clockwise with the arm *AB* coming out and the arm *CD* going in.

(iii) On interchanging the terminals of the battery, the coil will rotate anticlockwise.

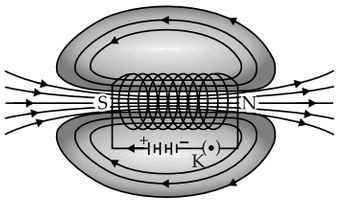



**29.** The pole of magnetic field will be south pole below the power line.

**30.** At smaller distances, the magnetic field will be described by concentric circles around the wire. As the distance increases, the circles become larger and larger. At the centre of the loop/ coil, the magnetic field will appear as straight line.

**31.** The force will act in upward direction perpendicular to both, the direction of current as well as to the field.

**32.** Solenoid : A coil of many circular turns of insulated copper wire wrapped in the shape of cylinder is called solenoid.




Field lines of the magnetic field through and around a current-carrying solenoid

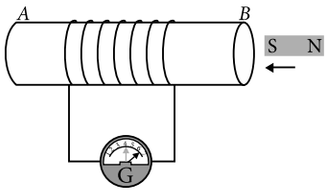
The pattern of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid.

Solenoid is used to form strong but temporary magnet called electromagnets. These electromagnets are used in wide variety of instruments and used to lift heavy iron objects.

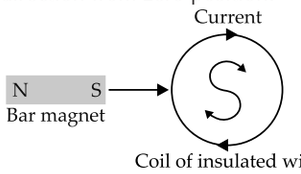
(a) Two magnetic field lines never intersect each other.

(b) Magnetic field are closed curves.

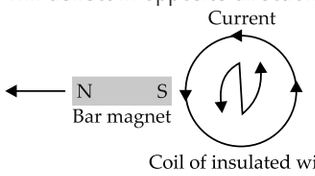
**33.** (a) If a coil of insulated wire is connected to a galvanometer and a bar magnet with south pole is moved towards one face of the coil then, given situation is shown in the figure.




(i) Moved quickly towards the coil : A current is induced in clockwise direction in the coil with respect to the side facing the north pole of the magnet and needle of galvanometer will deflect in one direction from zero position.




(ii) Moved quickly away from coil : A current is induced in anti-clockwise direction in the coil with respect to the side facing the north pole of the magnet and the needle of the galvanometer will deflect in opposite direction from (i).




(iii) Placed near its one face : No deflection of the needle of galvanometer is observed.

(b) The phenomena involved is called electromagnetic induction.

(c) Fleming's right hand rule: Stretch the right hand such that the first finger, the central finger and the thumb are mutually perpendicular to each other. If the first finger points along the direction of the field (magnetic field) and the thumb points along the direction of motion of the conductor, then the direction of induced current is given by the direction of the central finger.

**34.** (i) When a current carrying wire is placed in a magnetic field, it experiences a magnetic force that depends on

(a) current flowing in the conductor

(b) strength of magnetic field

(c) length of the conductor

(d) angle between the element of length and the magnetic field.

(ii) Force experienced by a current carrying conductor placed in a magnetic field is largest when the direction of current is perpendicular to the direction of magnetic field.

(iii) The rule used in finding the direction of motion of the conductor placed in a magnetic field is Fleming's left hand rule.

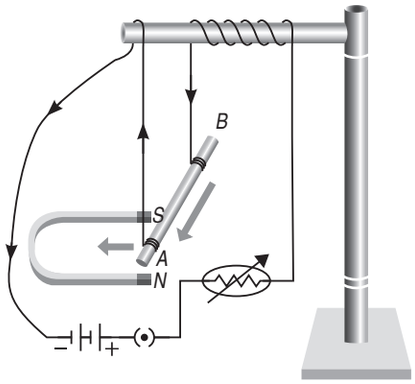
Fleming's left hand rule is as follows:

Stretch out the thumb, the forefinger, and the second (middle) finger of the left hand so that these are at right angles to each other. If the forefinger gives the direction of the magnetic field (N to S), the second (middle) finger the direction of current then the thumb gives the direction of the force acting on the conductor.

(iv) (a) Direction of force will be reversed when direction of magnetic field is reversed, *i.e.*, now force on conductor will act from left to right.

(b) Direction of force will be reversed, if the direction of current is reversed, *i.e.*, the force on the conductor will act from left to right.

**35.** A small aluminium rod suspended horizontally from a stand using two connecting wires. Place a strong horseshoe magnet in such a way that the rod lies between the two poles with the magnetic field directed upwards. For this, put the north pole of the magnet vertically below and south pole vertically above the aluminium rod.




Connect the aluminium rod in series with a battery, a key and a rheostat. Pass a current through the aluminium rod from one end to other (*B* to *A*). The rod is displaced towards left. When the direction of current flowing through the rod is reversed, the displacement of rod will be towards right. Direction of force on a current carrying conductor is determined by Fleming's left hand rule.