NCERT X CLASS PHYSICS
Chapter-4 - Magnetic effects of electric current

Q.1 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.
Sol. (D)

Q.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.
Sol. (C)

Q.3 The device used for producing electric current is called a
(A) generator (B) galvanometer (C) ammeter (D) motor
Sol. (A)

Q.4 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.
Sol. (D)

Q.5 At the time of short circuit, the current in the circuit –
(A) reduces substantially (B) does not change
(C) increases heavily (D) vary continuously
Sol. (C)

Q.6 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.
Sol. (a) False, (b) True, (c) True, (d) False.

Q.7 List three sources of magnetic fields.
Sol. (a) Natural and artificial magnets
(b) Electromagnets
(c) A current carrying conductor produces magnetic field.

Q.8 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.

Sol. The magnetic field produced by a current-carrying solenoid is similar to the magnetic field produced by a bar magnet. In fact, one end of the solenoid behaves as a magnetic north pole, while the other behaves as a south pole.

We can determine the north and south poles of a current-carrying solenoid with the help of a bar magnet. Bring the north pole of a bar magnet near both the ends of a current-carrying solenoid. The end of solenoid which will be repelled by the north pole of bar magnet will be its north pole, and the ends of solenoid which will be attracted by the north pole of bar magnet will be its south pole.

Q.9 When is the force experienced by a current–carrying conductor placed in a magnetic field largest?

Sol. The force experienced by a current-carrying conductor placed in a magnetic field is largest when the direction of current is at right-angles to the direction of the magnetic field.

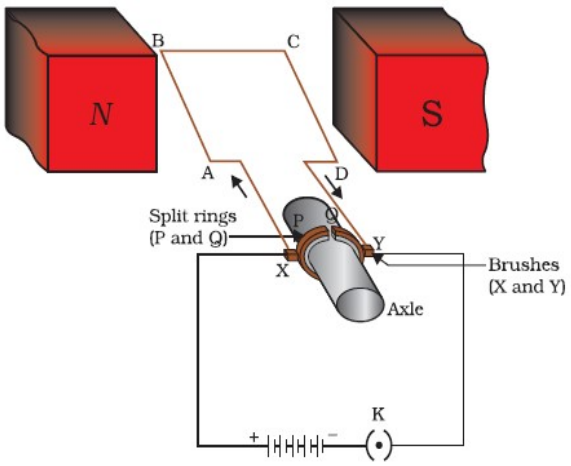
Q.10 Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

Sol. Since 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 back wall or towards us. The direction of force (or deflection) is towards our right side.

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

Q.11 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?

Sol.

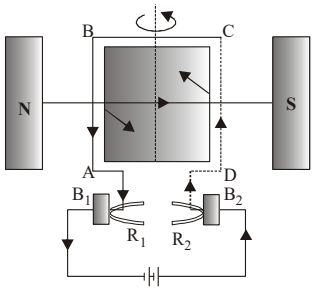


An electric motor is a rotating device that converts electrical energy to mechanical energy.

Principle : It is based on the fact that when a coil carrying current is held in a magnetic field, it experiences a torque, which rotates the coil.

Working : The battery sends current through the armature coil in the direction shown in fig. Applying Fleming's Left Hand Rule, CD experiences a force directed inwards and perpendicular to the plane of the coil. Similarly, AB experiences a force directed outwards and perpendicular to the plane of the coil. These two forces being equal,

unlike and parallel form a couple. The couple rotates the armature coil in the anticlockwise direction. After the coil has rotated through 180°, the direction of the current in AB and CD is reversed, fig. Now CD experiences an outward force and AB experiences an inward force. The armature coil thus continues rotating in the same i.e., anticlockwise direction.



Split-rings or Commutator : These are two halves of the same ring. The ends of the armature coil are connected to these halves which also rotate with the armature.It reverses the direction of flow of current through a circuit .

Q.12 Name some devices in which electric motors are used.

Sol. Electric motors are used in electric fans, refrigerators, mixers, washing machines, computers etc.

Q.13 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?

Sol. (i) When a bar magnet is pushed into the coil, a momentary deflection is observed in the galvanometer. This deflection indicates that a momentary current is produced in the coil.

(ii) When a bar magnet is held stationary inside the coil, there is no deflection in the galvanometer. It indicates that no current is produced in the coil.

(iii) When the bar magnet is withdrawn from the coil, the deflection of galvanometer is in opposite direction. It indicates that a current of an opposite direction is produced.

Q.14 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.

Sol. If the current in coil A is changed, some current will be induced in the coil B. Coil A is called the primary coil and coil B is called the secondary coil. As the current in the first coil changes, the magnetic field associated with it also changes. Thus, the magnetic field lines around the secondary coil also change. Hence the change in magnetic field lines associated with the secondary coil is the cause of induced electric current in it.

Q.15 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.

Sol. (i) The direction of magnetic field produced around a current-carrying conductor is given by right hand thumb rule. If the conductor carrying current is held in the right hand in such a way that the thumb points in the direction of current, then direction of curl of fingers gives the direction of the magnetic field.

(ii) The direction of force experienced by a straight conductor carrying current placed in a magnetic field, which is perpendicular to it determined by Fleming's left hand rule. Hold the thumb and first two fingers of the left hand at right angles to each other with the first finger pointing in the direction of the Field and the second finger in the direction of the current, then the thumb points in the direction of the motion.

(iii) The direction of current induced in a circuit by changing magnetic flux due to motion of a magnet is determined by Fleming's right-hand rule. If we stretch our right hand in such a way that the thumb, forefinger and central finger remain perpendicular to each other, so that the forefinger indicates the direction of the magnetic field and the thumb in the direction of motion of conductor. Then the central finger indicates the direction of induced current.

Q.16 Explain the underlying principle of an electric generator. What is the function of brushes?

Sol. Principle : It is based on the principle of electromagnetic induction, which is the process of producing induced current in a coil by relative motion between a magnet and the coil.
Function of brushes : The brushes carry the contact from rings to external load resistance.

Q.17 When does an electric short circuit occur?

Sol. If the insulation of the live wire and neutral wire gets damage, then the two wires touch each other. This touching of the live wire and neutral wire is known as short circuit. In this situation-resistance of a circuit decreases to a very small value. Due to this, current flowing through the wires becomes very large and heats the wires to a very high temperature, and a fire may be started.

Q.18 What is the function of an earth wire? Why is it necessary to earth metallic appliances?

Sol. Sometimes the insulation of live wire is teared and due to this the live wire touches the metallic body of the appliances. This causes the flow of current in metallic body. This current flow to the earth through earth wire and does not harm the user of the appliances. Therefore, to prevent the user by an electric shock, in case of leakage of current to metallic body, earth wire must always be used.