NCERT EXERCISE SOLUTIONS
CHAPTER: 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: (d) The field consists of concentric circles centred on the wire.
Explanation: According to the Right-Hand Thumb Rule, the magnetic field lines around a long straight current-carrying conductor form concentric circles around the wire, with the wire passing through their common centre.

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. [1]

Answer: (c) producing induced current in a coil due to relative motion between a magnet and the coil.
Explanation: Electromagnetic induction is the generation of a potential difference and an induced current in a closed circuit or coil when the magnetic flux linked with it changes due to relative motion between the coil and a magnet.

Q3. The device used for producing electric current is called a:
(a) generator
(b) galvanometer
(c) ammeter
(d) motor

Answer: (a) generator
Explanation: An electric generator converts mechanical energy into electrical

energy to produce current. An ammeter measures current, a galvanometer detects current direction, and a motor converts electrical energy into mechanical energy.

Q4. The essential difference between an AC generator and a DC generator is that:
(a) AC generator has an electromagnet while a DC generator has a 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.

Answer: (d) AC generator has slip rings while the DC generator has a commutator.
Explanation: An AC generator uses complete slip rings to maintain an alternating direction of current output. A DC generator uses a split-ring commutator to reverse the connections every half-cycle, maintaining a unidirectional (direct) current output.

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: (c) increases heavily.
Explanation: A short circuit occurs when the live wire and the neutral wire come into direct contact. This causes the resistance of the circuit to drop to almost zero, leading to an immediate and massive surge in the electric current.

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. (An electric motor converts electrical energy into mechanical energy).
(b) True.
(c) True.
(d) False. (A wire with green insulation is the earth wire; the live wire is usually red or brown).

Q7. List three sources of magnetic fields.

Answer:

1. Permanent magnets (like bar magnets or horseshoe magnets).
2. A current-carrying straight conductor, circular loop, or solenoid.
3. The planet Earth itself, which possesses its own natural magnetic field. [1]

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 containing a large number of close turns of insulated copper wire. When electric current passes through it, it creates a magnetic field pattern that is identical to that of a bar magnet. One end of the solenoid behaves as a magnetic North pole, while the other behaves as a magnetic South pole.

Yes, we can determine the poles using a bar magnet:
Bring the known North pole of a bar magnet near one end of the current-carrying solenoid. If that end of the solenoid is repelled, it is the North pole (since like poles repel). If it is attracted, that end is the South pole (since opposite poles attract).

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

Answer:
The force experienced by a current-carrying conductor is largest when the

direction of the electric current is perpendicular (at an angle of 90 degrees) to the direction of the magnetic field.

Q10. Imagine 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 is vertically downwards.
Explanation:

1. The electron beam moves from the back wall to the front wall. Because electrons carry a negative charge, the conventional direction of current is opposite, flowing from the front wall to the back wall.
2. The deflection force acts towards the right side.
3. Applying Fleming's Left-Hand Rule: Point the middle finger backward (current) and the thumb to the right (force). The forefinger (magnetic field) points vertically downwards.

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:
(Note for Word document: Leave space here to insert a standard rectangular coil motor diagram with parts: Armature coil ABCD, Split rings P and Q, Carbon brushes X and Y, Strong permanent magnets N and S, and a Battery connection).

Principle: It works on the principle of the magnetic effect of current. When a rectangular current-carrying coil is placed in a magnetic field, it experiences a mechanical torque or force that rotates it continuously.

Working: Current enters the rectangular coil ABCD through brush X and flows along A-B-C-D. According to Fleming's Left-Hand Rule, arm AB experiences a downward force while arm CD experiences an upward force, causing the coil to rotate anti-clockwise. After a half-rotation, the split rings change contact with the brushes, reversing the current direction to flow along D-C-B-A. Now arm

CD goes down and AB comes up, ensuring continuous rotation in the same direction.

Function of Split Rings: The split rings act as a commutator. Their primary role is to reverse the direction of the current flowing through the armature coil after every half-rotation, which maintains continuous rotation in a single direction.

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

Answer:
Electric motors are widely used in household appliances and machinery, including:

1. Electric fans and coolers
2. Washing machines
3. Refrigerators
4. Water pumps
5. Mixers, grinders, and blenders
6. Computer hard drives and DVD players

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 the bar magnet is pushed into the coil, a momentary current is induced due to the changing magnetic field, and the galvanometer needle deflects in a particular direction (e.g., to the right).
(ii) When the bar magnet is withdrawn, a current is induced in the opposite direction because the magnetic field lines decrease, causing the galvanometer needle to deflect momentarily in the opposite direction (e.g., to the left).
(iii) When the bar magnet is held stationary inside the coil, there is no change in the magnetic field lines linked with the coil. No current is induced, and the galvanometer shows zero deflection. [1]

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

Answer:
Yes, current will be induced in coil B.
Reason: This happens due to the phenomenon of mutual induction. When the current in coil A changes, the magnetic field lines surrounding it also change. Since coil B is placed close by, these changing magnetic field lines cut through coil B. This change in magnetic flux induces a potential difference and a current across the terminals of coil B.

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.
(iii) current induced in a coil due to its rotation in a magnetic field.

Answer:
(i) Right-Hand Thumb Rule: Imagine holding the current-carrying wire in your right hand with the thumb pointing in the direction of the current. The wrapped fingers will show the direction of the magnetic field lines.
(ii) Fleming's Left-Hand Rule: Stretch the thumb, forefinger, and middle finger of your left hand mutually perpendicular to each other. If the forefinger points to the magnetic field and the middle finger to the current, the thumb points to the direction of the force.
(iii) Fleming's Right-Hand Rule: Stretch the thumb, forefinger, and middle finger of your right hand mutually perpendicular to each other. If the thumb points to the motion of the conductor and the forefinger to the magnetic field, the middle finger shows the direction of the induced current.

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

Answer:
(Note for Word document: Leave space here to insert a standard AC generator diagram showing armature coil ABCD, two complete Slip Rings R1 and R2, Carbon Brushes B1 and B2, Permanent Magnets N and S, and an external Galvanometer circuit).

Principle: An electric generator works on the principle of electromagnetic induction. When a coil is rotated mechanically inside a uniform magnetic field, the magnetic flux passing through the coil changes continuously, which induces an electric current in the circuit.

Working: Let arm AB move up and CD move down as the armature coil rotates clockwise. By Fleming's Right-Hand Rule, current is induced along the path A-B-C-D, flowing out into the external circuit through brush B2. After a half-rotation, arm CD starts moving up and AB moves down. The induced current reverses direction to flow along D-C-B-A, leaving through brush B1. This produces an alternating current (AC).

Function of Brushes: Carbon brushes remain stationary while pressing lightly against the rotating slip rings. Their main function is to collect the induced current from the moving parts of the generator and transfer it smoothly to the external load circuit without tangling the wires.

Q17. When does an electric short circuit occur?

Answer:
An electric short circuit occurs when the live wire (high potential) and the neutral wire (zero potential) come into direct contact with each other without any load in between. This usually happens due to the wearing out or damage of plastic insulation on the wires, or due to a technical fault inside a connected appliance.

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

Answer:
The function of an earth wire is to provide a low-resistance return path for any leakage current to flow safely into the ground.

It is necessary to earth metallic appliances (like refrigerators, electric irons, and toasters) because if the live wire accidentally touches the metallic casing due to faulty insulation, the entire chassis becomes live. If a person touches it, they could receive a severe electric shock. The earth wire immediately transfers this leakage current to the ground, causing the circuit's fuse to blow or the circuit breaker to trip, protecting the user from harm.