Magnetic Effects of ElectricCurrent

Question 1:

State any two properties of magnetic field lines.

Solution :

Prop of magnetic field lines:

(i) The magnetic field lines originate from the north pole of a magnet and end at its south pole.

(ii) The strength of magnetic field is indicated by the degree of closeness of the field lines. Where the field lines are closest together, the magnetic field is the strongest there.

Question 2:

What are the two ways in which you can trace the magnetic field pattern of a bar magnet ?

Solution :

(i) By using iron filings

(ii) By using compass

Question 3:

You are given the magnetic field pattern of a magnet. How will you find out from it where the magnetic field is the strongest ?

Solution :

Magnetic field is the strongest at the place where the magnetic field lines are closest together.

Question 4:

State whether the following statement is true or false :

The axis of earth's imaginary magnet and the geographical axis coincide with each other.

Solution :

False

The axis of earth's imaginary magnet is inclined at an angle of 15o with the geographical axis.

Question 5:

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

Solution :

A compass needle gets deflected when brought near a bar magnet because the bar magnet exerts a magnetic force on the compass needle, which is itself a tiny pivoted magnet.

Question 6:

Where do the manufacturers use a magnetic strip in the refrigerator ? Why is this magnetic strip used ?

Solution :

Manufacturers use a magnetic strip in the refrigerator's door to keep it closed properly.

Question 7:

Fill in the following blanks with suitable words :

(a) Magnetic field lines leave the…….. pole of a bar magnet and enter at its……

(b) The earth's magnetic field is rather like that of a…….. magnet with its…….. pole in the northern hemisphere.

Solution :

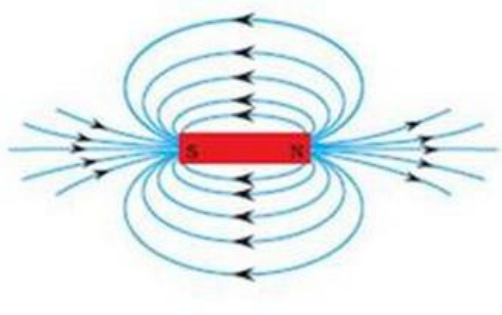
(a) north; south.

(b) bar; south.

Question 8:

Draw a diagram to show the magnetic field lines around a bar magnet.

Solution :



Magnetic field lines around a bar magnet.

Question 9:

What is a magnetic field ? How can the direction of magnetic field lines at a place be determined ?

Solution :

The space surrounding a magnet in which magnetic force is exerted, is called a magnetic field. The direction of magnetic field lines at a place can be determined by using a compass needle. A compass needle placed near a magnet gets deflected due to the magnetic force exerted by the magnet. The north end of the needle of the compass indicates the direction of magnetic field at the point where it is placed.

Question 10:

Explain why, two magnetic field lines do not intersect each other.

Solution :

Two magnetic field lines do not intersect each other due to the fact that the resultant force on a north pole at any point can be only in one direction. But if the two magnetic lines get intersect one another, this means that resultant force on a north pole placed at the point of interection will be along two directions, which is not possible.

Question 11:

When an electric current is passed through any wire, a magnetic field is produced around it. Then why an electric iron connecting cable does not attract nearby iron objects when electric current is switched on through it ?

Solution :

Because the strength of magnetic field produced by the cable is quite weak.

Question 12:

(a) Define magnetic field lines. Describe an activity to draw a magnetic field line outside a bar magnet from one pole to another pole.

(b) Explain why, a freely suspended magnet always points in the north-south direction.

Solution :

(a) The magnetic field lines are the lines drawn in a magnetic field along which a north magnetic pole would move. The magnetic field lines are also known as magnetic lines of forces.

Activity to draw a magnetic field line outside a bar magnet from one pole to another pole:

Take a small compass and a bar magnet.

Place the magnet on a sheet of white paper fixed on a drawing board, using some adhesive material.

Mark the boundary of the magnet.

Place the compass near the north pole of the magnet. The south pole of the needle points towards the north pole of the magnet. The north pole of the compass is directed away from the north pole of the magnet.

Mark the position of two ends of the needle.

Now move the needle to a new position such that its south pole occupies the position previously occupied by its north pole.

In this way, proceed step by step till you reach the south pole of the magnet .

Join the points marked on the paper by a smooth curve. This curve represents a magnetic field line.

(b) A freely suspended magnet points in the north-south direction because earth behaves as a magnet with its south pole in the geographical north and the north pole in the geographical south.

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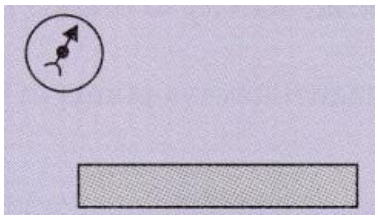
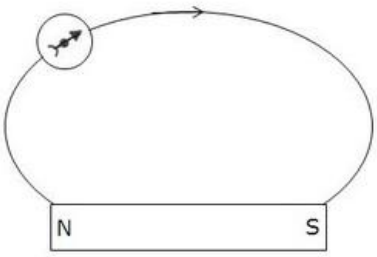
Question 24:

Copy the figure given below which shows a plotting compass and a magnet. Label the N pole of the magnet and draw the field line on which the compass lies.



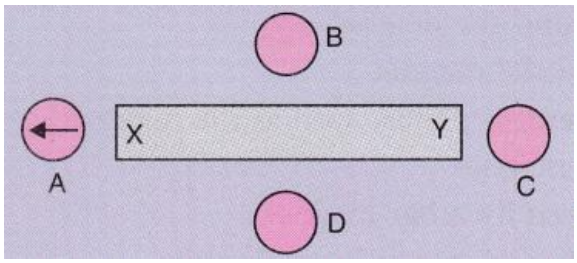
Solution :

As the north pole of the magnetic needle is pointing in the opposite direction,so the nearer end of the magnet will be north pole.



Question 25:

(a) The diagram shows a bar magnet surrounded by four plotting compasses. Copy the diagram and mark in it the direction of the compass needle for each of the cases B, C and D.

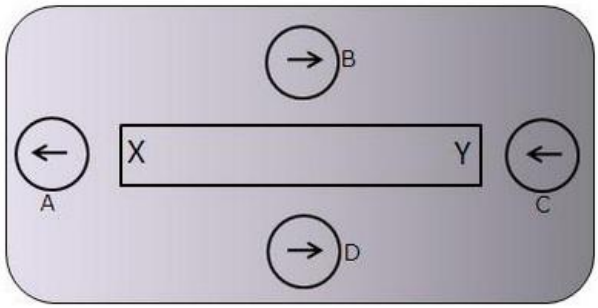


(b) Which is the north pole, X or Y ?

Solution :

(a)

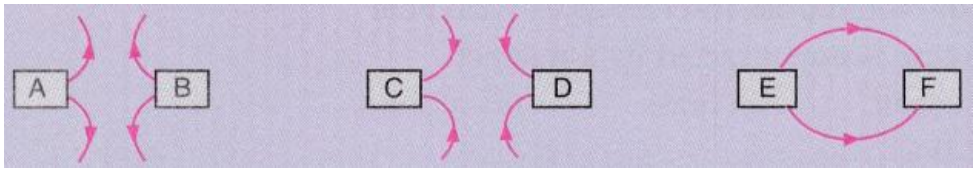
(a)



(b) X, as it repels the north pole (tip) of magnetic needle.

Question 26:

The three diagrams in the following figure show the lines of force (field lines) between the poles of two magnets. Identify the poles A, B, C, D, E and F.

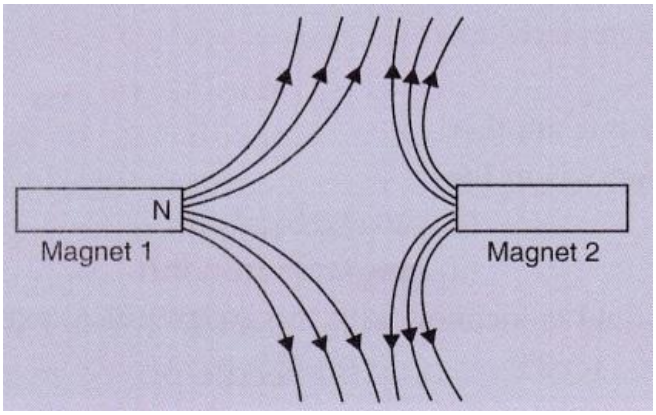


Solution :

A=N; B=N; C=S; D=S; E=N; F=S

Question 27:

The figure given below shows the magnetic field between two magnets :



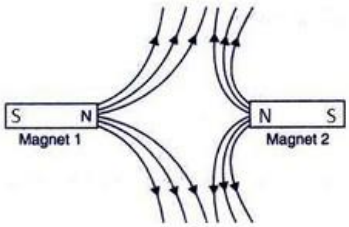
(i) Copy the diagram and label the other poles of the magnets.

(ii) Which is the weaker magnet ?

Solution :

(a)

(i)



(ii) Magnet 2 is weaker.

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Question 1:

Which effect of current can be utilised in detecting a currentcarrying wire concealed in a wall ?

Solution :

Magnetic effect.

Question 2:

What conclusion do you get from the observation that a current-carrying wire deflects a compass needle placed near it ?

Solution :

We conclude that a current carrying wire produces a magnetic field around it.

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Question 3:

Name the scientist who discovered the magnetic effect of current.

Solution :

Magnetic effect of current was discovered by Oersted.

Question 4:

State qualitatively the effect of inserting an iron core into a current-carrying solenoid.

Solution :

Magnetic field becomes very strong.

Question 5:

Name the rule for finding the direction of magnetic field produced by a straight current-carrying conducloj.

Solution :

Maxwell's right hand thumb rule.

Question 6:

State the form, of magnetic field lines around a straight current-carrying conductor.

Solution :

The magnetic field lines around a straight current-carrying conductor are concentric circles whose centres lie on the conductor.

Question 7:

What is the other name of Maxwell's right-hand thumb rule ?

Solution :

Maxwell's corkscrew rule.

Question 8:

State whether the following statement is true or false :

The magnetic field inside a long circular coil carrying current will be parallel straight lines.

Solution :

True.

Question 9:

What is the shape of a current-carrying conductor whose magnetic field pattern resembles that of a bar magnet ?

Solution :

Solenoid.

Question 10:

State three ways in which the strength of an electromagnet can be increased.

Solution :

The strength of an electromagnet can be increased by

(i) increasing the number of turns in the coil

(ii) increasing the current flowing in the coil

(iii) reducing the length of air gap between the poles

Question 11:

Fill in the following blanks with suitable words :

(a) The lines of……. round a straight current-carrying conductor are in the shape of……

(b) For a current-carrying solenoid, the magnetic field is like that of a……

(c) The magnetic effect of a coil can be increased by increasing the number of…… , increasing the…… , or inserting an…… core.

(d) If a coil is viewed from one end and the current flows in an anticlockwise direction, then this end is a pole.

(e) If a coil is viewed from one end, and the current flows in a clockwise direction, then this end is a……

Solution :

(a) magnetic field; concentric circles

(b) bar magnet

(c) turns; current; iron

(d) north

(e) south.

Question 12:

Describe how you will locate a current-carrying wire concealed in a wall.

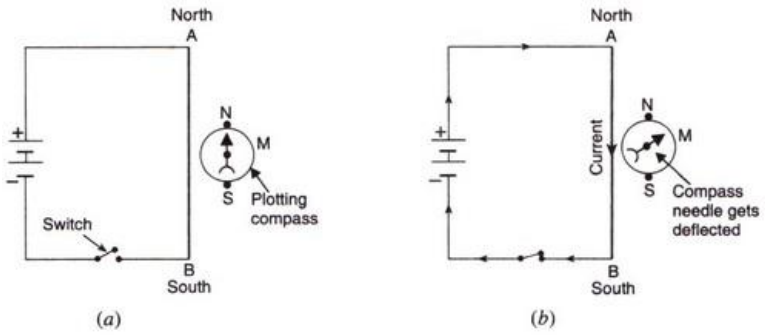
Solution :

A current-carrying wire concealed in a wall can be located due to the magnetic effect of current by using a plotting compass. If a plotting compass is moved on a wall, its needle will show deflection at the place where current-carrying wire is concealed.

Question 13:

Describe some experiment to show that the magnetic field is associated with an electric current.

Solution :



We take a thick insulated copper wire and fix it in such a way that the portion AB of the wire is in the north-south direction as shown in fig. A plotting compass M is placed under the wire AB. The two ends of the wire are connected to a battery through a switch. When no current is flowing in the wire AB, the compass needle is parallel to the wire AB and points in the usual north-south direction. When current is passed through wire AB by closing the switch, we find that the compass needle is deflected from its north-south position. On opening the switch, the compass needle returns to its original position.

Thus, the deflection of compass needle by the current carrying wire shows that magnetic field is associated with an electric current.

Question 14:

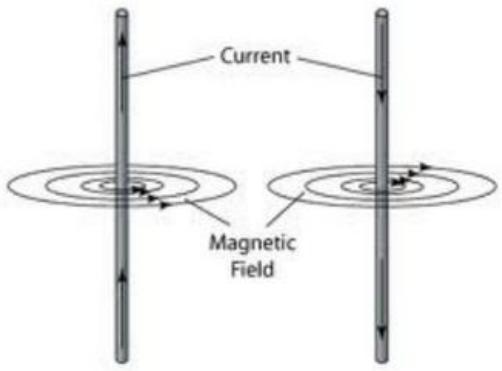
(a) Draw a sketch to show the magnetic lines of force due to a current-carrying straight conductoi

(b) Name and state the rule to determine the direction of magnetic field around a straight current-oar- ing conductor.

Solution :

(a)

(a)



(b) Maxwells right-hand thumb rule: According to this rule, imagine that you are grasping the current-carrying wire in your right hand so that your thumb points in the direction of current,

then the direction in which your fingers encircle the wire will give the direction of magnetic field lines around the wire.

Question 15:

State and explain Maxwell's right-hand thumb rule.

Solution :

(b) According to Maxwell's right hand thumb rule: Imagine that you are grasping the current-carrying wire in your right hand so that your thumb points in the direction of current, then the direction in which your fingers encircle the wire will give the direction of magnetic field lines around the wire.

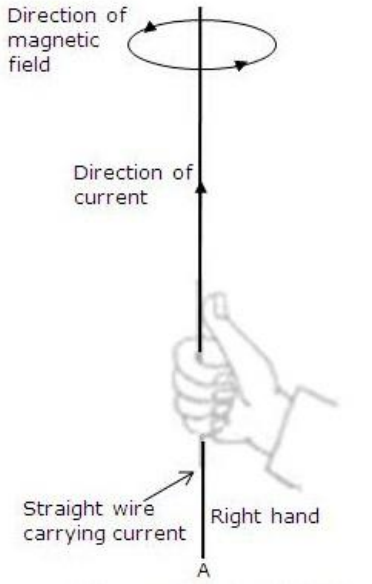


Figure : Right-hand thumb Rule to find the direction of Magnetic field

Let AB be the straight wire carrying current in the vertically upward direction from A to B. To find out the direction of the magnetic field lines produced by this current, we imagine that we are grasping the current carrying wire in our right hand as shown in fig. so that our thumb points in the direction of current towards B. Now, the direction in which our fingers are folded gives the direction of magnetic field lines. In this case, the direction of magnetic field lines is in the anticlockwise direction.

Question 16:

What is Maxwell's corkscrew rule ? For what purpose is it used ?

Solution :

According to Maxwell's corkscrew rule: Imagine driving a corkscrew in the direction of current, then the direction in which we turn its handle is the direction of magnetic field.

This rule is used to determine the direction of magnetic field around a straight current carrying conductor.

Question 17:

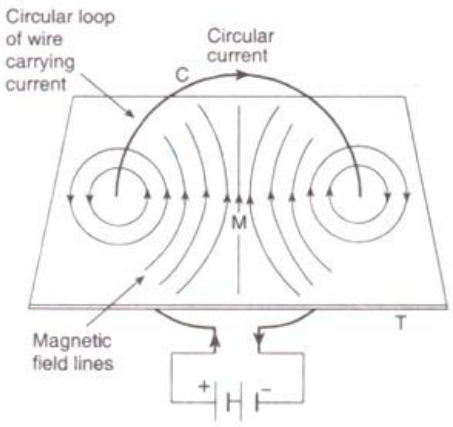
(a) Draw the magnetic lines of force due to a circular wire carrying current.

(b) What are the various ways in which the strength of magnetic field produced by a current-carrying circular coil can be increased ?

Solution :

(a)

(a)



Magnetic lines of force due to a circular wire carrying current

(b) The strength of magnetic field produced by a current-carrying circular coil can be increased by:

-increasing the number of turns of wire in the coil.

-increasing the current flowing through the coil.

Question 18:

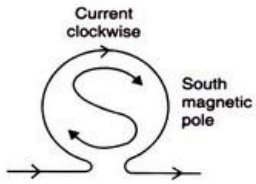
State and explain the Clock face rule for determining the polarities of a circular wire carrying current.

Solution :

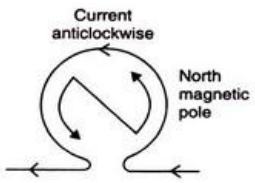
According to the Clock face rule, we look at one face of a circular wire (or coil) through which a current is passing:

(i) If the current around the face of the circular wire (or coil) flows in the clockwise direction, then that face of the circular wire will be South pole (S-pole).

(ii) If the current around the face of the circular wire (or coil) flows in the anti-clockwise direction, then that face of the circular wire will be North pole (N-pole).



(*a*) The direction of current in this face of circular wire is Clockwise, so this face of circular wire carrying current will act as a South magnetic pole (S-pole)



(*b*) The direction of current in this face of circular wire is Anticlockwise, so this face of circular wire carrying current will act as a North magnetic pole (or N-pole)

Question 19:

Name any two factors on which the strength of magnetic field produced by a current-carrying solenoid depends. How does it depend on these factors ?

Solution :

The strength of magnetic field produced by a current-carrying solenoid depends on:

1. The strength of current in the solenoid: Larger the current passed through solenoid, stronger will be the magnetic field produced.

2. The number of turns in the solenoid: Larger the number of turns in the solenoid, greater will be the magnetic field produced.

Question 20:

(a) Draw a circuit diagram to show how a soft iron piece can be transformed into an

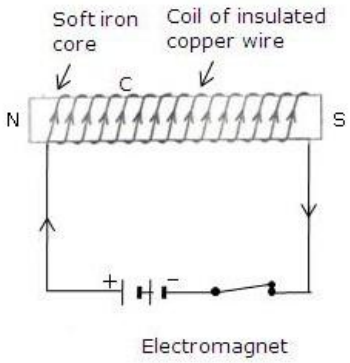
electromagnet.

(b) Describe how an electromagnet could be used to separate copper from iron in a scrap yard.

Solution :

(a)

(a)



Electromagnet

A coil C of insulated copper wire is wound around a soft iron core NS and the two ends of the copper coil are connected to a battery. Thus, an electromagnet using a soft iron core.

(b) Electromagnetic cranes are used to separate copper from iron in a scrap yard. The current is switched on to energise the electromagnet and pick up the iron pieces from the scrap. Then these iron pieces are moved to another position, the electromagnet in switched off and the iron pieces are released.

Question 21:

(a) How does an electromagnet differ from a permanent magnet ?

(b) Name two devices in which electromagnets are used and two devices where permanent magnets are used.

Solution :

(a) An electromagnet produces a magnetic field so long as current flows in its coil i.e., it produces temporary magnetic field.; but a permanent magnet produces a permanent magnetic field.

(b) Electromagnets: Electric bell, electric motors

Permanent magnets: Refrigerator doors, toys

Question 22:

(a) What is a solenoid ? Draw a sketch to show the magnetic field pattern produced by a current-carrying

solenoid.

(b) Name the type of magnet with which the magnetic field pattern of a current-carrying solenoid resembles.

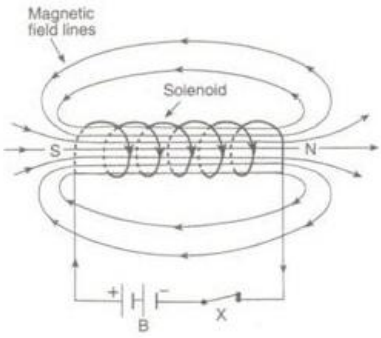
(c) What is the shape of field lines inside a current-carrying solenoid ? What does the pattern of field lines inside a current-carrying solenoid indicate ?

(d) List three ways in which the magnetic field strength of a current-carrying solenoid can be increased ?

(e) What type of core should be put inside a current-carrying solenoid to make an electromagnet ?

Solution :

(a) A solenoid is a long coil containing a large number of close turns of insulated copper wire.



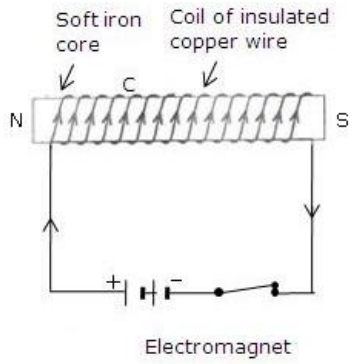
(b) The magnetic field produced by a current-carrying solenoid is similar to the magnetic field produced by a bar magnet.
(c) Magnetic field lines inside a current-carrying solenoid are in the form of parallel straight lines. This indicates that the magnetic field inside the solenoid is uniform.
(d) The magnetic field strength of a current-carrying solenoid can be increased by
(i) increasing the number of turns in the solenoid.
(ii) increasing the current flowing through the solenoid.
(iii) using soft iron as core in the solenoid.
(e) Soft iron core.

Question 23:

(a) What is an electromagnet ? Describe the construction and working of an electromagnet with the help of
a labelled diagram.
(b) Explain why, an electromagnet is called a temporary magnet.
(c) Explain why, the core of an electromagnet should be of soft iron and not of steel.
(d) State the factors on which the strength of an electromagnet depends. How does it depend on these factors ?
(e) Write some of the important uses of electromagnets.

Solution :

(a) An electromagnet is a temporary magnet that works on the magnetic effect of current. It consists of a long coil of insulated copper wire wrapped around a soft iron core that is magnetised ony when electric current is passed through the coil.
To make an electromagnet, we take a rod NS of soft iron and wind a coil C of insulated copper wire around it. When the two ends of the copper coil are connected to a battery, an electromagnet is formed.



Electromagnet

(b) An electromagnet is called a temporary magnet because it produces magnetic field so long as current flows in its coil.
(c) Core of an electromagnet should be of soft iron and not of steel because soft iron loses all its magnetism when current in the coil is switched off but steel does not lose its magnetism when the current is stopped.
(d) Strength of electromagnet depends on:

i. The number of turns in the coil – Increasing the number of turns in the coil increases the strength of the electromagnet.
ii. The current flowing in the coil – Increasing the current flowing in the coil increases the strength of the electromagnet.
iii. The length of air gap between its poles: Reducing the length of air gap between the poles of electromagnet increases the strength of the electromagnet.
(e) Electromagnets are used in several electrical devices such as electric bell, electric motor, loudspeaker etc. They are also used by doctors to remove particles of iron or steel from a patient's eye and to remove pieces of iron from wounds.

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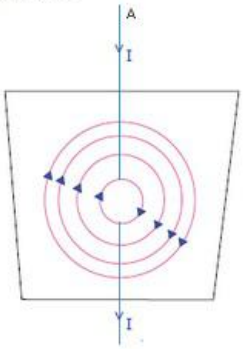
Question 37:

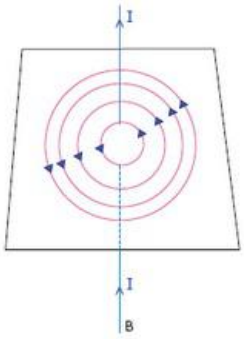
In the straight wire A, current is flowing in the vertically downward direction whereas in wire B the current is flowing in the vertically upward direction. What is the direction of magnetic field :
(a) in wire A ?
(b) in wire B ?
Name the rule which you have used to get the answer.

Solution :

(a) Clockwise



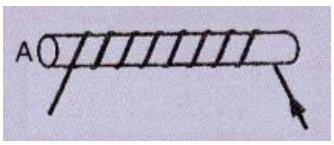
(b) Anticlockwise



We have used Maxwell's right hand thumb rule here.

Question 38:

The figure shows a solenoid wound on a core of soft iron. Will the end A be a N pole or S pole when the current flows in the direction shown ?



Solution :

End A will be a S-pole because current flows in the clockwise direction at A.

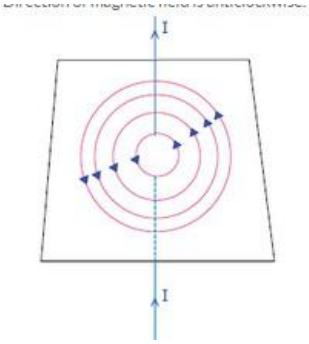
Question 39:

A current-carrying straight wire is held in exactly vertical position. If the current passes through

this wire in the vertically upward direction, what is the direction of magnetic field produced by it ? Name the rule used to find out the direction of magnetic field.

Solution :

Direction of magnetic field is anticlockwise.



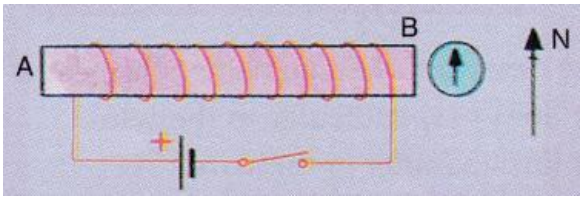
Maxwell's right hand thumb rule. is used to find out the direction of magnetic field.

Question 40:

For the coil in the diagram below, when the switch is pressed :

(a) what is the polarity of end A ?

(b) which way will the compass point then ?



Solution :

(a) End A becomes S-pole because current flows in clockwise direction at A.

(b) When A becomes S-pole, the other end becomes N-pole. So the tip of the compass (with also has North polarity) moves away from this end i.e., tip moves towards right.

Question 41:

A current flows downwards in a wire that passes vertically through a table top. Will the magnetic field lines around it go clockwise or anticlockwise when viewed from above the table ?

Solution :

Magnetic field lines around it will be clockwise (according to Maxwell's right hand thumb rule).

Question 42:

The directions of current flowing in the coil of an electromagnet at its two ends X and Y are as shown below:

(a) What is the polarity of end X ?

(b) What is the polarity of end Y ?

(c) Name and state the rule which you have used to determine the polarities.

Solution :

(a) End X is S-pole (because current flows in clockwise direction).

(b) End Y is N-pole (because current flows in anticlockwise direction).

(c) Clock face rule – Looking at the face of a loop, if the current around that face is in anticlockwise direction, the face has north polarity, while if the current at that face is in clockwise direction, the face has south polarity.

Question 43:

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 ?

Solution :

The direction of current will be from east to west.

We have applied MAxwell's right hand thumb rule here.

According to Maxwell's right hand thumb rule: Imagine that you are grasping the current-carrying wire in your right hand so that your thumb points in the direction of current, then the direction in which your fingers encircle the wire will give the direction of magnetic field lines around the wire.

Question 44:

A current-carrying conductor is held in exactly vertical direction. In order to produce a clockwise magnetic field around the conductor, the current should be passed in the conductor :

(a) from top towards bottom

(b) from left towards right

(c) from bottom towards top

(d) from right towards left

Solution :

(a) from top towards bottom.

Question 45:

A thick wire is hanging from a wooden table. An anticlockwise magnetic field is to be produced around the wire by passing current through this wire by using a battery. Which terminal of the battery should be connected to the :

(a) top end of wire ?

(b) bottom end of wire ?

(c) Give reason for your choice.

Solution :

(a) Negative terminal

(b) Positive terminal

Because the current should be passed into wire upwards.

Lakhmir Singh Physics Class 10 Solutions Page No:85

Question 1:

What produces magnetism in the human body ?

Solution :

Weak ionic currents flowing in the human body produce magnetism.

Question 2:

Name one medical technique which is based on magnetism produced in human body. For what purpose is this technique used ?

Solution :

The technique called Magnetic Resonance Imaging (MRI) is based on magnetism produced in human body. It is used for obtaining images of internal parts of the body.

Question 3:

Name two human body organs where magnetism produced is significant.

Solution :

Brain and heart.

Question 4:

What is the full form of MRI ?

Solution :

Magnetic Resonance Imaging.

Question 5:

Name the technique by which doctors can produce pictures showing insides of the human body.

Solution :

Magnetic Resonance Imaging (MRI)

Question 6:

Name one technique which can detect cancerous tissue inside the body of a person.

Solution :

Magnetic Resonance Imaging (MRI).

Lakhmir Singh Physics Class 10 Solutions Page No:91

Question 1:

What happens when a current-carrying conductor is placed in a magnetic field ?

Solution :

When a current-carrying conductor is placed in a magnetic field, a mechanical force is exerted on the conductor which can make the conductor move.

Question 2:

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

Solution :

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

Question 3:

In a statement of Fleming's left-hand rule, what do the following represent ?

(a) direction of centre finger.

(b) direction of forefinger.

(c) direction of thumb.

Solution :

(a) Current.

(b) Magnetic field.

(c) Force acting on the conductor.

Question 4:

Name one device which works on the magnetic effect of current.

Solution :

Electric bell works on the magnetic effect of current. It uses an electromagnet to produce sound.

Question 5:

Name the device which converts electrical energy into mechanical energy.

Solution :

Electrical motor.

Question 6:

A motor converts one form of energy into another. Name the two forms.

Solution :

Electrical energy to mechanical energy.

Question 7:

State whether the following statement is true or false :

An electric motor converts mechanical energy into electrical energy.

Solution :

False

An electric motor converts electrical energy into mechanical energy.

Question 8:

For Fleming's left-hand rule, write down the three things that are 90° to each other, and next to each one write down the finger or thumb that represents it.

Solution :

(a) Current – direction of center finger.

(b) Magnetic field – direction of fore finger.

(c) Force or Motion – direction of thumb.

Question 9:

Name the device which is used to reverse the direction of current in the coil of a motor.

Solution :

A commutator reverses the direction of current in the coil of a motor.

Question 10:

What is the other name of the split ring used in an electric motor ?

Solution :

Commutator.

Question 11:

What is the function of a commutator in an electric motor ?

Solution :

The function of commutator rings is to reverse the direction of current flowing through the coil every time the coil just passes the vertical position during a revolution.

Question 12:

Of what substance are the brushes of an electric motor made ?

Solution :

Carbon.

Question 13:

Of what substance is the core of the coil of an electric motor made ?

Solution :

The core of the coil of an electric motor made of soft iron.

Question 14:

In an electric motor, which of the following remains fixed and which rotates with the coil ?

Commutator ; Brush

Solution :

Brush remains fixed. Commutator rotates with the coil.

Question 15:

What is the role of the split ring in an electric motor ?

Solution :

The function of split rings is to reverse the direction of current flowing through the coil every time the coil just passes the vertical position during a revolution.

Question 16:

Fill in the following blanks with suitable words :

(a) Fleming's Rule for the motor effect uses the……..

(b) A motor contains a kind of switch called a……. which reverses the current every half……..

Solution :

(a) left

(b) Commutator; rotation.

Question 17:

(a) A current-carrying conductor is placed perpendicularly in a magnetic field. Name the rule which can be

used to find the direction of force acting on the conductor.

(b) State two ways to increase the force on a current-carrying conductor in a magnetic field.

(c) Name one device whose working depends on the force exerted on a current-carrying coil placed in a magnetic field.

Solution :

(a) Fleming's left hand rule.

(b) By increasing the current flowing in the conductor; by increasing the strength of magnetic field.

(c) Electric motor.

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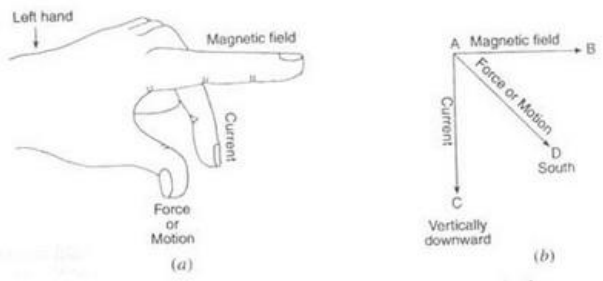
Question 18:

State Fleming's left-hand rule. Explain it with the help of labelled diagrams.

Solution :

Fleming's left hand rule: Hold the forefinger, the centre finger and the thumb of your left hand to right angles to one other. Adjust your hand in such a way that the forefinger points in the direction of magnetic field and the and the centre finger points in the direction of current, than the direction in which thumb points, gives the direction of force acting on the conductor.

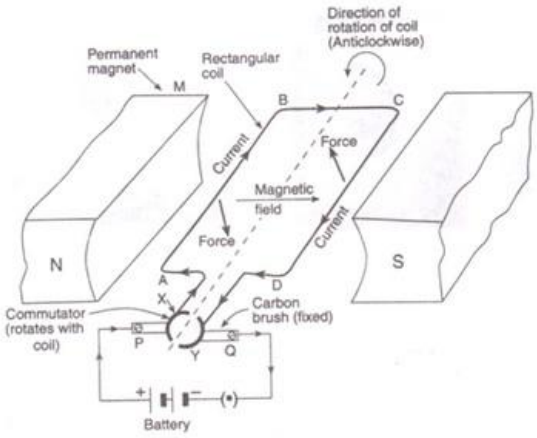


Question 19:

What is the principle of an electric motor ? Name some of the devices in which electric motors are used.

Solution :

Fleming's left hand rule: Hold the forefinger, the centre finger and the thumb of your left hand to right angles to one other. Adjust your hand in such a way that the forefinger points in the direction of magnetic field and the and the centre finger points in the direction of current, than the direction in which thumb points, gives the direction of force acting on the conductor.



Question 20:

(a) In a d.c. motor, why must the current to the coil be reversed twice during each rotation ?

(b) What device reverses the current ?

Solution :

(a) The current to the coil must be reversed twice during each rotation so that the coil keeps rotating continuously in the same direction.

(b) Commutator.

Question 21:

(a) State what would happen to the direction of rotation of a motor if :

(i) the current were reversed

(ii) the magnetic field were reversed

(iii) both current and magnetic field were reversed simultaneously.

(b) In what ways can a motor be made more powerful ?

Solution :

(a)

(i) Direction of rotation would be reversed

(ii) Direction of rotation would be reversed

(iii) Direction of the rotation would remain unchanged

(b) Motor can be made more powerful by winding the coil on a soft iron core of by increasing the number of turns of the coil.

Question 22:

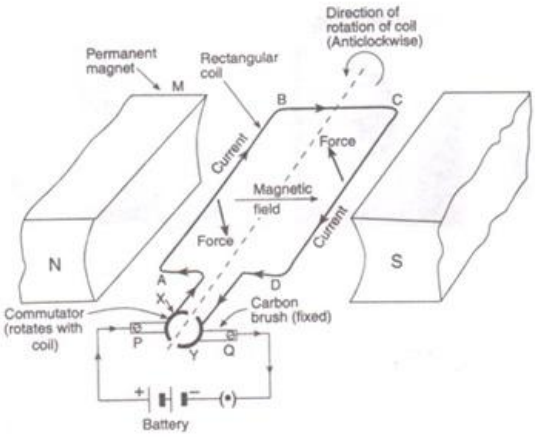
(a) What is an electric motor ? With the help of a labelled diagram, describe the working of a simple electric motor.

(b) What are the special features of commercial electric motors ?

Solution :

(a) Electric motor is a device used for converting electrical energy into mechanical energy.

Working of an electric motor:



Initially, the coil ABCD is in the horizontal position. On pressing the switch, current enters the coil through carbon brush P and commutator half ring X. The current flows in the direction ABCD and leaves via ring Y and brush Q. The direction of magnetic field is from N pole to S pole of the magnet. According to Fleming's left-hand rule, the force on sides AB and CD is in the downward and upward directions respectively. This makes the coil ABCD move in the anticlockwise direction.

When the coil reaches vertical position, then the brushes P and Q will touch the gap between the two commutator rings and current is cut off. But the coil does not stop rotating as it has already gained momentum. When the coil goes beyond the vertical position, the side CD comes on the left side and side AB comes to the right side, and the two commutator rings change contact from one brush to the other. This reverses the direction of current in the coil, which in turn reverses the direction of forces acting on the sides AB and CD of the coil. The side CD is pushed down and side AB is pushed up. Thus, the coil rotates anticlockwise by another half rotation.

The reversing of current in the coil is repeated after every half rotation due to which the coil (and its shaft) continues to rotate as long as current from the battery is passed through it. The rotating shaft of electric motor can drive a large number of machines which are connected to it.

(b) In commercial electric motors:

i. the coil is wound on a soft iron core. This increases the strength of magnetic field, which makes the motor more powerful.

ii. the coil contains a large number of turns of insulated copper wire.

iii. a powerful electromagnet is used in place of permanent magnet.

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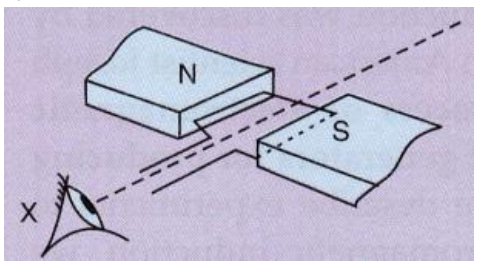
Question 31:

In the simple electric motor of figure given below, the coil rotates anticlockwise as seen by the eye from the position X when current flows in the coil.



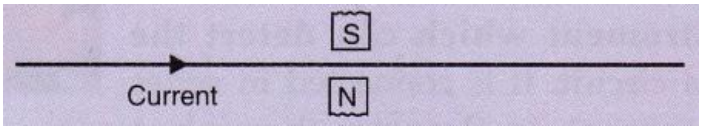
Is the current flowing clockwise or anticlockwise around the coil when viewed from above ?

Solution :

Clockwise direction (according to Fleming's left hand rule).

Question 32:

Which way does the wire in the diagram below tend to move ?



Solution :

According to Fleming's left hand rule, the wire moves in the upward direction (out of the page).

Question 33:

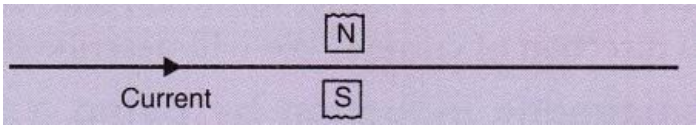
If the current in a wire is flowing in the vertically downward direction and a magnetic field is applied from west to east, what is the direction of force on the wire ?

Solution :

Force will be due South (according to Fleming's left hand rule).

Question 34:

Which way does the wire in the diagram below tend to move ?



Solution :

According to Fleming's left hand rule, the wire moves in the downward direction (into the page).

Question 35:

What is the force on a current-carrying wire that is parallel to a magnetic field ? Give reason for your answer.

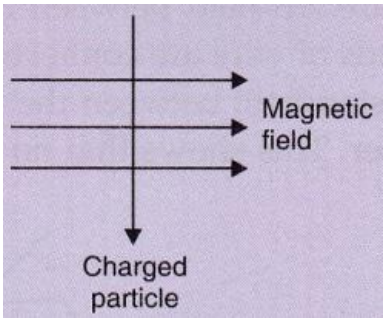
Solution :

Force on a current-carrying wire that is parallel to magnetic field will be zero.

This is because the magnitude of force depends on the sin of the angle between the direction of current and the direction of magnetic field, so if the current carrying wire is held parallel to the magnetic field, the force will be zero.

Question 36:

A charged particle enters at right angles into a uniform magnetic field as shown :



What should be the nature of charge on the particle if it begins to move in a direction pointing vertically out of the page due to its interaction with the magnetic field ?

Solution :

Positive charge.

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Question 1:

Name the device which converts mechanical energy into electric energy.

Solution :

Electric Generator.

Question 2:

Out of an A.C. generator and a D.C. generator :

(a) which one uses a commutator (split rings) ?

(b) which one uses slip rings ?

Solution :

(a) D.C. Generator.

(b) A.C. Generator.

Question 3:

Name the phenomenon which is made use of in an electric generator.

Solution :

Electromagnetic Induction.

Question 4:

Name the rule which gives the direction of induced current.

Solution :

Fleming's Right Hand Rule.

Question 5:

What condition is necessary for the production of current by electromagnetic induction ?

Solution :

The condition necessary for the production of current by electromagnetic induction is that there must be a relative motion between the wire and the magnet.

Question 6:

What type of generator is used at Power Stations ?

Solution :

AC Generator (or Alternator).

Question 7:

What change should be made in an a.c. generator so that it may become a d.c. generator ?

Solution :

If we replace the slip rings of an AC generator by a commutator, then it will become a DC generator.

Question 8:

State whether the following statements are true or false :

(a) A generator works on the principle of electromagnetic induction.

(b) A motor works on the principle of electromagnetic induction.

Solution :

(a) True

(b) False

Question 9:

What is the function of brushes in an electric generator ?

Solution :

Function of brushes is to transfer the current from coil to load.

Question 10:

When a wire is moved up and down in a magnetic field, a current is induced in the wire. What is this phenomenon known as ?

Solution :

This phenomena is known as electromagnetic induction.

Question 11:

When current is 'switched on' and 'switched off' in a coil, a current is induced in another coil kept near it. What is this phenomenon known as ?

Solution :

Electromagnetic induction

Question 12:

What is the major difference between the simple alternator and most practical alternators ?

Solution :

Simple alternator:- Magnet fixed and coil rotates;

Practical alternator:- Coil fixed and magnet rotates.

Question 13:

Why are Thermal Power Stations usually located near a river ?

Solution :

To obtain water for making steam for turning turbines and for cooling spent steam to condense it back into hot water for making fresh steam.

Question 14:

List three sources of magnetic fields.

Solution :

Electromagnet, permanent magnet, wire carrying current.

Question 15:

Complete the following sentence :

A generator with commutator produces…… current.

Solution :

direct.

Question 16:

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

Solution :

Yes, some current will be induced in the coil B because of change in magnetic field through the coil B due to change in current in coil A. This is called electromagnetic induction.

Question 17:

(a) Explain the principle of an electric generator.

(b) State two ways in which the current induced in the coil of a generator could be increased.

Solution :

(a) Electric generator is based on the principle that when a straight conductor is moved in a magnetic field, then current is induced in the conductor.

(b) Two ways in which the current induced in the coil of a generator could be increased are:

(i) by roating the coil faster.

(ii) by using a coil with a larger area.

Question 18:

(a) What is the difference between alternating current and direct current ?
(b) What type of current is given by (i) a dry cell, and (ii) a Power House generator ?

Solution :

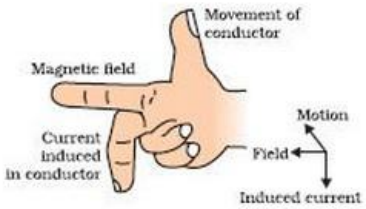
(a) The difference between AC and DC is that DC flows in one direction only while AC reverses direction after equal intervals of time.
(i) DC current remains same with time in its value and direction.
(ii) AC current changes with time and changes its direction every time after a certain interval of time.
(b)
(i) DC
(ii) AC

Question 19:

State and explain Fleming's right hand rule.

Solution :

The direction of induced current produced in a straight conductor moving in a magnetic field is given by Fleming's right hand rule.
According to Fleming's right hand rule : Hold the thumb, the fore finger and the centre finger of your right-hand at right angles to one another. Adjust your hand in such a way that forefinger points in the direction of magnetic field, and thumb points in the direction of motion of conductor, then the direction in which centre finger points, gives the direction of induced current in the conductor.

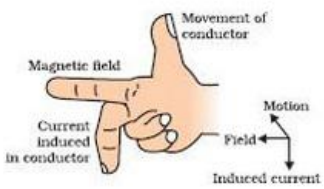


Question 20:

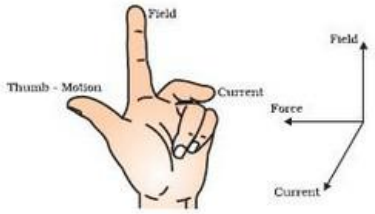
Name and state the rule to find the direction of :
current induced in a coil due to its rotation in a magnetic field.
force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it.

Solution :

(a) Fleming's right hand rule:- Hold the thumb, the fore finger and the centre finger of your right-hand at right angles to one another. Adjust your hand in such a way that forefinger points in the direction of magnetic field, and thumb points in the direction of motion of conductor, then the direction in which centre finger points, gives the direction of induced current in the conductor.



(b) Fleming's left hand rule:- Hold the forefinger, the centre finger and the thumb of your left hand at right angle to one another. Adjust your hand in such a way that the forefinger points in the direction of magnetic field and the and centre finger points in the direction of current, then the direction in which thumb points, gives the direction of force acting on the conductor.



Question 21:

(a) In what respect does the construction of an A.C. generator differ from that of a D.C. generator ?

(b) What normally drives the alternators in a Thermal Power Station ? What fuels can be used to heat water in the boiler ?

Solution :

(a). Construction-wise, the only difference between a D.C. generator and an A.C. generator is in the way the two ends of the generator coil are linked to the outer circuit. In a D.C. generator we connect the two ends of the coil to a commutator consisting of two half rings of copper. In an A.C. generator we connect the two ends of the coil to two full rings of copper called slip rings. There is no commutator in an A.C. generator.

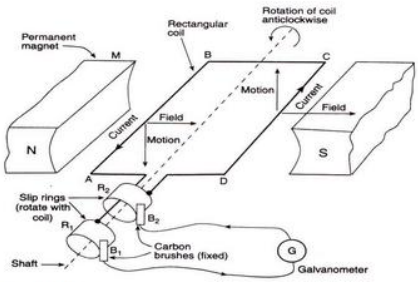
(b) Generally, the alternators in a Thermal Power Station are driven by the power of high pressure steam.

To heat water in the boiler, fuels like coal or natural gas can be used.

Question 22:

Draw the labelled diagram of an A.C. generator. With the help of this diagram, explain the construction and working of an A.C. generator.

Solution :



Construction:

A simple AC generator consists of a rectangular coil ABCD which can be rotated rapidly between the poles N and S of a strong horseshoe-type permanent magnet M. The coil is made of a large number of turns of insulated copper wire. The two ends A and D of the coil are connected to two circular pieces of copper metal called slip rings R_1 and R_2. As the slip rings rotate with the coil, the two fixed pieces of carbon called brushes, B_1 and B_2, keep contact with them. So, the current produced in the rotating coil can be tapped out through slip rings into the carbon brushes. The outer ends of carbon brushes are connected to a galvanometer to show the flow of current in the external circuit.

Working:

Suppose the coil ABCD, which is initially in the horizontal position, is rotated in the anticlockwise direction. The side AB of the coil moves down and side CD moves up. Due to this, induced current is produced in both the sides, which flows in the direction BADC (according to Fleming's right hand rule). Thus, in the first half rotation, the current in the external circuit flows from brush B_1 to B_2. After half revolution, sides AB and CD will interchange their positions. So, side AB starts moving up and side CD starts moving down. As a result, direction of induced current in the coil is reversed and flows in the direction CDAB. The current in the external circuit flows from brush B_2 to B_1.

Question 23:

(a) What do you understand by the term "electromagnetic induction"? Explain with the help of a diagram.

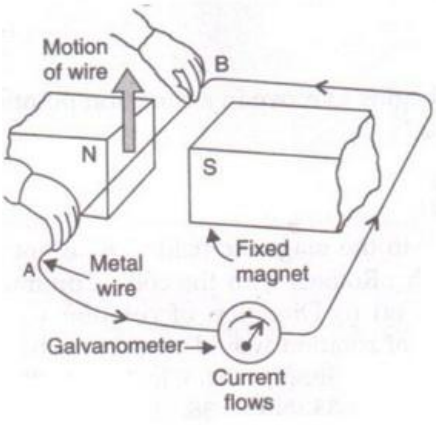
(b) Name one device which works on the phenomenon of electromagnetic induction.

(c) Describe different ways to induce current in a coil of wire.

Solution :

(a) The production of electricity from magnetism is known as electromagnetic induction.

Let us move a wire AB upward rapidly between the poles of the horseshoe magnet. When the wire is moved up, there is a deflection in the galvanometer pointer which shows a current is produced in the wire AB momentarily. Thus, as the wire is moved up through the magnetic field, an electric current is produced in it.



(b) Electric generator.
(c) Different ways to induce current in a coil of wire are:
(i) by moving the coil relative to a fixed magnet
(ii) by keeping the coil fixed and moving a magnet relative to it.

Question 24:

(a) What do you understand by the terms 'direct current' and 'alternating current' ?
(b) Name some sources of direct current and some of alternating current.
(c) State an important advantage of alternating current over direct current.
(d) What is the frequency of A.C. supply in India ?

Solution :

(a) If the current flows in one direction only, it is known as direct current; and if the current reverses direction after equal intervals of time, it is called alternating current.
(b) Source of DC are dry cell, car battery, DC generator etc.
Source of AC are AC generator, bicycle dynamos etc.
(c) An important advantage of AC over DC is that AC can be transmitted over long distances without much loss of electrical energy.
(d) 50Hz.

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Question 37:

A coil is connected to a galvanometer. When the N-pole of a magnet is pushed into the coil, the galvanometer deflected to the right. What deflection, if any, is observed when :
(a) the N-pole is removed ?
(b) the S-pole is inserted ?
(c) the magnet is at rest in the coil ?
State three ways of increasing the deflection on the galvanometer.

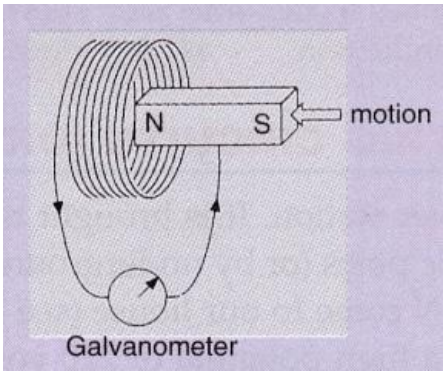
Solution :

(a) The galvanometer deflects to the left.
(b) The galvanometer deflects to the left.
(c) No deflection in galvanometer.
The deflection in the galvanometer can be increased by
i. increasing the number of turns in the coil
i. using a strong magnet
ii. increasing the speed with which magnet is moved in the coil.

Question 38:

When the magnet shown in the diagram below is moving towards the coil, the galvanometer

gives a reading to the right.



(i) What is the name of the effect being produced by the moving magnet ?
(ii) State what happens to the reading shown on the galvanometer when the magnet is moving away from the coil.
(iii) The original experiment is repeated. This time the magnet is moved towards the coil at a great speed. State two changes you would notice in the reading on the galvanometer.

Solution :

(i) Electromagnetic induction.
(ii) The galvanometer gives a reading to the left.
(iii) Large deflection to right occurs more quickly.

Question 39:

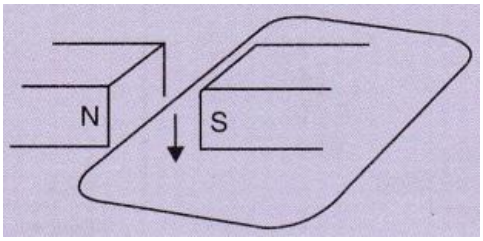
If you hold a coil of wire next to a magnet, no current will flow in the coil. What else is needed to induce a current ?

Solution :

Relative motion between the coil and the magnet.

Question 40:

The wire in Figure below is being moved downwards through the magnetic field so as to produce induced current.



What would be the effect of :
(a) moving the wire at a higher speed ?
(b) moving the wire upwards rather than downwards ?
(c) using a stronger magnet ?
(d) holding the wire still in the magnetic field ?
(e) moving the wire parallel to the magnetic field lines ?

Solution :

(a) Current increased.
(b) Current reversed.
(c) Current increased.
(d) Zero current.
(e) Zero current.

Question 41:

Two coils A and B of insulated wire are kept close to each other. Coil A is connected to a galvanometer while coil B is connected to a battery through a key. What would happen if :
(i) a current is passed through coil B by plugging the key ?

(ii) the current is stopped by removing the plug from the key ?
Explain your answer mentioning the name of the phenomenon involved.

Solution :

(i) Galvanometer pointer moves to one side showing that a momentary current is induced in the coil A.
(ii) Galvanometer pointer moves to the other side showing that the direction of momentarily induced current has been reversed.
The phenomenon taking place here is electromagnetic induction. When the current is passed through coil B or is stopped, the magnetic field linked with coil A changes due to which an induced current is produced in the coil.

Question 42:

A portable radio has a built-in transformer so that it can. work from the mains instead of batteries. Is this a step-up or step down transformer ?

Solution :

Step-down transformer (which reduces the voltage).

Lakhmir Singh Physics Class 10 Solutions Page No:113

Question 1:

What name is given to the device which automatically cuts off the electricity supply during short-circuiting in household wiring ?

Solution :

Electric fuse.

Question 2:

What is the usual capacity of an electric fuse used (z) in the lighting circuit, and (ii) in the power circuit, of a small house ?

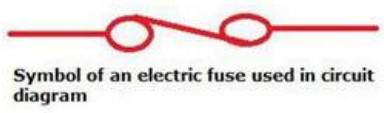
Solution :

(i) 5A
(ii) 15A.

Question 3:

Give the symbol of an electric fuse used in circuit diagrams.

Solution :



Symbol of an electric fuse used in circuit diagram

Question 4:

State whether the following statements are true or false :
(a) A wire with a green insulation is usually the live wire.
(b) A miniature circuit breaker (MCB) works on the heating effect of current.

Solution :

(a) False.
(b) False.

Question 5:

Along with live wire and neutral wire, a third wire is also used in domestic electric wiring. What name is given to this third wire ?

Solution :

Earth wire

Question 6:

List the colours of the three wires in the cable connected to the plug of an electric iron.

Solution :

Red wire – Live wire.

Black wire – Neutral wire.

Green wire – Earth wire.

Question 7:

What is the electric potential of the neutral wire in a mains supply cable ?

Solution :

Zero volt.

Question 8:

If fuses of 250 mA, 500 mA, 1 A, 5 A and 10 A were available, which one would be the most suitable for protecting an amplifier rated at 240 V, 180 W ?

Solution :

P = VI

I = P/V = 180/240 = 0.75A

The fuse wire should be such that it is able to withstand only a little more current than 0.75A. So the fuse of 1A is the most suitable.

Question 9:

When does an electric short circuit occur ?

Solution :

Short circuit occurs when live wire and neutral wire come in contact with each other.

Question 10:

In which wire in an A.C. housing circuit is the switch introduced to operate the lights ?

Solution :

Live wire.

Question 11:

In household circuits, is a fuse wire connected in series or in parallel ?

Solution :

In series.

Question 12:

Usually three insulated wires of different colours are used in an electrical appliance. Name the three colours.

Solution :

Red, black and green.

Question 13:

What is the usual colour of the insulation of: (a) live wire, (b) neutral wire, and (c) earth wire ?

Solution :

(a)red

(b)black

(c)green

Question 14:

What is the main purpose of earthing an electrical appliance ?

Solution :

To avoid the risk of electric shocks.

Question 15:

Give two reasons why different electrical appliances in a domestic circuit are connected in parallel.

Solution :

(i) In case of parallel connection, if one of the appliances is switched off, other appliances keep on operating.

(ii) In case of parallel connection, all the appliances are operated on same voltage i.e., the mains supply voltage.

Question 16:

How should the electric lamps in a building be connected so that the switching on or off in a room has no effect on other lamps in the same building ?

Solution :

Parallel connection.

Question 17:

Fill in the following blanks with suitable words :

(a) A fuse should always be placed in the……. wire of a mains circuit.

(b) The earth wire should be connected to the……. of an appliance.

Solution :

(a) live

(b) body.

Question 18:

(a) Of what substance is the fuse wire made ? Why ?

(b) Explain why, a copper wire cannot be used as a fuse wire.

Solution :

(a) The fuse wire is made of tin-plated copper wire because of its low melting point.

(b) Pure copper wire cannot be used as a fuse wire because it has a high melting point due to which it will not melt easily when a short circuit takes place.

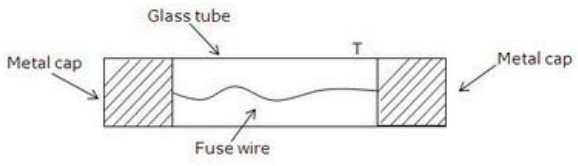
Question 19:

What type of electric fuse is used in electrical appliances like car stereos ? Explain with the help of a labelled diagram.

Solution :

Cartridge fuse.

It consists of a glass tube T having a thin fuse wire sealed inside it. The glass tube has two metal caps at its two ends. The two ends of the fuse wire are connected to these metal caps. The metal caps are for connecting the fuse in the circuit in a suitably made bracket.



Question 20:

Distinguish between the terms ‘overloading’ and ‘short-circuiting ‘ as used in domestic circuits.

Solution :

Live wire coming in contact with the neutral wire is known as short circuit.
When too many electrical appliances of high power rating are switched on at the same time or are connected to a single socket, they draw extremely large current. This is known as overloading.

Question 21:

(a) When does a fuse cut off current ? How does it do it ?
(b) What is the maximum number of 60 W bulbs that can be run from the mains supply of 220 volts if you do not want to overload a 5 A fuse ?

Solution :

(a) A fuse cuts off current when the current exceeds a safe value (due to short circuiting or overloading). When the current becomes large, it heats the fuse wire too much. Since the melting point of fuse wire is low, it melts and breaks the circuit. Thus, current in the circuit is cut off.
(b) Let the maximum number of bulbs be y.
Power of y bulbs, P=60y
V=220V, I=5A
We know that
P = VI
60y = 220 x 5
60y = 1100
y=18.33
So, number of bulbs required are 18.

Question 22:

Explain the importance of using in a household electric circuit (i) fuse, and (ii) earthing wire.

Solution :

(i) A fuse is one of most important protection devices, which is used for avoiding the damages happening due to over load or short circuit.
(ii) An earthing wire is used to save us from the risk of electric shock in case the live wire touches the metal case of the electric appliance.

Question 23:

(a) An electric iron is rated at 230 V, 750 W. Calculate (i) the maximum current, and (ii) the number of units
of electricity it would use in 30 minutes.
(b) Which of the following fuse ratings would be suitable for this electric iron ?
1 A, 3 A, 5 A, 13 A

Solution :

(a) V=230V, P=750 W, t=30/60=0.5hr
(i) Let max current be I
We have P=VI
750 =230xI
I= 3.26 A
(ii) Electric energy consumed, E = Pxt = 0.75kW x 0.5h = 0.375 kWh
No. of units used in 30 min = 0.375
(b) 5 A fuse rating will be suitable for this electric iron as the maximum current for this iron is 3.26 A.

Question 24:

What is the function of an earth wire ? Why is it necessary to earth the metallic bodies of electrical appliances ?

Solution :

When the live wire of a faulty appliance comes in direct contact with its metallic case, which has been earthed, the large current passes directly to the earth without passing through the user's body. Thus, it is necessary to earth the metallic bodies of electrical appliances so as to avoid fatal electric shocks.

Question 25:

(a) What current is taken by a 3 kW electric geyser working on 240 V mains ?

(b) What size fuse should be used in the geyser circuit ?

Solution :

(a) P = 3kW = 3000W

V = 240V

P = V x I

I = P/V

= 3000/240 = 12.5 A.

(b) A 13A fuse should be used in the geyser circuit.

Question 26:

(a) Why are fuses fitted in the fuse box of a domestic electricity supply ?

(b) What device could be used in place of the fuses ?

Solution :

(a) Fuses are fitted in the fuse box of a domestic electricity supply to protect the whole wiring of the house when excessive current flows in the circuit.

(b) MCB.

Question 27:

(a) Draw a labelled diagram to show the domestic electric wiring from an electric pole to a room. Give the
wiring for a bulb and a three-pin socket only.

(b) State two hazards associated with the use of electricity.

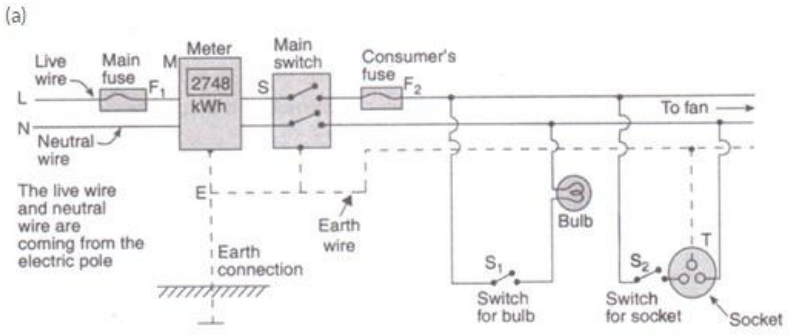
(c) State the important precautions which should be observed in the use of electricity.

(d) What will you do if you see a person coming in contact with a live wire ?

(e) Explain why, electric switches should not be operated with wet hands.

Solution :

(a)



(b) Two hazards associated with the use of electricity are:

i. If a person happens to touch a live electric wire, he gets a severe electric shock.

ii. Short-circuiting due to damanged wiring or overloading of the circuit can cause electrical fire in a building.

(c) Important precautions which should be observed in the use of electricity are:

(i) Use of good quality wires

(ii) Use of fuse and proper earthing.

(iii) Use of appliances in dry condition only.

(d) If a person comes in contact with a live wire, we will switch off the main switch immediately so as to cut off the electricity supply..
(e) Electric switches should not be operated with wet hands because water is a good conductor of electricity, so the user may get electric shock.

Question 38:

An air-conditioner of 3.2 kW power rating is connected to a domestic electric circuit having a current rating of 10 A. The voltage of power supply is 220 V. What will happen when this air-conditioner is switched on ? Explain your answer.

Solution :

Given: P=3.2kW=3200W, Fuse current rating=10 A, V=220 V
We have
P=VI
3200 = 220 x I
I=14.54 A
As the required current for the air-conditioner is 14.54A and the rated current of the fuse is 10A, so the fuse will blow cutting off the power supply.

Question 39:

Three appliances are connected in parallel to the same source which provides a voltage of 220 V. A fuse connected to the source will blow if the current from the source exceeds 10 A. If the three appliances are rated at 60 W, 500 W and 1200 W at 220 V, will the fuse blow ?

Solution :

P1=60 W, P2=1200W, P3=500W
Fuse rating = 10A
V=220V
We have, P=VI
Total power=60+1200+500=1760W
Therefore, 1760=220xI
I=8A
The required current is 8A and fuse rating is 10A. So, all the appliances will work normally and the fuse will not blow.

Question 40:

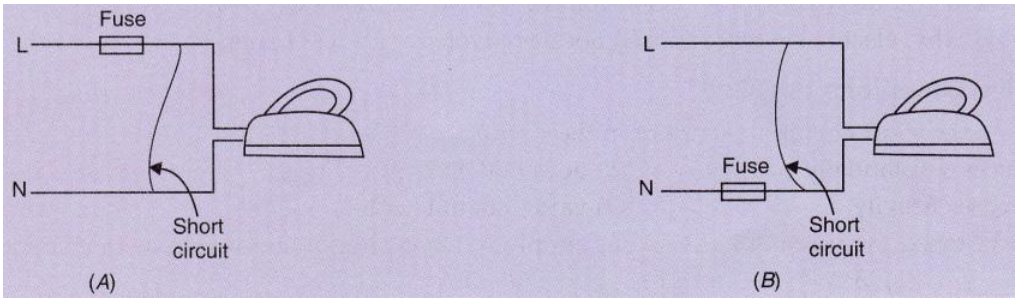
A vacuum cleaner draws a current of 2 A from the mains supply.
(a) What is the appropriate value of the fuse to be fitted in its circuit ?
(b) What will happen if a 13 A fuse is fitted in its circuit ?

Solution :

(a) The appropriate value of the fuse to be fitted in the circuit is 2.5A or 3A.
(b) If a 13A fuse is fitted in the circuit, it will not protect the vacuum cleaner against the very high current flowing through it. This may damage the appliance.

Question 41:

Which of the following circuits will still be dangerous even if the fuse blows off and electric iron stops working during a short circuit ?



Solution :

Circuit A is not dangerous after fuse blows because fuse is fitted in the live wire; but circuit B is dangerous even if fuse blows because the fuse is in the neutral wire.

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Question 42:

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An electric kettle rated as 1200 W at 220 V and a toaster rated at 1000 W at 220 V are both connected in parallel to a source of 220 V. If the fuse connected to the source blows when the current exceeds 9.0 A, can both appliances be used at the same time ? Illustrate your answer with calculations.

Solution :

P1=1200W, P2=1000W

V=220V

Fuse rating=9A

We know, P=VI

Total current required,

I=P/V

=(P1+P2)/V

=(1200+1000)/220

=10A

If both the appliances are switched on together, the fuse will get burnt. So, both the appliance cannot be used at same time.

Question 43:

What is the main difference in the wiring of an electric bulb and a socket for using an electric iron in a domestic electric circuit ? What is the reason for this difference ?

Solution :

No earth connection is required for the bulb connection as it does not draw heavy current and we hardly touch it. A socket for using an electric iron has an earth connection because electric iron has a metallic body and draws a large current.

Question 44:

(a) Explain why, it is more dangerous to touch the live wire of a mains supply rather than the neutral wire.

(b) Why is it safe for birds to sit on naked power lines fixed atop tall electric poles ?

Solution :

(a) It is more dangerous to touch the live wire rather than the neutral wire because live wire has a high potential of 220V, where as neutral wire has zero potential.

(b) Bird's body is not connected to the earth, so no current flows through its body into the earth. So, it is safe for birds to sit on naked power lines fixed atop tall electric poles.

Question 45:

A domestic lighting circuit has a fuse of 5 A. If the mains supply is at 230 V, calculate the maximum number of 36 W tube-lights that can be safely used in this circuit.

Solution :

Let the maximum number of tube-lights be y.

Power of y tube-lights, P=36y

V=230V, I=5A

We know that

P = VI

36y = 230 x 5

36y = 1500

y=31.94

So, number of tube-lights required are 31.