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Chapter – 13 Magnetic Effects of Electric Current

Q1. Which of the following correctly describes the magnetic field near a long straight 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 centred on the wire.**

Answer: Option d)

The magnetic field near a long straight wire are concentric circles. Their centres lie on the wire.

Q2. 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.**

Answer: Option c)

The phenomenon of inducing current in a coil due to the relative motion between the coil and the magnet is known as electromagnetic induction.

Q3. The device used for producing electric current is called a

a) **Generator**
b) **Galvanometer**
c) **Ammeter**
d) **Motor**

Answer: Option a)

The device used for producing electric current is known as a generator. Generator converts mechanical energy to electric energy.

Q4. The essential difference 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 g higher voltage.**

c) **AC generator will generate a higher voltage.**
d) **AC generator has slip rings while the DC generator has a commutator.**

Answer: Option d)

AC generator have two rings known as the slip rings while DC generators have two half rings known as the commutator. This is the main difference between AC generator and DC generator.

Q5. At the time of short circuit, the current in the circuit

a) **Reduces substantially**
b) **Does not change**
c) **Increases heavily**
d) **Vary continuously**

Answer: Option c)

When two naked wires in the circuit come in contact with each other, the amount of current flowing in the circuit increase abruptly resulting in short circuit.

Q6. State whether the following statements are true or false:

a) **An electric motor converts mechanical energy into electrical energy.**
b) **An electric generator works on the principle of electromagnetic induction.**
c) **The field at the centre of a long circular coil carrying current will be parallel straight lines.**
d) **A wire with a green insulation is usually the live wire of an electric supply.**

Answer:

a) False
b) True
c) True
d) False

Q7. List two methods of producing magnetic fields.

Answer:

The following are the methods for producing magnetic fields: -

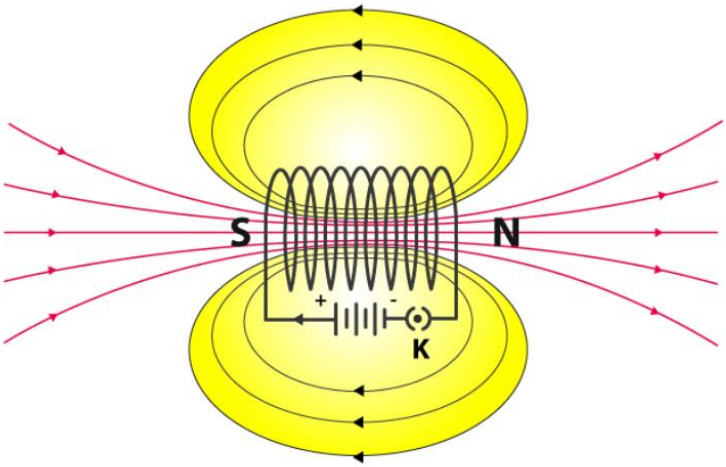
a) By using a permanent magnet, we can produce magnetic field and it can be visualized by spreading iron fillings on a white paper and keeping a magnet beneath the paper.

b) A current carrying straight conductor produces magnetic field.
c) Different types of conductors such as solenoid and circular loop can be used to see the presence of magnetic field.

Q8. How does a solenoid behave like a magnet? Can you determine the north and south poles of a current-carrying solenoid with the help of a bar magnet? Explain.

Answer:

A solenoid is a long coil of circular loops of insulated copper wire. The magnetic field produced around the solenoid when the current is passed through it is similar to the magnetic field produced around the bar magnet when current is passed through it. The figure shown below shows the arrangement of magnetic fields produced around the solenoid when current is passed through it.



When the north pole of the bar magnet is brought close to the end connected to the negative terminal of the battery, the solenoid repels the battery. As like poles repel each other, we can infer that the end connected to the negative terminal behaves as a north pole while the end connected to the positive terminal behaves as a south pole.

Q9. When is the force experienced by a current-carrying conductor placed in a magnetic field largest?

Answer:

When the direction of the current is perpendicular to the direction of the magnetic field is when the force experienced is the largest.

Q10. 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 magnetic field?

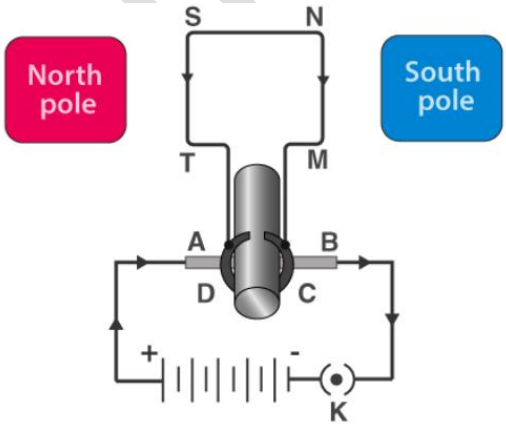
Answer:

The direction of the magnetic field can be determined using the Fleming's Left-hand rule. The direction of the magnetic field will be perpendicular to the direction of current and the direction of deflection, that is, either upward or downward. The direction of the current is from the front wall to the back wall because negatively charged electrons move from the back wall to the front wall. The directed of the magnetic force is rightward. So, using Fleming's left-hand rule it can be concluded that the direction of the magnetic field inside the chamber is downward.

Q11. Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

Answer:

An electric motor is a device that converts electrical energy to mechanical energy. It works on the principle of magnetic effect of current. The figure listed below shows a simple electric motor.



When current is made to flow through the coil M-N-S-T by closing the switch, the coil starts to rotate in the anticlockwise direction. This is due to the downward force acting on the length M-N and simultaneously an upward force acting along the length S-T. As a result of which the coil rotates in the anticlockwise direction. Current in the length M-N flows from M to N and the magnetic fields act from left to right normal to the length M-N. According to Fleming's Left-Hand rule, a downward force acts along the length M-N. Similarly, the current along the length S-T flows from S to T and the magnetic field acts from left to right. Therefore, an upward force acts along the length S-T. These two forces together cause the coil to rotate anti-clockwise. After half a rotation, the position of MN and S-T interchange. The half ring C come in

contact with brush B and the half ring D comes in contact with rush C. Hence the direction of current in the coil M-N-S-T gets reversed.

Q12. Name some devices in which electric motor are used.

Answer:

A few devices in which electric motors are used are:

- Electric fans
- Water pumps
- Mixers
- Washing machines

Q13. A coil of insulated copper wire is connected to a galvanometer. What will 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) When a bar magnet is pushed into the coil, current is induced in the coil momentarily as a result the galvanometer deflects in a particular direction momentarily.

(ii) When the bar magnet is withdrawn from inside the coil, current is induced momentarily but in the opposite direction and the galvanometer deflects in the opposite direction momentarily.

(iii) When the bar magnet is held stationary inside the coil, no current will be induced as a result there will be no deflection in the galvanometer.

Q14. Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

Answer:

When the current in coil A changes, the magnetic field associated with it also changes. As a result, the magnetic field around coil B undergoes change. The change in the magnetic field of coil B induces current in it.

Q15. State the rule to determine the direction of a (i) magnetic field produced around a straight conductor-carrying current, (ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and (iii) current induced in a coil due to its rotation in a magnetic field.

Answer:

(i) The rule used to determine the direction of the magnetic field produced around a straight conductor-carrying current is the Maxwell's right hand thumb rule.

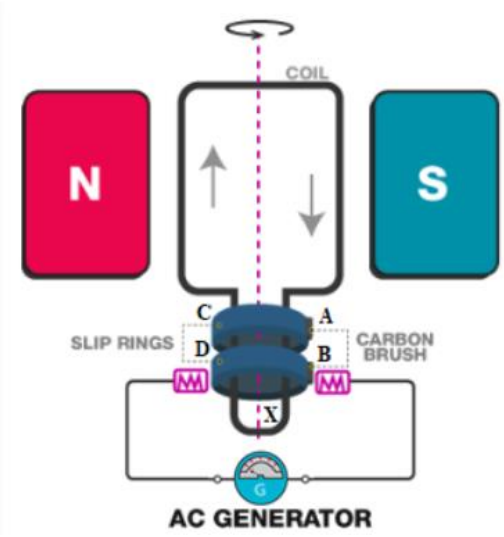
(ii) The rule used to determine the force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it is the Fleming's left-hand rule.

(iii) The rule used to determine the current induced in a coil due to its rotation in a magnetic field is the Fleming's right-hand rule.

Q16. Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

Answer:

The electric generator coverts the mechanical energy into the electrical energy. The working principle of the electric generator is the electromagnetic induction. It generates electricity by rotating a coil in the magnetic field. The figure below shows the construction of a simple AC generator.



In the diagram,

A and B are brushes,

C and D are slip rings

X is the axle

G is the galvanometer

When the axle X is rotated clockwise, MN moves upwards while ST moves downward. The movement of MN and ST in the magnetic field results in the production of electric current due to electromagnetic induction. MN moves upwards and the magnetic fields act from left to right. Therefore, according to Fleming's right-

hand rule, the direction of the induced current will be from M to N along the length MN. Similarly, the direction of the induced current will be from S to T along the length ST. The direction of the current in the coil is MNST. Hence, galvanometer shows a deflection in a particular direction.

After half a rotation, length MN starts moving downwards while the length ST starts moving upwards. Now, the direction of the induced current reverses to TSNM. Since the direction of the induced current reverses every half rotation, the current induced is known as alternating current.

Brushes are kept pressed on to two slip rings separately. Outer ends of brushes are connected to the galvanometer. Thus, brushes help in transferring current from coil to the external circuit.

Q17. When does an electric short circuit occur?

Answer:

Listed below are two instances of when a short-circuit can occur:

1) When too many appliances are connected to a single socket or when high power rating appliances are connected to a light circuit, the resistance of the circuit becomes low as a result the current flowing through the circuit becomes very high. This condition results in a short-circuit.

2) When live wires whose insulation have worn off come in contact with each other, the current flowing in the circuit increases abruptly which results in a short circuit.

Q18. What is the function of an earth wire? Why is it necessary to earth metallic appliances?

Answer:

The metallic body of electric appliances is earthed by means of earth wire. Any leakage of electric wire is transferred to the ground by means of earth wire. This prevents the user of the electric appliance from getting electric shocks. This is the reason why it is important for the metallic appliances to be earthed.