Chapter -12 Magnetic Effects of Electric Current

MULTIPLE CHOICE QUESTIONS

1.Choose the incorrect statement from the following regarding magnetic lines of field
(A)The direction of the 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.

2. The phenomenon of electromagnetic induction is

(a) the process of charging a body.

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

(c) producing induced current in a coil due to relative motion between a magnet and the coil.

(d) the process of rotating a coil of an electric motor.

3. Which of the following correctly describes the magnetic field near along straight current carrying wire?

(A)The field consists of straight lines perpendicular to the wire.

(B)The field consists of straight lines parallel to the wire.

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

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

4. The device used for producing electric current is called a

(a) generator.

(b) galvanometer.

(c) ammeter.

(d) motor.

5.The strength of magnetic field inside a long current carrying straight solenoid is :

(A) More at the ends than at the centre

(B) Minimum in the middle

(C) Same at all points

(D) Found to increase from one end to the other

6. The essential difference between an AC generator and a DC generator is that

(a) AC generator has an electromagnet while a DC generator has permanent magnet.

(b) DC generator will generate a higher voltage.

(c) AC generator will generate a higher voltage.

(d) AC generator has slip rings while the DC generator has a commutator.

7. Choose the incorrect statements 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.

8. What should be the core of an electromagnet?

(A) Soft iron

(b) Hard iron

(C) Rusted iron

(D) None of above

9. The most important safety method used for protecting home appliances from short- circuiting or Overloading is

(a) earthing

(b) use of stabilisers

(c) use of fuse

(d) use of electric metre

10. No force acts on a current carrying conductor when it is placed-

(A) Perpendicular to the magnetic field

(B) Parallel to the magnetic Field

(C) Far away from the magnetic field

(D) Inside a magnetic field

11. The direction of force on a current carrying conductor in a magnetic field is given by

(a) Fleming's left-hand rule.

(b) Fleming's right-hand rule.

(c) Right hand thumb rule.

(d) Left hand thumb rule.

12. Switches are connected to

(a) live wire.

(b) neutral wire.

(c) earth wire.

(d) anyone.

13.Two magnetic field lines:

a) Intersect at neutral point

b) Never intersect each other

c) Intersect near north-pole or south pole

d) Intersect at the midpoint of the magnet

VERY SHORT ANSWER QUESTIONS

1. What do you understand about the magnetic effect of current?

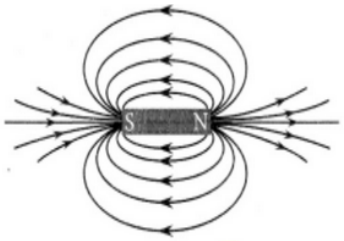
Ans: When electric current flows through a conductor it produces a magnetic field around it and behaves like a magnet. This is called the magnetic effect of electric current.

2. What is meant by magnetic field?

Ans: It is defined as the space surrounding the magnet in which magnetic force can be experienced.

3. Draw magnetic field lines around a bar magnet. Name the device which is used to draw magnetic field lines.

Ans: Compass needle is used to draw magnetic field lines.



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

Ans: The magnetic field of the magnet exerts force on both the poles of the compass needle.The forces experienced by the two poles are equal and opposite. These two forces form a couple which deflects the compass needle.

5. Write one application of Fleming's left hand rule

Ans: Fleming's left hand rule is used to find the direction of force on a current carrying conductor placed in a magnetic field acting perpendicular to the direction of current.

6. List the properties of magnetic lines of force.

Ans: Properties of magnetic lines of force:

● Outside the magnet, the direction of field lines is from north pole to south pole,

● Inside the magnet, the direction of field lines is from south pole to north pole.

● The magnetic field lines are closed curves.

● The magnetic field is stronger, where the field lines are crowded.

● **No two field-lines intersect each other.**

7. What is the function of a galvanometer in a circuit?

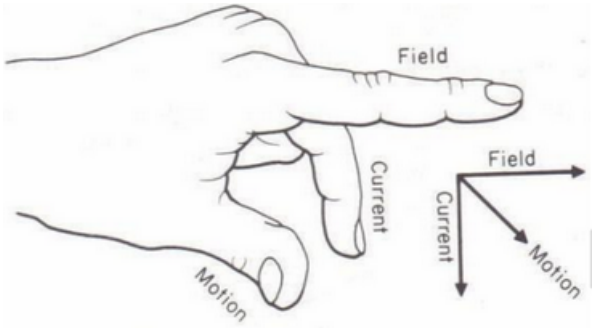
Ans: Galvanometer is an instrument that can detect the presence of electric current in a circuit

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

Ans: A compass needle behaves like a small bar magnet when it is brought near a bar magnet. Its magnetic field lines interact with that of a bar magnet. Hence the compass needle gets deflected.

9. State Fleming's left hand rule.

Ans: Fleming's left hand rule : Stretch the first finger, the middle finger and the thumb of your left hand mutually perpendicular to each other in such a way that the first finger represents the direction of the magnetic field, the middle finger represents the direction of the current in the conductor, then the thumb will represent the direction of Force(motion of the conductor).



10. A beam of alpha particles enters a chamber moving along the magnetic field. What is the magnetic force experienced by the beam?

Ans: Zero, it is because beam is moving parallel to the magnetic field.

SHORT ANSWER QUESTIONS

1. Write the frequency of alternating current (AC) in India. How many times per second does it change its direction?

Ans: The frequency of A.C. in India is 50 Hz and it changes direction twice in each cycle. Therefore, it changes direction 2 × 50 = 100 times in one second.

2. 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.

Ans: (a) Observation: The compass needle is deflected more. Reason: Current carrying wire produces magnetic field, (B α I).

(b) Observation: The deflection of magnetic needle decreases.

Reason: The strength of magnetic field decreases with increase in distance from the wire. (B∝ 1/d)

3. How is the type of current that we receive in a domestic circuit different from the one that runs a clock?

Ans: The current that we receive from the domestic circuit is alternating current (A.C.) and the current that is used to run the clock is direct current (D.C.). Direct current always flows in one direction whereas the alternating current reverses its direction periodically.

4. 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.

Ans: When the observer observes the direction of magnetic field from west then the direction of current is from east to west and if observer is at east side then the direction of current is from\ west to east. Right hand thumb rule: If we hold a current carrying conductor in our right hand in such a way that the stretched thumb is along the direction of the current, then curls of fingers around the conductor represent the direction of magnetic field lines.

5. Define alternating current and direct current. Explain why alternating current is preferred over direct current for transmission over long distances.

Ans: Alternating current (A.C.) : An electric current whose magnitude changes with time and direction reverses periodically is called alternating current.

Direct current (D.C.) : An electric current whose magnitude is either constant or variable but the direction of flow in a conductor remains the same is called direct current.

A.C. can be transmitted to distant places without much loss of electric power than D.C. That is why A.C. is preferred over D.C. for transmission of current over long distances.

6. Find the direction of magnetic field due to a 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) vertically 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.

Ans: to right hand rule, the direction of magnetic field is

(i) west to east

(ii) north to south

(iii) into the paper.

7. Name some sources of direct current.

Ans: Some of the sources of direct current are dry cells, button cells, lead accumulators.

8. Distinguish between a bar magnet and an electromagnet.

Bar Magnet	Electromagnet
The bar magnet is a permanent magnet.	An electromagnet is a temporary magnet.
It produces a comparatively weak magnetic force.	It produces a very strong magnetic force.
The strength of a bar magnet cannot be changed.	The strength of an electromagnet can be changed by changing the number of turns in its coil or by changing the current passing through it.
The polarity of a bar magnet is fixed and cannot be changed.	The polarity of an electromagnet can be changed by changing the direction of current in its coil.

LONG ANSWER QUESTIONS

1. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from the 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 ?

Ans: Here the electron beam is moving from our back wall to the front wall, so the direction of current will be in the opposite direction, from front wall towards the back wall or towards us. The direction of deflection (or force) is towards our right side.Now, we know two things :direction of current is from front towards us and direction of force is towards our right side.

Let us now hold the forefinger, middle finger and thumb of our left hand at right angles to one another. We now adjust the hand in such a way that our centre finger points towards us (in the direction of current) and our thumb points towards the right side (in the direction of force). Now, if we look at our forefinger, it will be pointing vertically downwards. Since the direction of the forefinger gives the direction of the magnetic field, therefore, the magnetic field is in the vertically downward direction.

2 A current carrying conductor is placed in a magnetic field and 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?

Ans: (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 the 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.

3. Mention and explain the function of an earth wire. Why is it necessary to earth metallic appliances?

Ans: Many electric appliances of daily use like electric press, heater, toaster, refrigerator, table fan etc. have a metallic body. If the insulation of any of these appliances melts and makes contact with the metallic casing, the person touching it is likely to receive a severe electric shock. This is due to the reason that the metallic casing will be at the same potential as the applied one. Obviously, the electric current will flow through the body of the person who touches the appliance. To avoid such serious accidents, the metal casing of the electric appliance is earthed. Since the earth does not offer any resistance, the current flows to the earth through the earth wire instead of flowing through the body of the person.

4. Give reason for the following :

a.The burnt out fuse should be replaced by another fuse of identical rating.

Ans: A burnt out fuse should be replaced with another fuse of identical rating because it helps in protecting the circuit from overloading and short circuiting. If a fuse of higher rating is used then it may not melt and cut off the supply during overloading. Similarly a fuse of lower rating may melt frequently even for a normal flow of current. This results in decreasing the efficiency of the circuit.

b. It is dangerous to touch the live wire of the main supply rather than neutral wire.

Ans: Live wire is at 220V and neutral wire is at zero volt since the electric current flows from higher potential to lower potential, we can get an electric shock by touching live wire but that is not the case with neutral wire.

c. Using a fuse in a household electric circuit is important.

Ans: Fuse is an important safety device. It is used in series with any electrical appliance and protects it from short-circuiting and overloading.

5. (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,

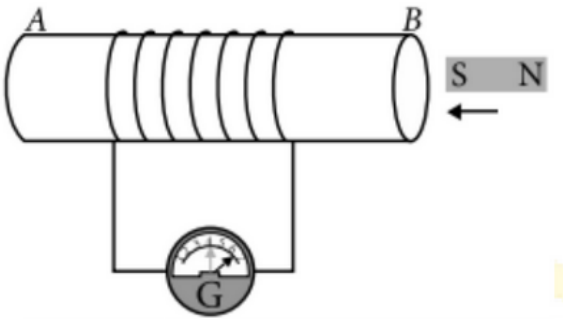
(ii) moved quickly away from it,

(iii) placed near its one face?

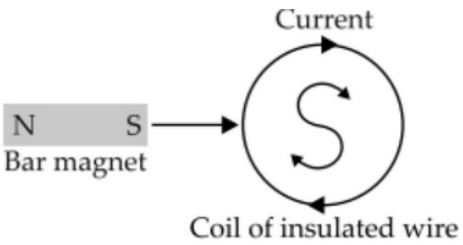
(b) Name the phenomena involved in the above cases.

(c) State Fleming's right-hand rule.

Ans: (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, the 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 the galvanometer will deflect in one direction from zero position.



(ii) Moved quickly away from the 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 the opposite direction from (i).

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

(b) The phenomenon 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.

CASE STUDY QUESTION

The region around a magnet where magnetism acts is represented by the magnetic field.The force of magnetism is due to moving charge or some magnetic material. Like stationary charges produce an electric field proportional to the magnitude of charge, moving charges produce magnetic fields proportional to the current. In other words, a current carrying conductor produces a magnetic field around it. The subatomic particles in the conductor like the electrons moving in atomic orbitals, are responsible for the production of magnetic field. The magnetic field lines around a straight conductor (straight wire) carrying current are concentric circle whose centres lie on the wire.

1)The magnetic field associated with a current carrying straight conductor is in anti-clockwise direction. If the conductor was held horizontally along east west direction,what is the direction of current through it?

Ans. Direction of current will be from east to west

2)Name and state the rule applied to determine the direction of magnetic field in a straight current carrying conductor.

Ans. Right hand thumb rule. Imagine that you are holding a straight current carrying conductor in your right hand so that your thumb points in the direction of current, the direction of fingers encircling the wire will give the direction of magnetic field

3)Ramus performs an experiment to study the magnetic effecT of current around a current carrying straight conductor with the help of a magnetic compass. He reports that

a)The degree of deflection of magnetic compass increases when the compass is moved away from the conductor.

b)The degree of deflection of the magnetic compass increases when the current through the conductor is increased.

Which of the above observations of the student appears to be wrong and why?

Ans. Observation a is wrong because as the distance from the conductor increases the strength of the magnetic field will decrease.

4)What type of field is produced by stationary and moving charges respectively?

Ans. Stationary charges produce an electric field proportional to the magnitude of charge, moving charges produce magnetic fields proportional to the current.