Chapter 4

Magnetic Effects of Electric Current

In Text Questions-Pg-224

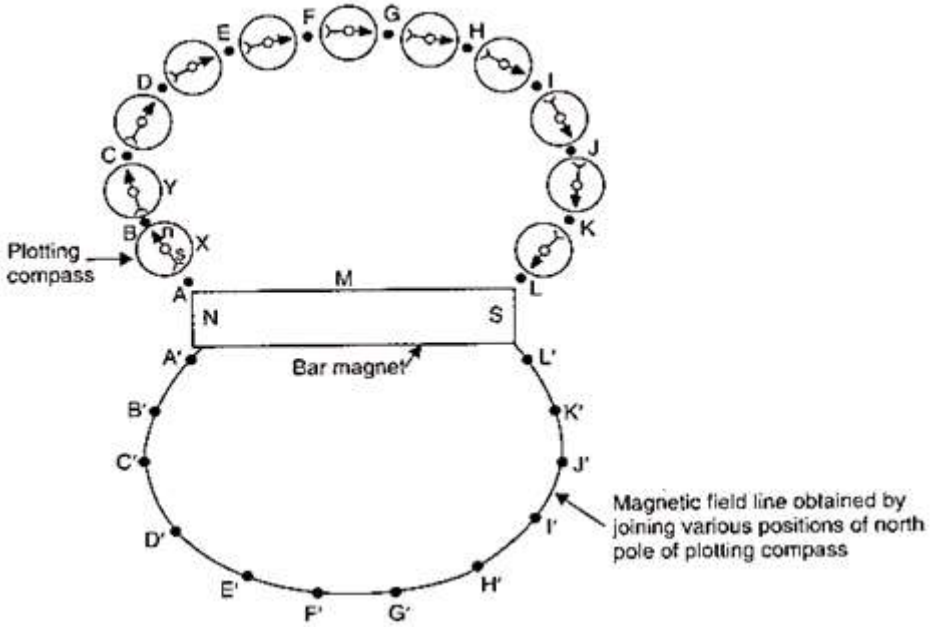
Q.1 Why does a compass needle get deflected when brought near a bar magnet ?

Ans.: A compass needle is a tiny pivoted magnet. It gets deflected when it is brought near a bar magnet because the bar magnet exerts a magnetic force on the compass needle.

In Text Questions-Pg-228

Q.1 Draw magnetic field lines around a bar magnet.

Ans.:



Q.2 List the properties of magnetic lines of force.

Ans.: (i) The magnetic lines of force always originate from north pole and end at the south pole of the magnet.

(ii) The magnetic lines of force are closer to one another near the ends of the poles of the magnet but they are spread away from each other in the middle region of the magnet.

(iii) The magnetic lines of force do not cross with each other.

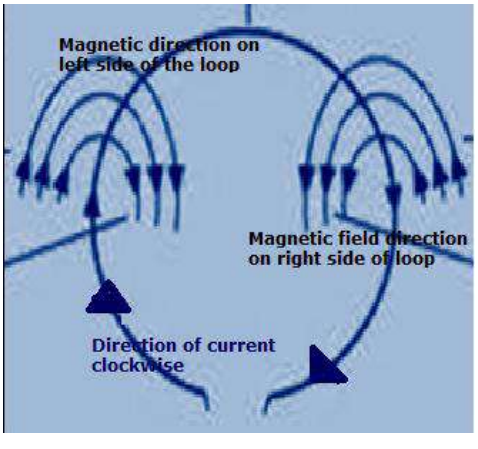
Q.3 Why don't two magnetic lines of force intersect with each other?

Ans.: The two magnetic lines of force do not intersect each other because net force acting at any point on a magnetic line of force will be in one direction only. If the two magnetic lines of force intersect with each other, then the compass needle would point in two directions at the same time at that point, which is not possible at all.

In Text Questions-Pg-229

Q.1 Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right hand rule to find out the direction of the magnetic field inside and outside the loop.

Ans.:

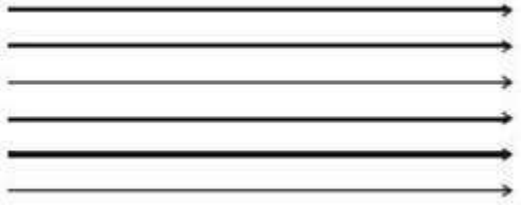


Fleming right-hand rule states that the direction of the magnetic field is perpendicular to the direction of current to flow.

To find the direction of the magnetic field we curl our hand in the direction of the current and our thumb will point to the direction of the magnetic field In the diagram, the current is flowing clockwise. If we apply the process as mentioned above the direction of the magnetic field will point towards inside the table if the current flowing in the circuit is clock-wise

Q.2 The magnetic field in a given region is uniform. Draw a diagram to represent it.

Ans.: Magnetic field is said to be uniform if the magnetic induction has the same magnitude and the same direction at all the points in the region. It is represented by drawing parallel lines, as given below:



Q.3 Choose the correct option:

The magnetic field inside a long, straight solenoid carrying current:

(a) is zero

(b) decreases as we move towards its end

(c) increases as we move towards its end

(d) is the same at all points

Solution: The magnetic field inside a long, straight solenoid carrying current is the same at all points. Therefore, option (d) is correct option.

In Text Questions-Pg-231

Q.1 Which of the following property/properties of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer):

(a) mass

(b) speed

(c) velocity

(d) momentum

Ans.: A proton when moves in a magnetic field, magnetic force is exerted on it. Due to this force, its velocity can change. And, since momentum is dependent on velocity, momentum can also change. Thus, options (c) and (d) are correct.

Q.2 A small aluminium rod AB is suspended horizontally from a stand by the ends of two connecting wires as shown in the Figure given here. A horseshoe magnet is placed in such a way that north pole of the magnet is vertically below and its south pole vertically above the aluminium rod. The aluminium rod is connected in series with a battery, a key and a rheostat. How do you think the displacement of rod AB will be affected if:

(i) current in rod AB is increased?

(ii) a stronger horseshoe magnet is used?

(iii) length of the rod AB is increased?

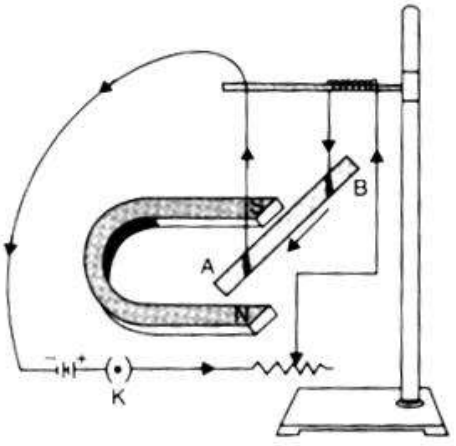
Ans.:

When a current-carrying conductor is perpendicular to the magnetic field, the force acting on it is directly proportional to the following parameters:

(a) magnitude of current flowing in the conductor

(b) strength of magnetic field applied, and

(c) length of the conductor.



Here, greater is the force, greater will be the displacement of the aluminium rod.

(i) if the current in rod AB is increased, then more force will act on the rod and hence the displacement of rod will also be more.

(ii) if a stronger horseshoe magnet is used, then the strength of magnetic field will increase leading to greater magnetic force on the rod, which will provide greater displacement.

(iii) If the length of rod AB is increased, then more force will act on the rod and hence the displacement of rod will also be more.

Q.3 A positively charged particle (alpha particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is:

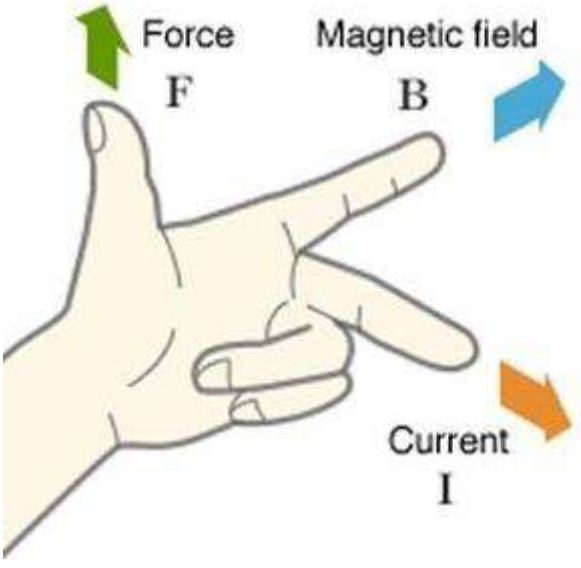
(a) towards south

(b) towards east

(c) downward

(d) upward

Ans.: We know according to the Question the positively charged particles are moving towards West indicating the direction of current is towards West, as the deflection is towards North we can interpret that the Force is Towards North.Using Flemings Left-hand thumb rule we adjust our forefinger, center finger and thumb of our left-hand indicating the direction of Magnetic Field, Current and Force/Motion Respectively.

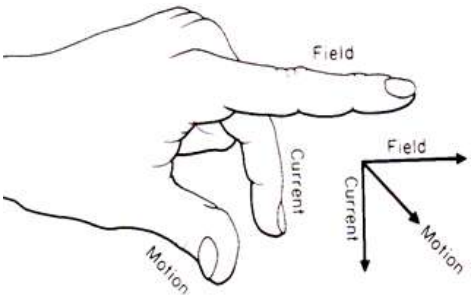


Hence the direction of Magnetic Field is (d)Upward

In Text Questions-Pg-233

Q.1 State Flemings left-hand rule.

Ans.: According to Fleming's left-hand rule:

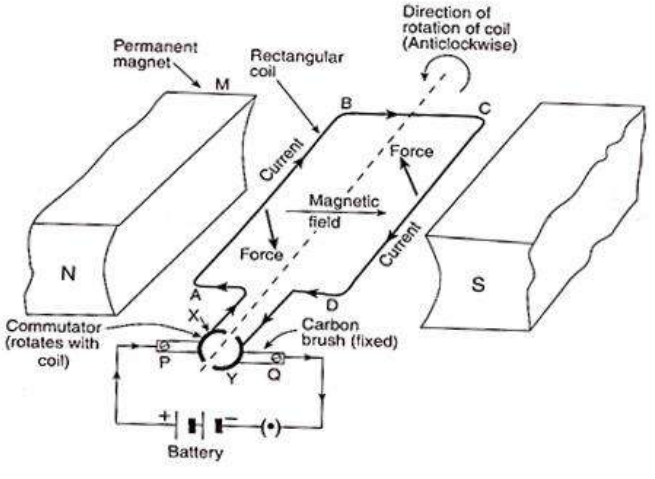


Hold the forefinger, the center finger and the thumb of your left hand at right angles to one another as shown in figure above. Adjust your hand in such a way that the forefinger points in the direction of magnetic fields and the center finger points in the direction of current, then the direction in which thumb points, gives the direction of force acting on the conductor.

Q.2 What is the principle of an electric motor?

Ans.: The Principle of an electric motor is stated below:

When a rectangular coil is placed in a magnetic field and current is passed through it, forces acts on the coil which rotates it continuously. When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.



In Text Questions-Pg-236

Q.1 State different ways to induce current in a coil.

Ans.: The different ways to induce current in a coil is listed below:

(a) The current can be induced in a coil by rotating it in the magnetic field between the poles of a U-shaped magnet.

(b) The current can be induced in the coil by keeping it stationary and rotating a magnet inside it.

c) The current can be induced in a coil by changing the current continuously in 'another coil' kept near it.

In Text Questions-Pg-237

Q.1 State the principle of an electric generator.

Ans: The electric generator works on the principle that when a conductor is moved in a magnetic field then the current is induced in the conductor or in other words electricity can be generated by rotating a coil inside magnetic field.

Q.2 Name some sources of direct current.

Ans.: The examples of sources of direct current:

a) Dry cell

b) Dry cell battery

c) Car battery

d) Solar cell and

e) D.C. generator.

Q.3 Which sources produce alternating current?

Ans.: The examples of sources of alternating current:

a) A.C. generators

b) Car alternators

c) Bicycle dynamos.

Q.4 Choose the correct option:

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced cum changes once in each:

(a) two revolutions

(b) one revolution

(c) half revolution

(d) one-fourth revolution

Ans.: When a rectangular coil of copper wires is rotated in a magnetic field, the direction of the induced cum changes once in each half revolution. Thus, option (c) is correct.

In Text Questions-Pg-238

Q.1 Name two safety measures commonly use in electric circuits and appliances.

Ans.: The two safety measures that are commonly used in electric circuits and appliances are:

a) Make a Provision for electric fuse

b) Earthing of metal bodies of electrical appliances is must.

Q.2 An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Ans.: We will first calculate the Current drawn by the oven,

Given, Power(P) = 2kW

= 2 x 1000 W

= 2000 W

Voltage(V)= 220V

We know

P= V x I

Therefore the current drawn (I) = $\frac{2000}{220}$

= 9 AThe Current drawn by the electric oven is 9 Amperes which is high as compared to the fuse in the electric circuit which is of only 5 Amperes as a result the fuse will blow off cutting of the power supply when the electric oven will operate.

Q.3 What precautions should be taken to avoid the overloading of domestic electric circuits?

Ans.: The following precautions should be taken to avoid the overloading of domestic electric circuits:

a) Too many high power rating electrical appliances (such as electric iron, geyser, air conditioner etc.) should not be switched on at the same time when used.

b) Too many electrical appliances should not be operated on a single socket.

Exercise-Pg-240

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 centered on the wire

Ans.: The magnetic field near a long straight wire consists of concentric circles centered on the wire.

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

Ans.: The phenomenon of electromagnetic induction is the production of induced current in a coil placed in a region where the magnetic field changes with time.

The magnetic field may change due to the relative motion between the coil and a magnet placed near to the coil. The direction of the induced current is given by Fleming's right-hand rule.

Q.3 The device used for producing electric current is called a:
A. generator
B. galvanometer
C. ammeter
D. motor
Ans.: A generator is used to produce electricity. Thus, option (a) is correct.

Q.4 The essential difference between an AC generator and a DC generator is that:
A. AC generator has an electromagnet while 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
Ans.: The main difference between an AC generator and a DC generator is the commutator. An AC generator has slip rings while the DC generator has a commutator. Thus, option (d) is correct option.

Q.5 At the time of short circuit, the current in the circuit:
A. reduces substantially
B. does not change
C. increases heavily
D. varies continuously
Ans.: During short circuit, the current in the circuit increases very heavily. Thus, option (c) is the correct option.

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
Ans.: An electric generator works on the principle of electromagnetic induction. Thus option (b) is correct.

Q.7 List three sources of magnetic fields.
Ans.: The Magnetic fields can be produced:

a) By using a permanent magnet.
b) By passing electric current through circular coil.
c) By using an electromagnet.

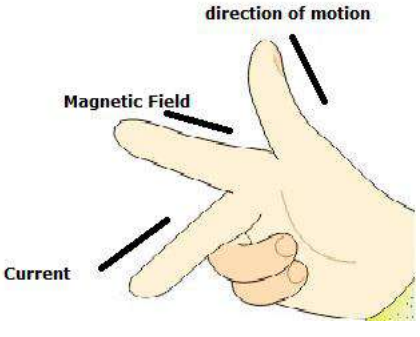
Q.8 How does a solenoid behave like a magnet? Can you determine the north and south poles of a current carrying solenoid with the help of a bar magnet? Explain.
Ans.: (a) A current carrying solenoid behaves like a magnet when its end one acts like a north pole and the other end as a south pole. So, if a current-carrying solenoid is suspended freely by tying a thread in the middle, it will come to rest pointing in the north and south directions in the say manner like a freely suspended bar magnet.

(b) We can determine the north and south poles of a current-carrying solenoid by using a bar magnet. This can be done as follows: We bring the north pole of a bar magnet near both the ends of a freely suspended

current-carrying solenoid. The end of solenoid which will be repelled by the north pole of bar magnet will be the north pole of the solenoid. And the end of solenoid which will be attracted by the north pole of the bar magnet and move towards it, will be its south pole.

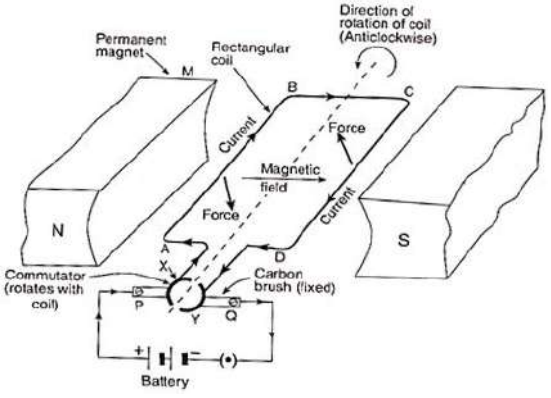
Q.9 When is the force experienced by a current-carrying conductor placed in a magnetic field largest ?
Ans.: The force experienced by a current-carrying conductor placed in a magnetic field is the largest when the current-carrying conductor is perpendicular to the direction of magnetic field.

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?
Ans.: The direction of electric current is from front wall to back wall as it is opposite to the direction of electron. Now , since the direction of force is towards the right side. Hence by applying Fleming's left hand rule, we can conclude that the magnetic field inside the chamber is in downward direction.



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?

Ans.: The labelled diagram of an electric motor is shown below:



The electric motor is a device which converts electrical energy to mechanical energy. When a rectangular coil is placed in a magnetic field and current is passed through it, forces acts on the coil which rotates it continuously. When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.

The direction of magnetic forces is towards our right side and the direction of current is clockwise as we look into the diagram.

In an electric motor the role of split rings is to reverse the direction of current flowing through the motor coil after every half rotation of the coil. Due to this reversing of current, the direction of force remains unchanged on the two sides of the coil and hence the coil continues to rotate in the same direction

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

Ans.: Electric motors are used in electric fans, coolers, refrigerators, mixer and grinders, washing machines, water pumps and electric cars.

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) held stationary inside the coil

(iii) withdrawn from inside the coil.

Ans.: (i) As a bar magnet is pushed into the coil, a slight deflection for a very less time is observed in the galvanometer including the production of a momentary current in the coil.

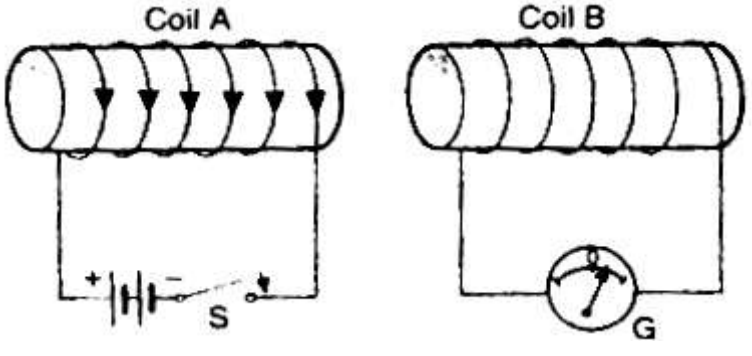
(ii) When the bar magnet is held stationary inside the coil, there is no deflection in galvanometer indicating that no current is produced in the coil.

(iii) When the bar magnet is withdrawn from the coil, the deflection of galvanometer is in opposite direction showing the production of an opposite current.

Tagging ||| Physics||Magnetic Effects of Electric Current‖Electromagnetic Induction

Q.14 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.

Ans.: If the current in coil A is 'switched on' or 'switched off', then an electric current is induced in the coil B (see Figure given here). This can be explained as follows:



(i) When we switch on the current in the coil A, through switch S, it produces a magnetic field around the coil B and in this way coil A becomes an electromagnet and produces a magnetic field around coil B. The change would also be seen on inserting a magnet into the coil B. So, an induced current flows in coil B for a moment. When the current in coil A becomes steady, its magnetic field also becomes steady and the current in coil B stops.

(ii) When we switch off the current in coil A, then its magnetic field in coil B stops quickly. This effect is just the same as pulling a magnet quickly out of coil B. So, in this case an induced current flows in coil B in the opposite direction.

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.

(iii) current induced in a straight conductor moving in a magnetic field.

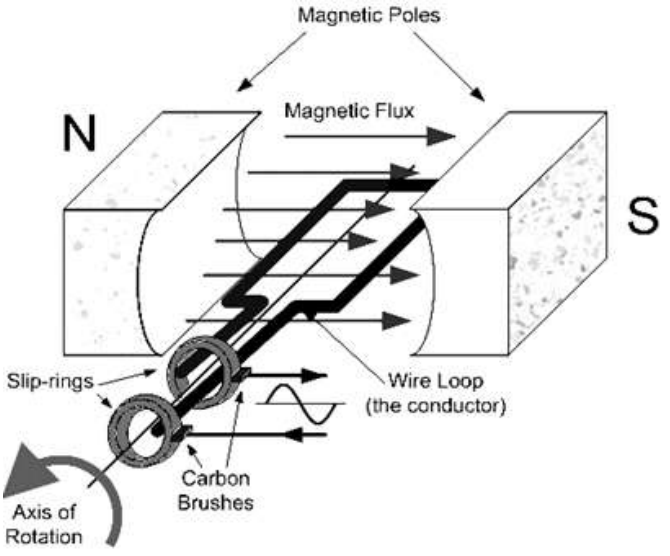
Ans.: (i) The direction of magnetic field produced around a straight current-carrying conductor is determined by using Maxwell's right hand thumb rule.

(ii) The direction of force experienced by a current-carrying straight conductor placed in a magnetic field is determined by Fleming's left-hand rule.

(iii) The direction of current induced in a straight conductor moving in a magnetic field is determined by Fleming's right-hand rule.

Q.16 Explain the underlying pricipal and working of an electric generator by drawing a labelled diagram.What is the function of brushes.

Answer.: The principle of electric generator is Electromagnetic Induction. The schematic is shown below:



An electric generator is a device that converts mechanical energy obtained from an external source into electrical energy as the output. The flow of electric charges is induced by moving an electrical conductor, such as a wire that contains electric charges, in a magnetic field. This movement creates a voltage difference between the two ends of the wire or electrical conductor, which in turn causes the electric charges to flow, thus generating electric current.

The function of brushes is to make proper contact with the rotating rings because through them the current is supplied to the coil.

Q.17 When does an electric short circuit occur?

Ans.: An electric short circuit takes place when the live wire and the neutral wire of electricity supply line touch each other directly. This occurs when the plastic insulation of live wire and neutral wire get torn.

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

Ans.: Earthing of a metallic appliance is done by connecting a metal wire to the earth, because the earth is at zero potential. This is done to avoid the risk of electric shocks. This is because when live wire at the high potential of 220 volts touches the metal case of the electrical appliance, then the current passes from the electrical appliance directly to the earth through the low resistance earth wire. Since the current does not pass through our body, we do not get an electric shock. Thus, the function of an earth wire is to provide an easy passage to the leaking current from an electrical appliance to go into the earth and hence prevent electric shocks to the user of electrical appliance.