Electricity and Magnetism

Points to Remember

- Some materials behave in a particular manner showing magnetic properties.
- A freely suspended bar magnet always point in North-South direction.
- Like poles repel each other while unlike poles attract each other.
- Magnet is neutral at its centre and has maximum magnetic effects at its ends called the poles.
- Poles always exist in pairs with opposite polarities and can never be isolated.
- Examples of magnetic substances are :- iron, cobalt, nickel.
- Examples of non-magnetic substances are :- wood, plastic, aluminium, copper.
- The poles are not exactly the ends of the magnet but thev are slightly inside.
- For a given magnet, both the poles are of equal strength.
- Earth's magnet has its south pole situated near the geographic north.
- Electromagnets are the temporary magnets which are made up of soft iron core with a winding of insulated copper wire.
- Freely suspended current carrying solenoid always rests in north- south direction.
- A direct current source has the fixed positive and negative terminals, e.g. a battery.
- Hans Christian Oersted discovered that if an electric current is passed through a conductor, a magnetic field is developed around it.
- The study of magnetic effects produced due to electric current is known as electromagnetism.
- The direction of magnetic field due to a straight current carrying conductor is obtained by any of the following rules:
  (a) Right Hand Thumb Rule.
  (b) Right Hand Cork Screw Rule.
- The property due to which a changing magnetic field within a closed conducting coil induces electric current in the coil is called electromagnetic induction.
- The current produced in a closed coil when magnetic lines of force rapidly change within it is called the induced current.
- The symbol for alternating current is 0.
- The strength of induced current can be increased by increasing the
  (a) the number of turns in the coil
  (b) strength of the magnet used
  (c) relative speed between the magnet and closed coil.
- We cannot think of modem life without electricity. We light our homes and other places of work with electricity.
- It is used to run electric fans, televisions, geyser, electric irons, room heaters, refrigerators, music system etc.
- Cell is a primary source of electricity. A combination of two or more cells is a battery.
- Some other sources of electricity are generator and solar cells.
- The path along which an electric current flows is called a circuit.

- Electricity has the following effects
  (a) Heating effect
  (b) Magnetic effect
  (c) Chemical effect
  (d) Mechanical effect
- When an electric path is complete is called closed circuit and the path with a break is called open circuit.
- The substances which allow the electricity to flow through them are called conductors, e.g. metals, human body etc.
- The substances which do not allow electricity to flow through them are called insulators, e.g. wood, paper, glass etc.
- The consumption of electricity is calculated from the meter in kWh.
- Electric fuse is a device which limits the current in an electric circuit.
- All electrical appliances are connected in parallel in household circuits.
- We should be cautious in using electricity. Certain precautions should be taken before working on an electrical gadget or circuit.

Activity 6

List five such electrical gadgets in your house in which electromagnet is used.

1. ……
2. ……
3. ……
4. ……
5. ……

Answer.

1. Computer
2. Electric motor
3. Fan, Toaster
4. Refrigerator
5. Television
6. Electric Bell

Activity 9

Test material	State of the bulb	Conductor or insulator
Plastic	Does not glow	Insulator
Copper	Glows	Conductor
Eraser (Rubber)	.....	.....
Matchstick (wood)	.....	.....
Pencil lead (graphite)	.....	.....

Answer.

Test material	State of the bulb	Conductor or insulator
Plastic	Does not glow	Insulator
Copper	Glows	Conductor
Eraser (Rubber)	**Does not glow**	**Insulator**
Matchstick (wood)	**Does not glow**	**Insulator**
Pencil lead (graphite)	**Glows**	**Conductor**

Test Yourself

A. Objective Questions

1. Write true or false for each statement

(a) A current carrying coil when suspended freely can rest in any direction.
Answer. False.

(b) A coil carrying current behaves like a magnet.
Answer. True.

(c) In an electromagnet, the core is made up of copper.
Answer. False.

(d) An electric bell uses an electromagnet.
Answer. True.

(e) An electromagnet with soft iron core is a temporary magnet.
Answer. True.

(f) We use cell as the source of electricity to run an electric immersion rod.
Answer. False.

(g) A torch bulb glows if the terminals of the bulb are connected to the terminals of a cell by the metallic wire.
Answer. True.

(h) Wool is a conductor of electricity.
Answer. False.
Wool is a insulator of electricity.

(i) Silver is an insulator of electricity.
Answer. False.
Silver is good conductor of electricity.

(j) Our body is a conductor of electricity.
Answer. True.

(k) For a circuit to be complete, every part of it must be made up of conductors.
Answer. True.

(l) All metals are conductors of electricity.
Answer. True.

(m) The switch should not be touched with wet hands.
Answer. True.

(n) A switch is an on-off device in an electric circuit.
Answer. True.

2. Fill in the blanks

(a) A magnet has **two** poles.
(b) Like poles **repel** each other and unlike poles **attract.**
(c) An electromagnet is used to separate large mass of **iron** scrap.
(d) The strength of magnetic field of an electromagnet is increased by inserting a core of soft **iron.**
(e) In a torch we use **dry cell** as the source of electricity.
(f) To light a table lamp and to run a refrigerator, we use **mains** as the source of electricity.
(g) A group of two or more cells is called a **battery.**
(h) Conductors pass electricity through them.
(i) Insulators do not pass electricity through them.

3. Match the following

	Column A		**Column B**
(a)	**Human body**	**(i)**	**electric bell**
(b)	**Silk thread**	**(ii)**	**current**
(c)	**Charge in motion**	**(iii)**	**conductor**
(d)	**Soft iron**	**(iv)**	**electromagnet**
(e)	**Electromagnet**	**(v)**	**insulator**

Ans.	**Column A**		**Column B**
(a)	Human body	(iii)	conductor
(b)	Silk thread	(v)	insulator
(c)	Charge in motion	(ii)	current
(d)	Soft iron	(iv)	electromagnet
(e)	Electromagnet	(i)	electric bell

4. Select the correct alternative

(a) A freely suspended magnet rests in

1. east-west direction
2. **north-south direction**
3. north-east direction
4. north-west direction.

(b) Electromagnets are made up of

1. steel
2. copper
3. brass
4. **soft iron.**

(c) An electromagnet is used in

1. electric oven
2. ammeter
3. **electric bell**
4. radio set.

(d) The purpose of armature in an electric bell is

1. **to make and break the circuit**
2. to produce sound
3. to produce magnetic field
4. to provide spring action.

(e) In a torch, the source of electricity is

1. the bulb
2. the switch
3. **the cell**
4. the mains.

(f) Electricity can flow through

1. wood
2. rubber
3. plastic
4. **copper wire.**

(g) Electricity does not flow through

1. human body
2. animals body
3. **rubber**
4. silver.

(h) We should not touch the switch with wet hands otherwise

1. **electricity may pass through our body**
2. electricity may not pass through the appliance
3. circuit may break
4. the switch may get off.

B. Short/Long Answer Questions

Question 1.
State two properties of a bar magnet.
Answer:
Properties of a bar magnet

1. Attractive property : A magnet attracts small pieces of iron, cobalt or nickel.
2. Directive property : A magnet when suspended freely, always point towards North and South direction.
3. Like poles i.e. North and North or South and South poles repel each other.
4. Unlike poles i.e. North and South attract each other.
5. Poles always exist in pairs, i.e. poles of a magnet cannot be separated.

Question 2.
How will you test whether a given rod is a magnet or not ?
Answer:
Aim— To test whether a given rod is a magnet or not.
Apparatus —

1. rod to be tested
2. a bar magnet
3. a stand
4. a thread

Procedure —

1. Suspend the rod to be tested with a thread on the stand.
2. Bring the bar magnet near the rod with its north pole towards the rod's end.
3. Observe.

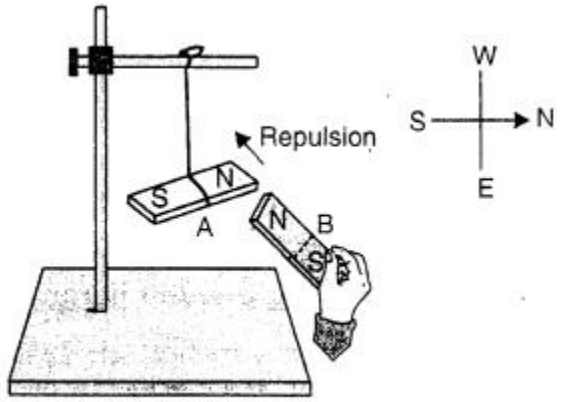
Inference — In every case, the magnet comes to rest in a north- south direction which shows its directive property.
Observation and Inference —
— If the rod is attracted towards the bar magnet, the rod may be magnet or not.
— But if the rod remains in the same direction of rest as in the start of the experiment, it show it is not a magnet.

Question 3.
How will you test whether a given rod is made of iron or not?
Answer:
Bring a magnet near the rod if the rod is attracted by the magnet then it will be made of iron else not.

Question 4.
You are given two similar bars. One is a magnet and the other is of soft iron. How will you distinguish and identify them ?
Answer:
Take first bar and suspend it in a stand with the help of a thread. So that it is free to rotate in horizontal plane. Note the direction in which it sets itself. If the direction is North and South it may be magnet. Again rotate it, if this time again it sets itself in north and south direction, it is a magnet, otherwise it is iron.
Now repeat above experiment with second bar and in the same way find it if it sets always in north and south direction then it will be a magnet.

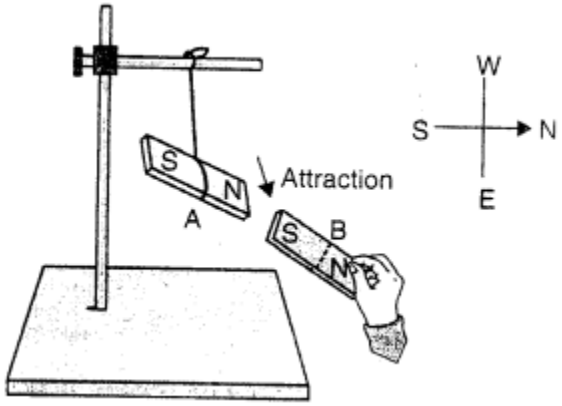
Question 5.
You are given a magnet. How will you use it to find north- south direction at a place ?
Answer:
The earth is a huge magnet in itself with its North and South poles. The North and South of the place can easily be detected with the help of a bar magnet. A freely suspended bar magnet always rest in the geographic N-S direction. Since the South pole of the earth's magnet is closer to the geographic North, the North pole of the suspended magnet will always rest in the geographic North, and the South pole of the freely suspended magnet will point towards geographic South.

Question 6.
Describe a simple experiment to illustrate that like poles of two magnets repel each other while the unlike poles attract.
Answer:
Like poles repel and unlike poles attract.
Two like poles (both North poles or both South poles) repel each other. Two unlike poles (one North pole and the other South pole) attract each other. This can be demonstrated by the following simple experiment.
Take two bar magnets A and B. Suspend one magnet A with a silk thread from a support so that it is free to swing. The magnet A will come to rest in the North-South direction. The North pole of the magnet A is in the North direction and its South pole is in the South direction. Now holding the other magnet B in your hand if you bring its North pole near the North pole of the suspended magnet A as shown in figure you will observe that the two poles repel each other. Care is taken that the two magnets do not touch each other.



Like poles repel

Now if you bring the South pole of the magnet B near the north pole of the suspended magnet A as shown in figure without touching it, you will observe that the two poles attract each other.



The above experiment shows that the like poles repels each other while the unlike poles attract each other.

Question 7.

"Poles exist in pair". Comment on this statement.

Answer:

The magnetic poles always exist in pairs. It is not possible to separate the two poles of a magnet.

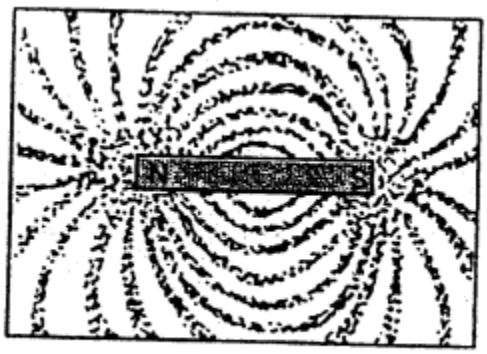
If a bar magnet is broken at the middle in two parts each part is found to be a magnet. Each part has the property to attract the small iron pieces. Each part rests in the North-South direction when suspended such as to swing freely. This shows that the new poles are formed at the broken ends.

If these pieces are broken again and again, each part will still found to be a complete magnet. Each part contains both the poles (N-pole and S-pole). Thus, the two poles of a magnet exist simultaneously.

Question 8.
What is a magnetic compass ? State its use.
Answer:
Magnetic compass is a device which is used to locate the direction of a place. It always rests in a North-South direction. It is used in the navigators in : ships, submarines, aeroplanes etc.

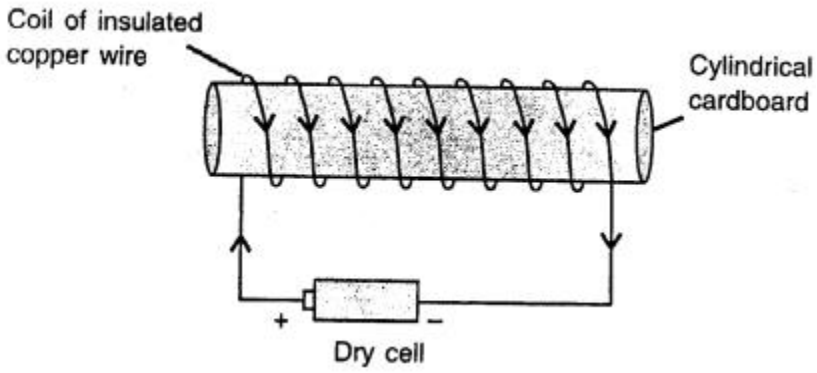
Magnetic compass

Question 9.
Explain the meaning of the term magnetic field.
Answer:
The space around the magnet where its influence can be experienced is known as magnetic field. This field is formed by the magnetic lines of force which run from the North pole to the South pole. These lines can be found to be maximum crowded at the two ends of the magnet which are the poles i.e. the North pole and the South pole.



Magnetic field

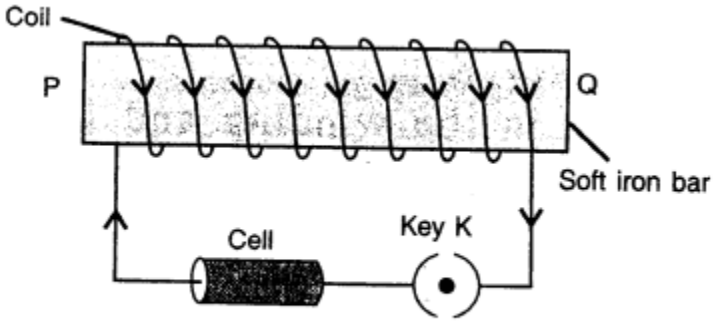
Question 10.
What is an electromagnet ?
Answer:
An electromagnet — An electromagnet is a temporary magnet which behaves as a magnet when electric current is passed through the insulated copper wire and loses its magnetism when current is stopped. It has a soft iron piece called the core with an insulated copper wire wound on it.



Question 11.
Name the material of an electromagnet.
Answer:
Iron bar, insulated copper wire, battery.

Question 12.
Draw a labelled diagram to make a soft iron bar as an electromagnet. Describe in steps the procedure.
Answer:
Usually, the electromagnets are made in two shapes :
(1) bar or I shaped magnet and (2) horse shoe or U shaped magnet.

1. **To make a fiar or I shaped electromagnet**: Take a soft iron bar PQ and wind a thin insulated copper wire around the bar. Connect a cell or a battery B, and a key K in series between the ends of the coil. The circuit diagram is shown in figure.

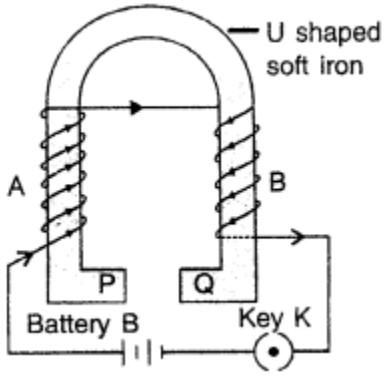


Making a bar electromagnet

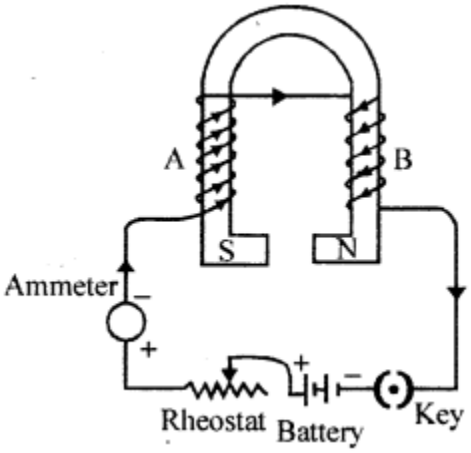
When key K is closed, current passes through the winding of the coil and the bar becomes a magnet. As the key K is opened, the current stops flowing in the coil and the bar loses its magnetism. Thus, the bar behaves like an electromagnet.

2. **To make a horse shoe or U shaped electromagnet**: Take a U shaped soft iron piece. Wind a thin insulated copper wire on its arms such that the winding in the two arms is in opposite direction. In figure winding in the arm A starts from the front and is in clockwise direction (when seen from the bottom).

On reaching the upper end of the arm A, winding starts from the back at the top of the arm B and is in anticlockwise direction. Connect a battery B and a key K between the two ends of the wire.



Question 13.
You are given a U shaped soft iron piece, insulated copper wire and a battery. Draw a circuit diagram to make a horse shoe electromagnet.
Answer:
End A becomes S-pole and B becomes N-pole.



Question 14.
Name two factors on which the strength of magnetic field of an electromagnet depends.
Answer:
The magnetic field of an electromagnet (I or U-shaped) can be increased by the following two ways :

1. By increasing the number of turns of winding in the solenoid.
2. By increasing the current through the solenoid.

Question 15.
State two ways by which the strength of magnetic field of an electromagnet can be increased.
Answer:
The magnetic field of the electromagnet can be increase in the following two ways :

1. By inserting a rod of soft iron or steel inside the cylindrical tube. This rod is called the core.
2. By increasing the total number of turns of the coil.

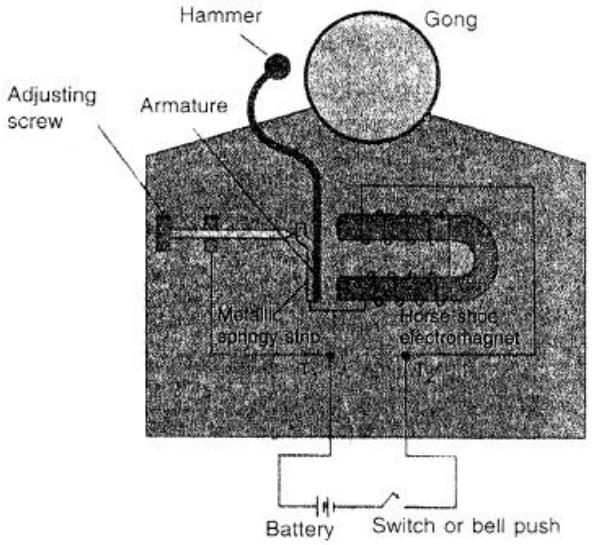
Question 16.
State two common uses of electromagnets.
Answer:
Uses of electromagnet —

1. In electrical appliances such as electric bell, fan etc.
2. In lifting heavy loads of iron scrap.
3. To remove tiny particles of iron from the wound.
4. In loading furnaces with iron.
5. In separation of magnetic substances from the non-magnetic substances.

Question 17.
Name a domestic device in which an electromagnet is used.
Answer:
Electromagnet is used in ELECTRICAL APPLIANCES like ELECTRIC BELL, RADIO, T.V., FAN and MOTORS etc.

Question 18.
Draw a neat and labelled diagram of an electric bell and describe its working.
Answer:
Working of the bell— Principle of working of electromagnetism When the switch is pushed on, the circuit gets completed and current stalls flowing through the U-shaped electromagnet which creates magnetic field in the core. This attracts the iron armature. Now when the armature moves towards the electro-magnet, the hammer strikes the gong and the bell rings. But as the armature
moves towards the electromagnet, the contact with the adjustment screw breaks which breaks the closed circuit and stops the current. Now when there is no current there is no electromagnetism and the armature returns to the original position. This making and breaking of the circuit of the electromagnet continues as long as the button remains

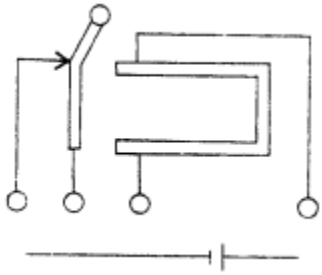
pressed.



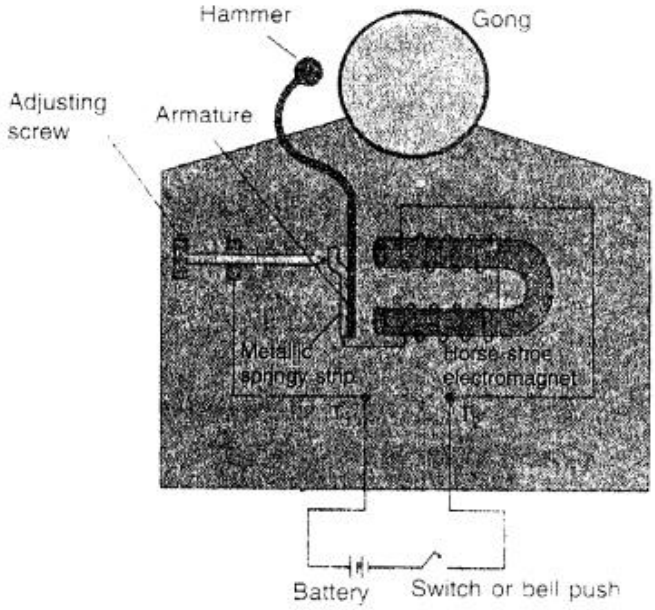
An electric bell

Question 19.

The incomplete diagram of an electric bell is given in fig. Complete the diagram and label its different parts.

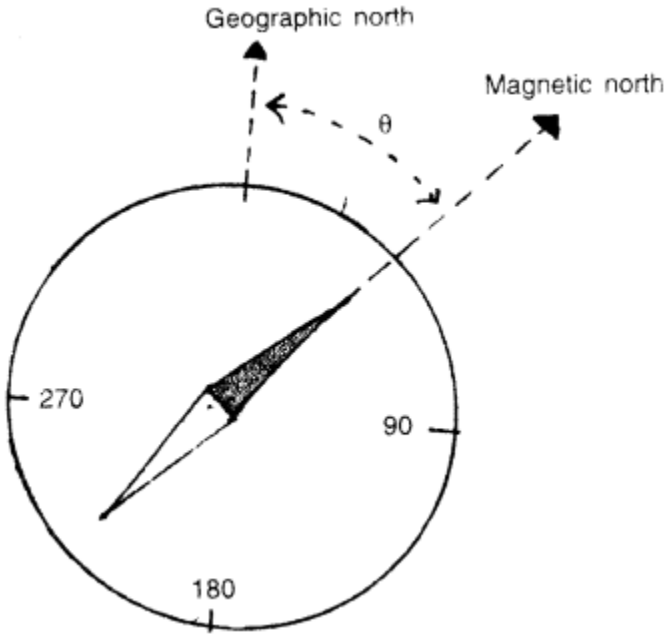


Answer:



An electric bell

Question 20.
What is declination ? Draw a diagram to show the angle between the declination and true direction of geographic north.
Answer:



Magnetic declination is the angle of the horizontal plane between the magnetic North and the geographic North (or true North). This angle is shown in figure by symbol θ. The angle of declination is different at different places on the earth surface and it also changes at a place with time. The declination is taken positive if the magnetic North is towards the east of the true North as in figure and is negative if the magnetic north if towards the west of the true North.

Question 21.
Define the term current.
Answer:
An electric current is a flow of electric charge. In electric circuits this charge is often carried by moving electrons in a wire.
The S.I. unit of electric current is the ampere.

Question 22.
Name four appliances which work using electricity.
Answer:

1. an electric iron
2. an electric heater
3. an electric kattle
4. an immersion rod

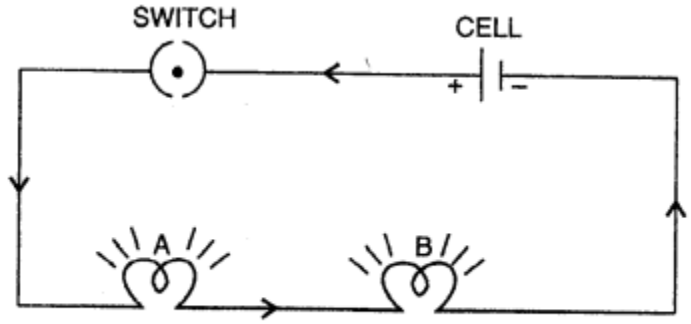
Question 23.
Name two sources of electricity.
Answer:

1. dry cell and battery
2. generator and solar cell

Question 24.
What is a battery ?
Answer:
If we use a group of two or more cells, it is called a battery. A battery is used where we require more electricity.

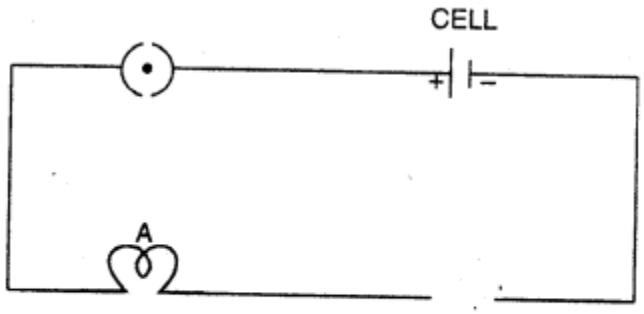
Question 25.
What is an electric circuit ?
Answer:
For a smooth flow of electric current, a complete circuit is needed. This is known as electric circuit.

Question 26.
Describe an experiment to show that electricity flows only if the circuit is complete and it does not flow if the circuit is incomplete.
Answer:
Take two torch bulbs A and B. Connect them to a cell through a switch as shown in fig. The bulbs are said to be in series. Close the switch (i.e., the circuit it completed), you will see that both the bulbs glow.



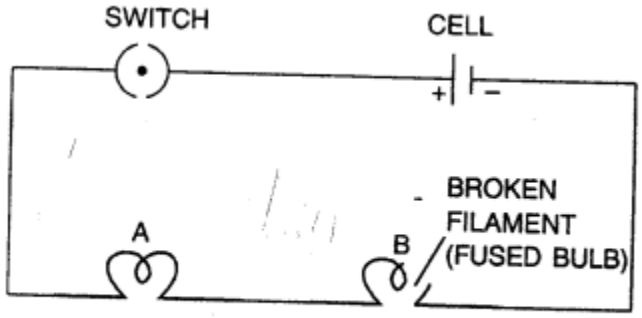
Circuit is complete, both bulbs glow

Now take out the connection of the bulb B as shown in fig. Now close the switch, you will observe that the bulb A does not glow, because the circuit is now incomplete.



Circuit is incomplete, bulb A does not glow

Now replace the bulb B by a fused bulb fig. and close the switch. Again you will see that the bulb A does not glow. This is because the circuit being in series, is still incomplete.



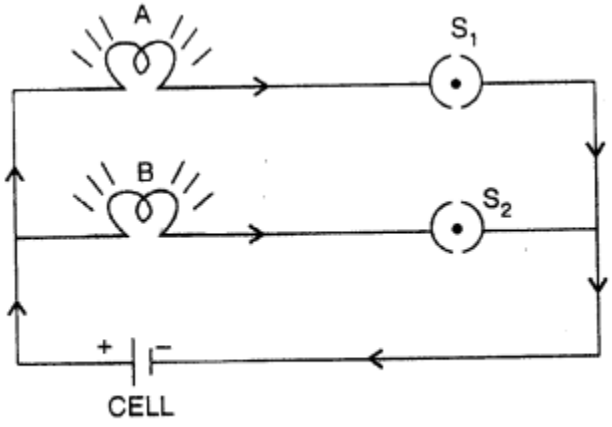
Incomplete circuit, bulb A does not glow

Question 27.

You are provided with a torch bulb, a cell and two plastic coated f metal wires. Draw a diagram to show a complete circuit to light the bulb.

Answer:

Take two bulbs A and B. Connect them through switches S_1 and S_2 in parallel as shown in fig. Close both the switches. You will see that both the bulbs glow.



Circuit is complete, both bulbs glow

Question 28.
In which of the following case the bulb will glow :

1. Only one terminal of a cell is joined with a metal wire to one terminal of the bulb.
2. Both terminals of the bulb are joined with two metal wires to one terminal of the cell.
3. One terminal of the cell is joined to one terminal of the bulb and other terminal of the cell to the other terminal of the bulb.

Answer:
The bulb will glow in (3) case i.e.

Question 29.
Distinguish between conductors and insulators of electricity. Give two examples of each.
Answer:
Conductors

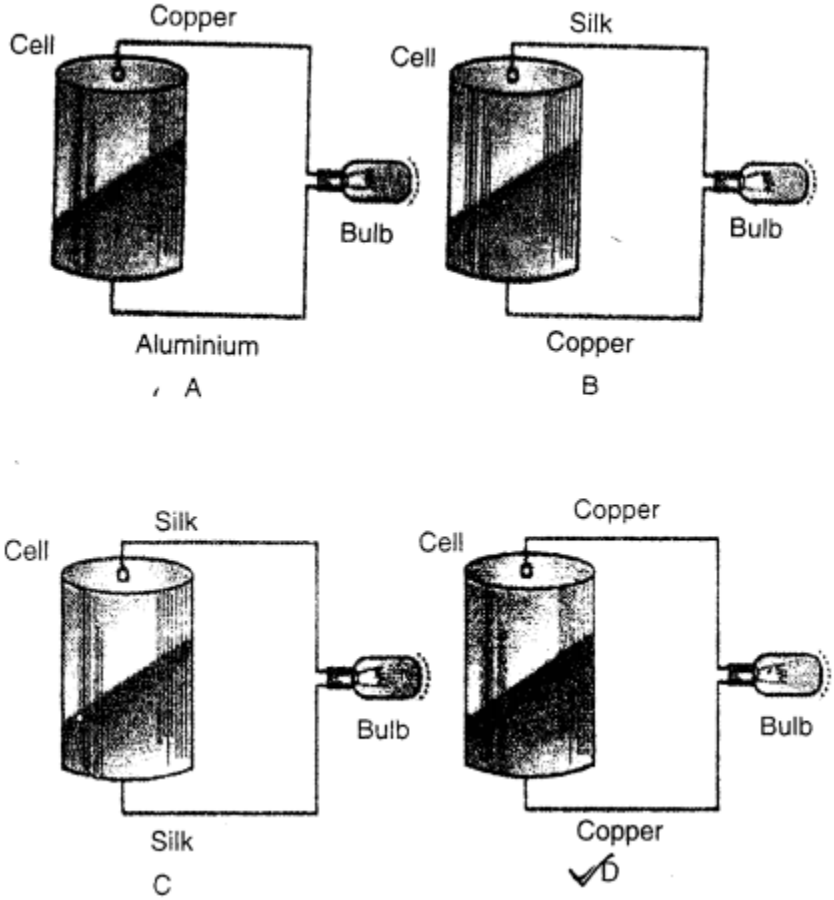
1. Conductors are those subs¬tances which allow electricity to flow through them.
2. e.g. all metals, human body.

Insulators
Insulators are those which do not allow electricity to pass through them. –
e.g. wood, paper, glass.

Question 30.
Select conductors and insulators from the following :
Glass, silver, copper, wood, paper, pure water, impure water, aluminium, iron, leather, plastic, steel, human body and ebonite.
Answer:
Conductors — Silver, copper, impure water, aluminium, iron, steel, human body.
Insulators — Glass, wood, paper, pure water, leather, plastic and ebonite.

Question 31.

The following diagram shows four circuits A, B, C and D. Each circuit has a cell and a torch bulb. Name the circuits in which the bulb will glow ? Give reason to your answer



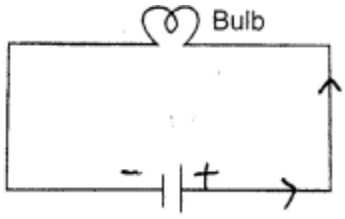
Answer:

The bulb will glow in circuit (D).

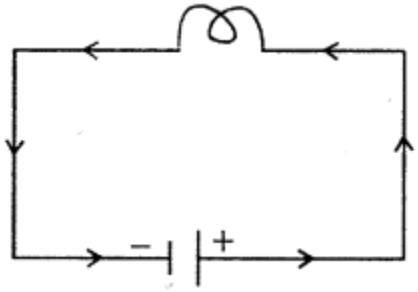
This is because copper is the best conductor of electricity as compared to aluminium. Silk is a non-conductor of electricity.

Question 32.

The diagram given below shows a bulb connected with a cell having terminals A and B. Mark the direction of current in the bulb.



Answer:



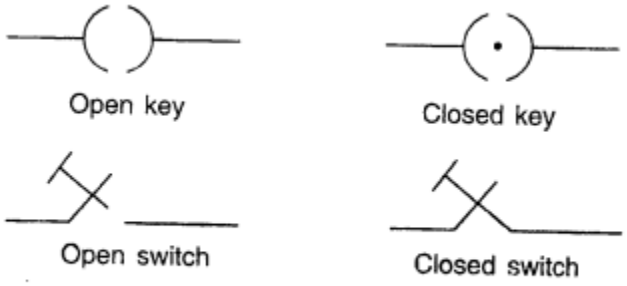
Current always flows from +ve terminal to the -ve terminal of a cell.

Question 33.

State the function of each of the following in an electric circuit and draw its symbolic representation: (1) Switch and (2) Cell.

Answer:

1. **Switch** – A switch or key is used to put the circuit on and off. fig. shows the symbol of a switch or key when it is open (to put the circuit off and when it is closed (to put the circuit on)

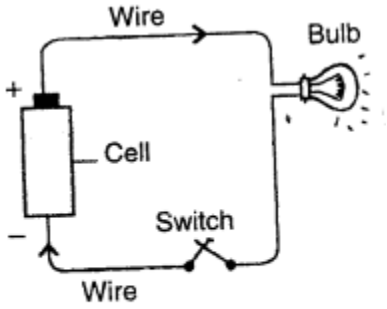


Switch and key

2. **Cell** – A cell or a group of cells is generally used as a source of electricity. A positive (+) and a negative (-). It is represented by the two vertical lines of unequal lengths. The long vertical line represents the positive terminal and the short line represents the negative terminal as shown in fig.

A cell

Question 34.
Draw a circuit diagram for a bulb connected to a cell with a switch. Mark arrow in the diagram to indicate the direction of flow of current.
Answer:



(a) A circuit contianing a cell, a switch and a bulb

Question 35.
In which arrangement are the appliances connected in the electric circuit of our homes, Series or Parallel ? Give one reason for your answer.
Answer:
Parallel circuit: When the circuit is in parallel, the appliances work independently. This is the reason that in our household wiring system, all the circuits are in parallel. Every appliance when put on, works on its own without the interruption of the other appliance.

Question 36.
State two precautions that you must take when switching on an electric circuit.
Answer:
Precautions to be taken beofre the circuit is switched on
Before the circuit is switched on, following precautions must be taken :

1. See that all the components of the circuit are properly connected.
2. See that the connection wire is tightly connected to each appliance or component.
3. Do not touch the switch or any component with wet hands.