Chapter 7

# Electricity and Magnetism

**Chapter Objectives**

In this chapter, you will learn about:

- Laws of magnetism
- Electromagnetism
- Electromagnetic induction
- Magnetic field due to a straight current-carrying wire
- Magnetic field due to a circular current-carrying wire
- Uses of electromagnet
- Electric bell
- Electricity and its sources
- Electric circuits (in series and parallel)
- Symbolic representation of electrical components

All of you must have seen electric wires at homes. These wires supply electricity and make the sockets, bulbs, fans and other electronic gadgets work. Ask any elder person in your family to show you a piece of wire. Observe that piece of wire carefully. Does electricity flow through the hollow inside the wire?

## INTRODUCTION

In class 6, we studied about magnets and their properties. A magnet is an object made up of materials like iron, cobalt, nickel, etc., and exerts a force of attraction or repulsion on similar materials kept in its surroundings. *The force which a magnet exerts on the surrounding materials is known as the* **magnetic force**. This magnetic force around any magnet has a range, beyond which the strength of this force weakens. We know that a magnetic field is produced by magnets which occurs naturally on Earth or can be made artificially. It is also seen that when a current is passed through a conductor, it also produces a magnetic field around the conductor. This revolutionary discovery was accidentally made by a Danish scientist Hans Oersted in 1820. He noticed that a compass needle shows deflection when an electric current from a battery was switched on and off.

In class 6, we had discussed properties of magnets in detail. Let us sum up those properties here.

1. Magnets attract magnetic materials such as iron, cobalt, nickel and steel.
2. All magnets have two poles, namely North Pole and South Pole. The force of attraction of a magnet is greater at its poles than in the middle.
3. Unlike poles of two magnets attract each other, whereas like poles repel each other.

## LAWS OF MAGNETISM

One of the basic laws of magnetism is that like poles of a magnet repel and unlike poles attract.

Let us demonstrate this through an activity.

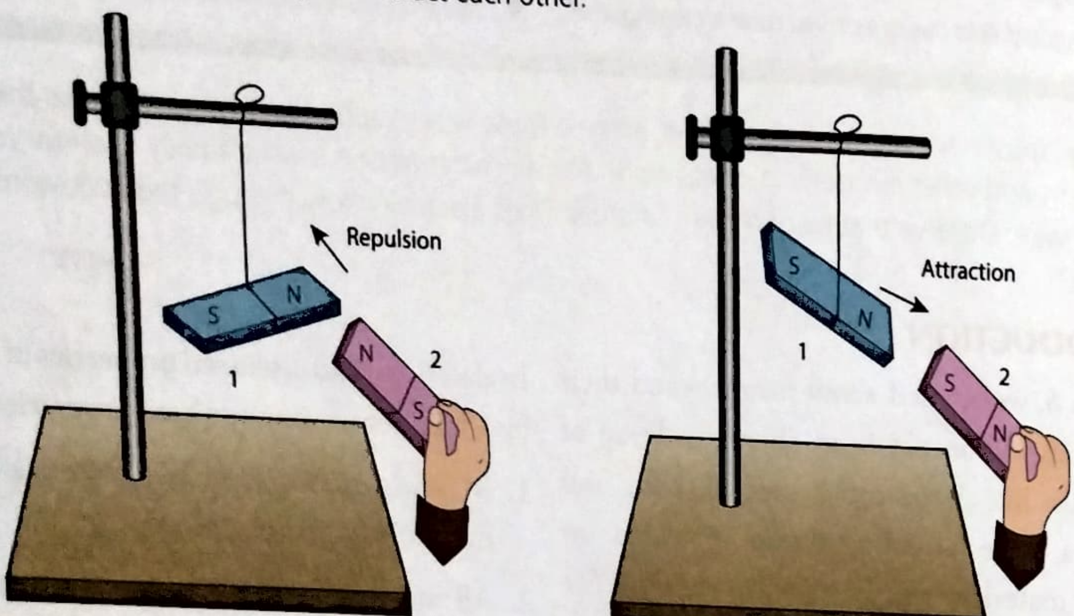
**Aim: To demonstrate that like poles of magnets repel and unlike poles attract.**

**Materials required:** two bar magnets with theirs poles marked, a stand

**Procedure:**

- Take two bar magnets.
- Suspend one bar magnet with a thread at the centre and tie it to the stand.
- Bring the North Pole of one bar magnet closer towards the North Pole of the other magnet.
- What do you observe?
- Do the same with the north poles of both the magnets.
- Now, bring the South Pole of one magnet closer to the North Pole of the suspended magnet. What do you observe now?

**Observation:** When we bring North Poles or South Poles of both the magnets closer, they repel each other. But, if you bring two unlike poles, for example, North Pole of one magnet and South Pole of the other magnet or vice versa, they will attract each other.




| Magnet 1 | Magnet 2 | Push or Pull? |
|---|---|---|
| North Pole | North Pole | |
| South Pole | South Pole | |
| North Pole | South Pole | |
| South Pole | North Pole | |

## REPULSION AS A TEST FOR MAGNETS

Look at the Fig. 7.1 shown here. As discussed in the activity also, when we bring like poles closer to each other (S-S, N-N), the magnets will repel each other. On the other hand, if we bring unlike poles of two magnets closer to each other (N-S or S-N), they will attract each other.

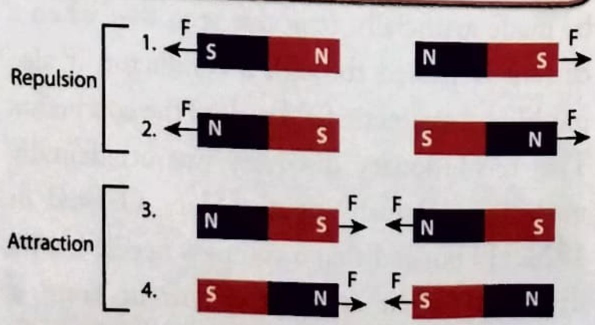



**Fig. 7.1** Like poles of magnets repel each other.

If a magnet attracts another object, we cannot say for sure that the other object is a magnet, as magnetic materials such as, iron, nickel and cobalt are also attracted towards a magnet. But if the magnet repels the object, then we can surely say that the other object is a magnet. Because 'like poles of a magnet repel each other'. *So repulsion is a sure test for a magnet.*

## ELECTROMAGNETISM

In previous classes we have studied about magnetic fields, and how it can be produced. We now know that a magnetic field can be produced by permanent magnets, like a bar magnet or a lodestone. Apart from that, magnetic field can also be produced by a current-carrying wire. Thus, a current acts as a source of magnetic field. But can the reverse be true? Can magnetic field be the source of an electric current? The answer to this question is a YES. Physics is all about nature and the natural phenomena that take place around us and in this universe. As an electric current can produce magnetic field, similarly, a magnetic field can also produce electric current. The branch of physics that deals with the effects produced by electric currents or fields and magnetism is called **electromagnetism.**

### Electromagnetic Induction

Michael Faraday, in 1831, was the first person to demonstrate that magnetic field in a circuit can also produce electricity. He showed that whenever a magnetic field linked with a circuit changes with time, an electric current is induced in the circuit. This effect is ~~popularly~~ known as electromagnetic induction. Faraday arranged a set-up of an electric coil wound in a helical manner and attached to a galvanometer. A galvanometer is a simple device that can detect the presence of electric current in a circuit. He took a bar magnet which was initially kept stationary near the coil and galvanometer arrangement. No current was detected in the galvanometer. Now, he started moving the bar magnet in and out of the helical coil. By doing so, the galvanometer showed deflection. *The direction of the deflection was opposite when the magnet was moved into the coil and when taken out.*

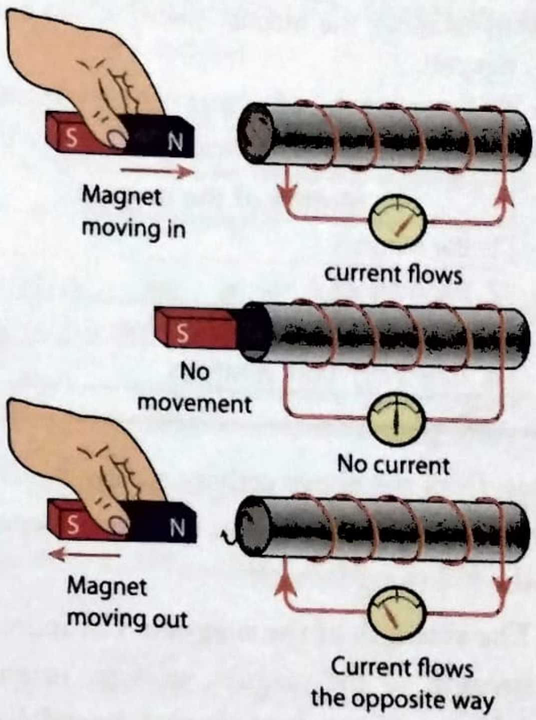



**Fig. 7.2** Phenomenon of electromagnetic induction

Similar results could be seen when the magnet was kept stationary and the coil was moved towards the magnet. Thus, the experiment proves that by changing the amount of magnetic field lines linked with a circuit, electric current can be produced in it.

## ACTION TIME 2

**Aim: To demonstrate Faraday's experiment.**

**Materials required:** a small piece of hollow cylindrical tube, some insulated copper wire, a galvanometer, some scotch tape and two different bar magnets of different strengths

**Procedure:**

- Take the cylindrical tube and wind a copper wire over it. Fix the ends of the copper wire with a scotch tape.
- Connect the loose ends of the copper wire with a galvanometer.
- Now, take a bar magnet of lesser strength and move it in and out of the hollow tube. What do you observe?

Does the galvanometer show deflection?

- Now, stop the motion of the magnet. What happens to the deflection of the galvanometer?

Bring a stronger magnet and move it in the same manner. Is there any change in the deflection?

- Try to move the magnet swiftly in and out. Also, note down the change in the deflection of the magnet.
- Take another roll with large number of copper windings and repeat the same steps.
- Note down your observations in the table below.

| Motion of the magnet | Deflection of the galvanometer |
|---|---|
| 1. Bar magnet 1 | |
| 2. Bar magnet 2 | |
| 3. Bar magnet 1 moved swiftly | |
| 4. Tube with more windings | |

Thus, from the above activity, we can conclude that the current induced in the circuit depends on the following factors:

1. **The strength of the magnet:** The more the strength of the magnet, stronger magnetic field it will produce around it and hence more will be the magnitude of the current induced in the circuit. Weaker magnets induce weaker currents in the circuit.
2. **The change in the magnetic field:** The faster the magnetic field changes with time in the region, more is the magnitude of the current induced in the circuit.
3. **Number of turns of the wire:** More the number of windings of the wire in a coil, more is the magnitude of the current induced.

### Quick Check 1

**Fill in the blanks.**

1. The idea of electromagnetic induction was given by .................. .
2. The coil with larger number of turns will have .................. current induced.
3. An electric current can also be produced by .................. .
4. A .................. is a simple device that can measure the presence of electric current in a circuit.
5. A stronger magnet induces .................. current in the circuit.
6. Repulsion is a sure test for a .................. .

## ELECTROMAGNETS

*An electromagnet is a piece of iron, generally a soft iron called core, with an insulated copper wire wrapped around it.* The free ends of the wire are connected to the terminals of a battery. As the current flows through the wire, it produces a magnetic field around itself. This magnetic field then magnetises the iron bar enclosed within the wire. As the iron bar gets magnetised, it starts behaving like a magnet. This type of magnet is known as an electromagnet. *The iron bar retains its magnetic power as long as the current is flowing through the insulated copper wire.* The moment current is switched OFF; it loses its magnetic nature. Thus, it behaves like a temporary magnet.

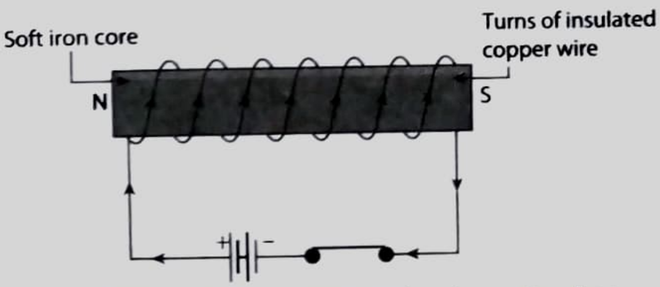



**Fig. 7.3** An electromagnet made using an iron bar

If a steel bar is used in place of a soft iron bar as core, it will retain its magnetism for a longer duration, even when the current is switched off.

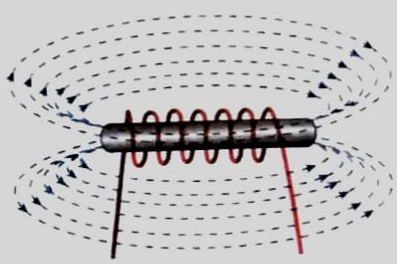


**Fig. 7.4** Magnetic field lines around an electromagnet.

This is because steel is a hard magnet or hard magnetic material.

The magnetic strength of an electromagnet can be altered. It depends on the following factors:

1. **Number of windings** of the insulated copper wire. More the number of windings, more will be the strength of the electromagnet thus formed.

2. **Nature of the material** to be magnetised. Hard magnetic materials are strongly magnetised and can sometimes retain their magnetism for a few minutes even after the current is switched OFF. Steel is an example of a hard magnet.

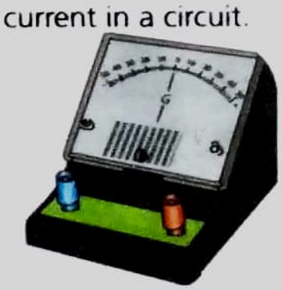
3. **Magnitude of current** flowing through the copper wire. The more the current, the more will be the strength.

**INFO HUB**

Magnets which tend to lose their magnetic properties easily are known as **temporary magnets**.

**INFO HUB**

Galvanometer is a sensitive, electrical instrument which is used to detect the presence of current in a circuit.



A galvanometer

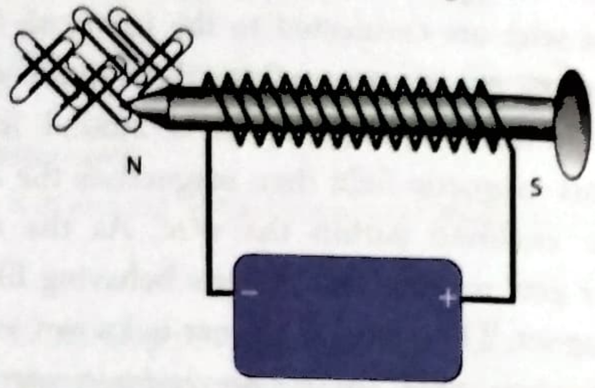
ACTION TIME 3

**Aim: To design an electromagnet.**

**Materials required:** soft iron nail, insulated copper wire, duct tape, battery, paper clips

**Procedure:** Take a soft iron nail and wrap the insulated copper wire around it along its length.

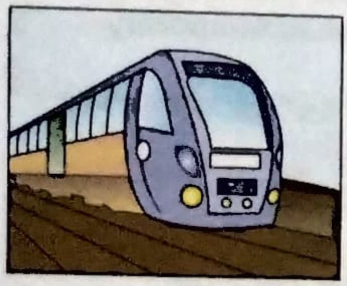
- Now, with the help of a duct tape, connect the loose ends of the insulated wire with the positive and the negative terminals of the battery.
- Keep the battery OFF and bring some paper clips close to the nail.
- Does the nail attract the paper clips? No.
- Now, switch ON the battery.
- Bring the paper clips close to the iron nail again.
- It starts attracting paper clips. This is because we have magnetised the iron nail.



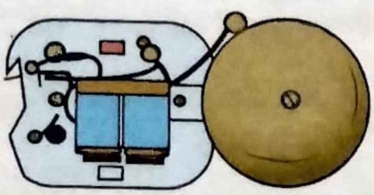

Soft iron nail as an electromagnet attracts paper clips

## Uses of Electromagnet

1. It is used in devices like electric-bell, loudspeakers, generators, etc.
2. It is used in electrical instruments like ammeter, galvanometer and voltmeter.
3. It is used in electric motors.



a. Train tracks



b. Electric bell

**Fig. 7.5** Some of the uses of electromagnets

4. Electromagnets are used in MRI scans.
5. It is used in the junkyard to separate the magnetic/metallic junk or to lift heavy metallic loads that are attracted towards a magnet.
6. In the track of high speed Maglev trains.

## Solenoid

A solenoid is a tightly wound coil of insulated wire rolled in the form of a cylinder, connected to a battery from both the ends. As the current flows through it, a magnetic field is generated. The number of magnetic lines of force is more at the centre than outside. This means that the magnetic field strength is more at the middle than outside.

The magnetic field produced by a solenoid is similar to that produced by a bar magnet. The only difference is that the moment the current is switched off, the magnetic field produced by a solenoid becomes zero. Thus, a solenoid is based only on magnetic effects of current.

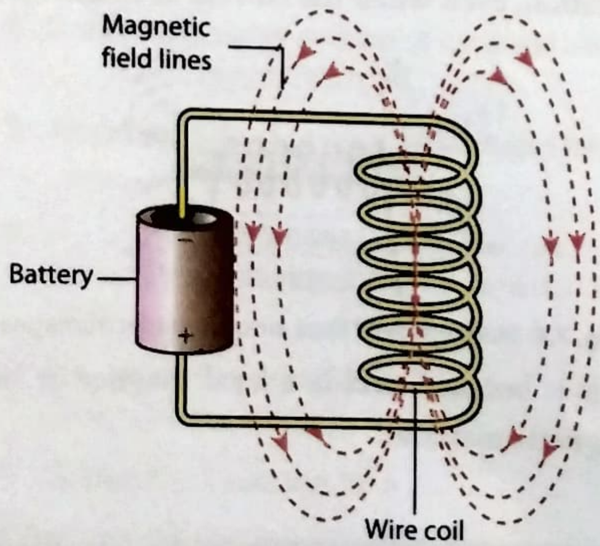



**Fig. 7.6** A solenoid

### Properties of magnetic field produced by a solenoid

1. A solenoid carrying current produces a magnetic field.
2. The nature of magnetic field is the same as that produced by a bar magnet.
3. The magnetic lines of force crowd at the centre of the solenoid.
4. The magnetic lines form closed loops.
5. A solenoid also has two magnetic poles. The face of the solenoid with current moving in anti-clockwise direction becomes the north pole. The face of the solenoid with current moving in clockwise direction becomes the south pole.
6. The polarity of a solenoid can be reversed by changing the direction of current.
7. The strength of the magnetic field produced by a solenoid can be changed by changing the magnitude of the current and number of windings per unit length of the wire.
8. A tightly wound solenoid is stronger than a loosely bound solenoid.

## ELECTRIC BELL

One of the most important applications of an electromagnet is an electric door bell. Let us study the construction and working of a simple electric bell.

### Main Parts of an Electric Bell

1. **An electromagnet:** A U-shaped electro-magnet is used in the construction of an electric bell. It has an insulated copper wire wound over it.
2. **Armature:** It is a piece of soft iron.
3. **Spring:** A contact metallic thin plate is attached to one end of the armature. The loose end of the spring is near the contact screw.
4. **Screw:** It is an adjustable metallic screw hanging over the spring and operated by a switch.
5. **Hammer:** A steel hammer is attached to the armature and is controlled by the spring.
6. **Gong:** The gong is usually made up of brass mounted over a wooden or plastic board. When the spring is pressed, the hammer strikes against the gong to make a noise.
7. **Switch and a battery:** One terminal of the battery is connected to the electromagnet and the other terminal is connected to the contact screw through a switch. When pressed, the electric circuit gets completed and the current starts flowing into the circuit.

### Working

When the switch is pressed, the circuit is complete and the current starts flowing in it. The current magnetises the electromagnet. This electromagnet generates a magnetic field around it, which attracts the armature towards it. As the armature gets attracted towards the electromagnet, the hammer moves and hits the gong and makes the sound.

As the hammer strikes the gong, the connection between the screw and the armature breaks. This breaks the circuit and the current stops flowing. When there is no current flowing in the circuit, the electromagnet de-magnetises. The spring brings the armature back to its position and forms the contact with the screw. This completes the circuit again and the cycle repeats itself, as long as the switch is pressed.

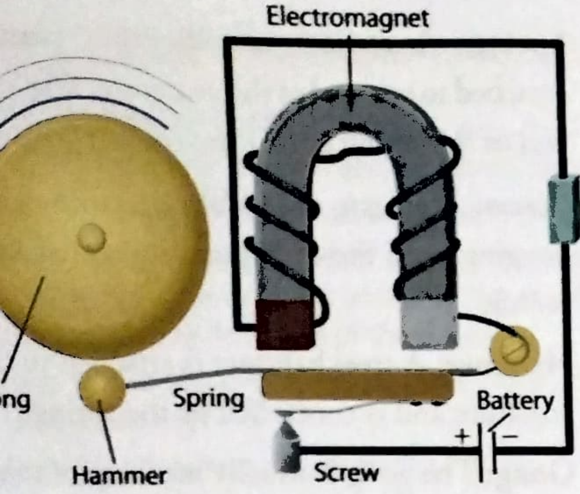


**Fig. 7.7** An electric bell

**Quick Check 2**

**State whether the following statements are True or False.**

1. A U-shaped type of electromagnet is used in an electric doorbell. ..........
2. The magnetic strength of an electromagnet cannot be changed. ..........
3. When the spring is pressed, the hammer strikes against the gong to make a noise. ..........
4. A solenoid produces a similar magnetic field as electromagnet. ..........
5. The field produced by an electromagnet is stronger than a solenoid. ..........
6. The soft piece of iron bar placed in the centre around which the copper wire is wound is called core. ..........
7. The strength of the magnetic field produced by an electromagnet can be changed by changing the magnitude of current and number of windings per unit length of the wire. ..........

## ELECTRICITY

In our daily life, we can see a large number of appliances operated by electricity. Let us discuss about some appliances which make use of electricity.

1. Electricity is used to run appliances which help us to keep ourselves warm in the winter (room heaters), and to stay cool in the summer (air conditioners).
2. Electricity is used to produce light. The fan, an important ventilation appliance is operated by electricity.
3. Refrigerators use electricity to keep fruits and vegetables fresh for a longer period.
4. Television, telephone, radio and computer also need electricity for working.
5. Electricity is used to produce sound, as in a calling bell or blowing a horn, as in a car or operating the siren in a factory.

### Electric Current

The flow of water in a river is called water current. Similarly, **the electric current** is the flow of charged particles (electrons) through a conducting medium, such as a wire. When we talk about electricity, the charged particles we are referring to are electrons. You see, the atoms in a conducting material have lots of free electrons that float around from atom to atom and everywhere in between. The motion of these electrons is random, so there is no flow in any given direction.

In case of liquids which conduct electricity (electrolytes), the current flows due to movement of ions. An atom, on losing an electron, acquires positive charge (cation) and on gaining one or more electrons attain(s) negative charge (anion). These ions move and help the current flow in an electrolyte.

Charges do not flow in a wire or any other conductor by themselves. Electrons move along the conductor in the same direction only if there is a difference of electric pressure, known as the potential difference in the form of a battery or a cell. The direction of an **electric current** is by convention the direction in which a positive charge would move. This movement is opposite to the direction of flow of electrons. The SI unit of electric current is ampere (A).

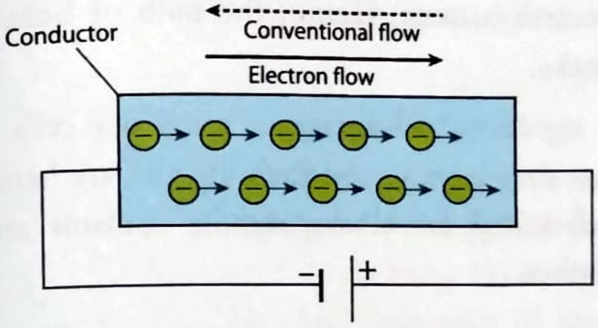



**Fig. 7.8** Direction of flow of current in a conductor.

## SOURCES OF ELECTRICITY

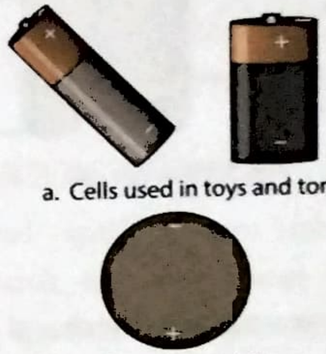
Electricity can be generated from many different energy sources. For example, in a cell, electricity is produced from chemical energy. Electricity that you use at home is generated from other energy sources such as coal, water, sunlight, wind and so on.

There are several devices that can generate electricity. The most common sources are cells, batteries and generators.

### Cells

You might have seen electric cells in devices like torch, TV remote, wall clock, toys and so on. An electric cell is a device which produces electricity from stored chemical energy. Cells have a positive terminal and a negative terminal. The positive terminal is the knob on top of the cell and the negative terminal is the flat end of the cell. On the other hand, button cells are used in wrist watches, calculators, hearing aids and so on.

The cells shown in the picture here cannot be recharged after using them. They are used only once and are disposed off after that. These kind of cells are called primary cells.



a. Cells used in toys and torch

b. Cell used in watches

**Fig. 7.9** Different types of cells that we use.

### Dry cell or primary cell

Dry cell or Leclanché cell is a primary cell, invented by the French engineer Georges Leclanché. It is now widely used in devices such as, radio and TV remotes. You can identify the parts of a dry cell by observing the vertical cross-section of the dry cell.

***Construction***

The dry cell consists of a carbon electrode packed in a porous pot. The space around the carbon rod is filled with manganese dioxide and activated charcoal. The porous pot is immersed in a jelly-like substance which is a mixture of ammonium chloride, gelatine and a little amount of water. The entire arrangement is kept in a cylindrical case made of thick zinc. The zinc container is again covered with a non-conducting case which was made of cardboard in earlier days and other non-conducting materials are used in recent days. A brass cap is fixed with the carbon rod.

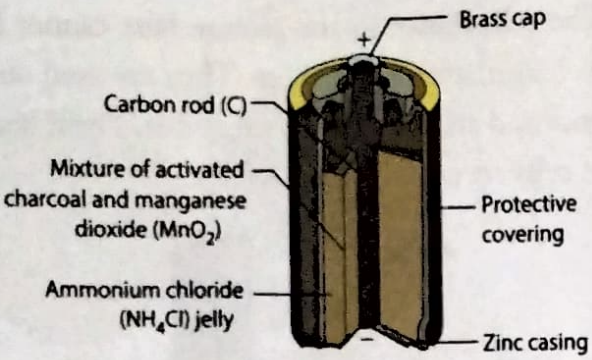



**Fig. 7.10** A dry cell

*Working*

In the above arrangement, a chemical reaction occurs and liberates free electrons. In the cell, the carbon rod acts as a positive terminal and zinc base acts as a negative terminal. When an electric component, such as a bulb or buzzer, is connected in between the brass cap and base, the free electrons move around the circuit and constitute an electric current. Hence, the bulb or buzzer works.

A significant advantage of using dry cells is that they have a good shelf life and are hence well-suited for clocks, remote controls and torches.

**ACTION TIME 4**

**Aim: To demonstrate that the production of electricity will increase on increasing the number of cells in a battery.**

**Materials required:** 3–4 dry cells, a torch bulb, wire and a switch.

**Procedure:** Take one cell and attach wires on its both terminals and connect to the torch bulb. The bulb will glow.

- Connect one more cell to the first one in series. Now, switch it ON and you will see that the bulb glows brighter.
- Again, take another cell and connect 3 cells in a series. What do you observe?

You will find that the torch bulb will glow even brighter. This shows that, on increasing the number of cells in a battery the electric current also increases and the bulb glows brighter.

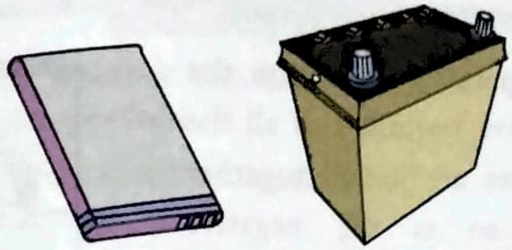
### Battery

A battery can be constructed by combining two or more than two cells. To form a battery, the cells are arranged as shown in Fig. 7.11. Positive terminal of one cell is connected with the negative terminal of the previous cell. A battery will have positive and negative terminals to connect the devices with. For example, in a TV remote, two cells are used to make a battery. The number of cells used to make a battery depends on the requirement of electricity to run electric devices.

**Fig. 7.11** Formation of a battery.

### Secondary cells

In mobile phones, trucks and cars, we use storage cells or rechargeable cells. When an electric current is passed through these cells, a reverse chemical reaction takes place and the original chemical is restored. These cells can be used multiple times by recharging them. Such cells are called **secondary cells**. As these cells can accumulate electricity, they are also known as **storage cells**.



a. Used in mobiles b. Used in vehicles

**Fig. 7.12** Types of secondary cells

### Conductors

*Materials that allow electricity to pass through them are called* **conductors**. Copper, silver, gold, aluminium, steel, lead, iron, brass, tin and human body are a few examples of electrical conductors. Since metals are good conductors of electricity, electric wires are made up of metals. These conducting wires are used to connect various components of an electrical circuit. Copper is the most commonly used material for making connecting wires. Sometimes, we receive an electric shock because our bodies are also good conductors of electricity.

### Insulators

Materials that do not allow electricity to pass through them are called **insulators.** Some common insulators are glass, air, plastic, cotton, Thermocol, wood, nylon, ebonite, cork, pure water, leather, alcohol and rubber. As insulators do not conduct electricity, they are used to protect us from the dangerous effects of electricity. Without the help of insulators, the use of electrical appliances is impossible.

## RESISTORS

**Resistors** are the most commonly used components in electrical circuits. Their purpose is to create specified values of current flow. As shown in Fig. 7.13, resistors produce resistance and regulate the flow of electrical current in a circuit.

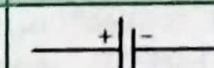
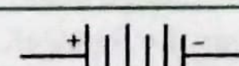
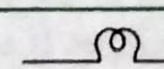
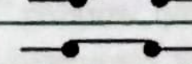
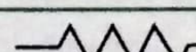
**Fig. 7.13** Symbol to represent resistor

## ELECTRICAL SYMBOLS

Electrical symbols are small drawings, or pictograms, used to denote various electrical devices in a drawing or plan of an electric circuit.

Some common components can be represented by the symbols as shown in the table. If you notice the symbols, a connecting wire is represented by a line. A cell is represented by a shorter and a longer parallel line. An incandescent lamp and a switch, in ON and OFF positions are represented as shown in Table 7.1.

**Table 7.1** Different electric components and their symbols

| Electric component | Symbol |
|---|---|
| 1. Electric cell |  Cell |
| 2. Electric wire |  Wire |
| 3. Battery |  |
| 4. Bulb |  |
| 5. Switch OFF |  |
| 6. Switch ON |  |
| 7. Resistor |  |

## ELECTRICAL CIRCUIT DIAGRAMS

It is much easier to represent an electric circuit by using the symbols of components used. For example, a simple open circuit with a bulb, a battery, connecting wire and a switch can be easily represented as shown in the illustration.

Since the switch is open, the electric current will not flow in the circuit and hence, the bulb will not glow. Have you ever felt warmth near an incandescent bulb or tube light when it is ON?

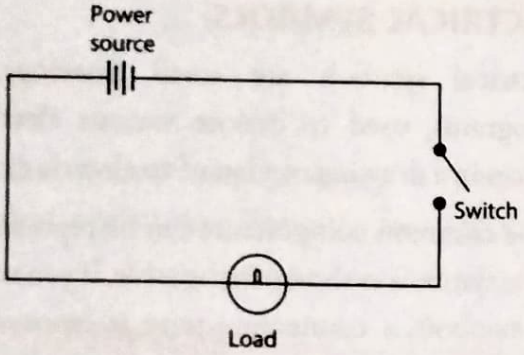



**Fig. 7.14** An electric circuit

In an electrical circuit, at times there are more than one devices attached. These devices in a circuit can be connected in two ways—series and parallel. Let us discuss these circuits in detail.

### Electric Circuit in Series

In series connection, devices are connected back to back. In series electric circuits, the devices work simultaneously as the current flows through them one after the other. If we look at the figure shown, the three devices are connected to the source battery in series one after the other. If any of the devices shown in series stops working, all the other devices will also stop working. This is because the circuit was not completed here (circuit breaks) as the devices have a single pathway for current to flow.

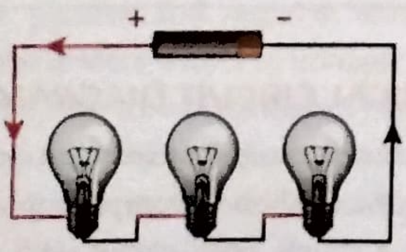



**Fig. 7.15** Electric circuit in series

### Electric Circuit in Parallel

In a parallel connection, the positive terminals of all the devices are joined together and so is the negative terminals. In parallel electric circuits, all the devices have a separate pathway for electricity so that they work independently. Even if one of the devices stops working, the other devices connected in the parallel circuit will continue working. The circuits that we use in our houses are mostly connected in parallel, so that if one of the devices is switched off, the other one will work independently.

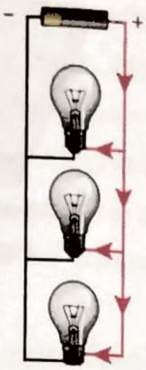



**Fig. 7.16** Electric circuit in parallel

### Closed and Open Circuits

Observe the diagram given here. Notice that the key or switch can be placed anywhere in the circuit. When the switch is in the 'ON' position, the circuit from the positive terminal of the battery to the negative terminal is complete. The circuit is then said to be closed and the current flows throughout the circuit instantly. Hence, the bulb glows. When the switch is in the 'OFF' position, the circuit is incomplete. It is said to be open. No current flows through any part of the circuit. The bulb does not glow.

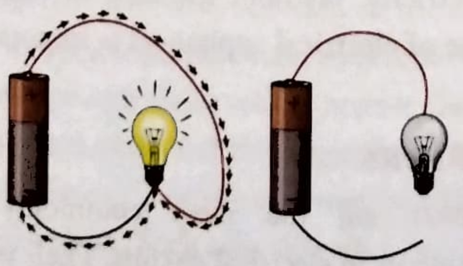



**Fig. 7.17** Closed and open circuits

**Quick Check 3**

**State whether the following statements are True or False.**

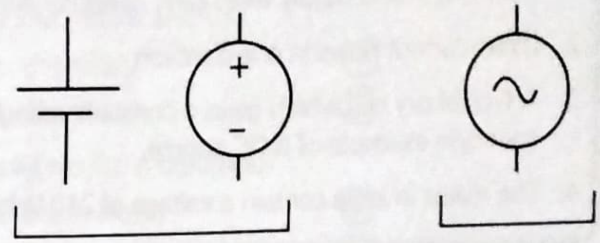
1. Human body is a conductor of electricity. ..........
2. A switch is a component which makes a circuit close or open. ..........
3. Electricity can be generated from various energy sources. ..........
4. Materials that allow electricity to pass through them are called insulators. ..........
5. Current flows only when a circuit is kept open. ..........
6. A single cell is called a battery. ..........

## ALTERNATING AND DIRECT CURRENT

Electric current can be of two types: direct and alternating. A **direct current** (DC) is a current that flows only in one direction with a constant magnitude at all times. A typical dry cell which gives a constant voltage of 1.5 volts, is the most common example of a DC source.

An **alternating current** (AC), on the other hand, is a current whose magnitude and the direction of flow do not remain constant at all times, rather vary periodically with time. The mains supply in India is of 220 volt AC and has a frequency of 50 hertz, which means that its direction changes 50 times in one second. Almost all the appliances at home work on AC voltage, for example fans, bulbs, tube lights, air conditioner, etc. Some of the devices like toys, laptops, mobiles, flashlights (torches) work on DC.

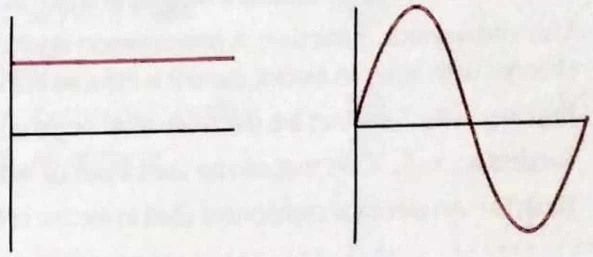
All home appliances use AC voltage because it is easy and cheap to generate and transport it to longer distances as compared to DC voltage.




a. DC Voltage circuit symbol

b. AC Voltage circuit symbol

**Fig. 7.18** Symbols to show voltage



a. Direct current

b. Alternating current

**Fig. 7.19** Direct and alternating current

| Direct Current | Alternating Current |
|---|---|
| 1. The magnitude of the current remains constant with time. | 1. The magnitude of the current varies with time. |
| 2. The current flows only in one direction throughout. | 2. It reverses its direction after a fixed interval of time. |
| 3. The direct current has zero frequency. | 3. The frequency of the AC is 50 Hz in India. |
| 4. It can be obtained from cells or batteries. | 4. It is obtained from the AC mains supply and generators. |

**INFO HUB**

The main supply of electricity enters the houses through live wire. The maximum voltage that the mains wire carry is 220 volts. This voltage is so high that it can prove fatal. So, one should always take precautions while handling electrical switches.

## Quick Check 4

**State whether the following statements are True or False.**

1. Electricity mains supply wires carry direct current. ..............
2. Direct current flows in one direction. ..............
3. A typical dry cell which gives a constant voltage of 1.5 volts is the most common example of a DC source. ..............
4. The mains in India contain a voltage of 210 Volts AC. ..............

## KEY TERMS

**Magnetic field:** Space around a magnet in which its influence can be felt

**Electromagnetic induction:** A phenomenon in which whenever a magnetic field linked with a circuit changes with time, an electric current is induced in the circuit

**Primary cells:** Cells that are discarded after single use

**Secondary cells:** Cells that can be used again by recharging them

**Resistor:** An electrical component used in electric circuit to reduce current flow

## QUICK NOTES

* The force which a magnet exerts on the surrounding material, is known as the magnetic force.
* The poles of a magnet co-exist and hence, they can never be separated.
* Like poles of a magnet repel each other, whereas the unlike poles always attract each other.
* An electromagnet is a piece of iron, generally soft iron, with an insulated copper wire wrapped around it.
* A solenoid is a tightly wound coil of insulated wire rolled in the form of a cylinder, connected to a battery from both ends.
* Most common devices that produce electricity are cells, batteries and generators.
* A cell is a device that converts chemical energy to electrical energy.
* Primary cells are the devices which produce electricity and are non-rechargeable once used completely. These cells are used in TV, radio, wrist watches and so on.
* Secondary or storage cells are used in cars, trucks and mobile phones as they are rechargeable.
* Electric circuits can be arranged in series and in parallel.

## RUN-THROUGH

### I. Very Short Answer Questions

**A. Tick (✓) the correct option.**

1. Which of the following is an example of an electromagnet?

a. Galvanometer ☐ b. Wire ☐

c. Solenoid ☐ d. None of these ☐

2. What is the SI unit of electric current?

a. Volt ☐ b. Resistor ☐

c. Ampere ☐ d. None of these ☐

3. An electric cell converts ........................ energy into electric energy.

a. heat ☐ b. chemical ☐

c. mechanical ☐ d. sound ☐

4. Which of the following situations of magnetic poles results in repulsion?

a. South-South ☐ b. South-North ☐

c. North-South ☐ d. All of these ☐

5. Which of the following is responsible for flow of current in a wire or a conductor?

a. Bulb ☐ b. Magnetic field ☐

c. Electrons ☐ d. None of these ☐

6. Which of the following is the true test for magnets?

a. Attraction ☐ b. Electromagnetism ☐

c. Repulsion ☐ d. All of these ☐

7. Which of the following is an example of insulator?

a. Copper ☐ b. Silver ☐

c. Aluminium ☐ d. None of these ☐

8. What are the materials, which do not allow electricity to pass through them called?

a. Electromagnets ☐ b. Conductors ☐

c. Insulators ☐ d. All of these ☐

9. Which of the following is correct for main supply AC voltage in India?

a. 200 V ☐ b. 210 V ☐

c. 220 V ☐ d. 250 V ☐

10. In case of dry cells, this acts as positive terminal.

a. Zinc ☐ b. Carbon rod ☐

c. Paper ☐ d. None of these ☐

**B. State True or False. Correct the false statements.**

1. Electromagnets are made using a wooden bar at the core. ☐
2. The SI unit of electric current is electron. ☐
3. We can make a battery by combining two or more than two cells. ☐
4. Dry cell is also known as primary cell. ☐
5. Electricity is used by refrigerators and televisions to work. ☐
6. In cells, chemical energy is converted into electrical energy. ☐
7. Primary cells can be recharged. ☐
8. Resistors do not let electric current to pass through them. ☐

**C. Give one example of each of the following:**

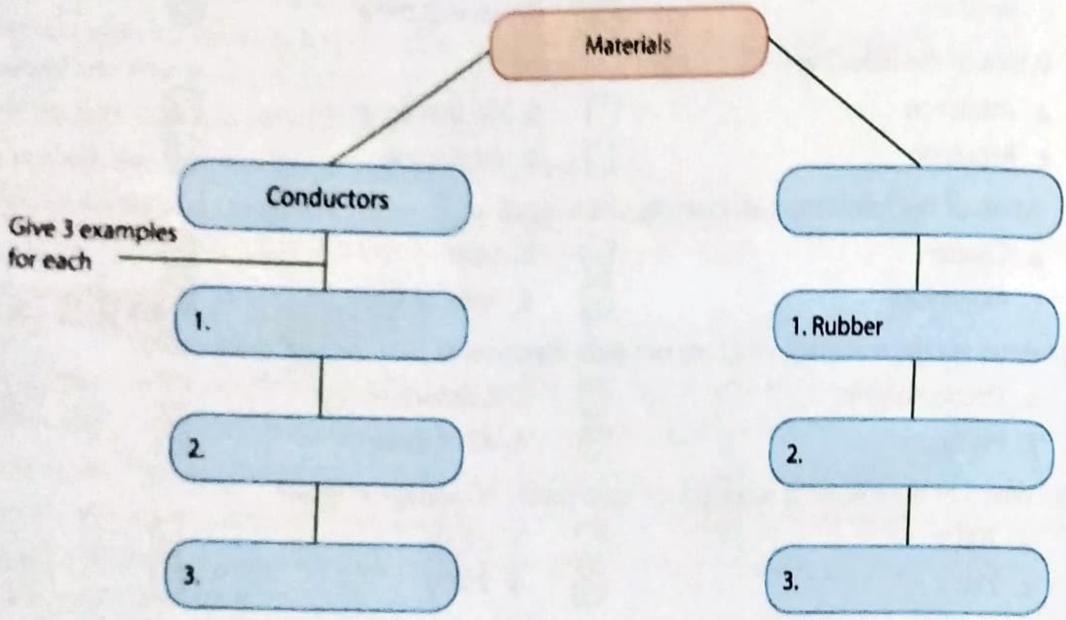
1. An electromagnet
2. An insulator
3. A conductor
4. A source of electric supply
5. Any electrical component of a circuit
6. Secondary cell

**D. Define the following:**

1. Electric current
2. Electrons
3. Battery
4. Key in a circuit
5. Gong in a bell
6. Resistor

**E. Complete the concept map.**

Flow of electricity through different types of materials.




## II. Short Answer Questions.

**A. Give reasons.**

1. Why is steel called a hard magnet?
2. Why different components in domestic circuits are joined in parallel and not in series?
3. A person should be careful while handling electrical appliances having an alternating current source of electricity.
4. Why do we use a soft iron bar to make electromagnets?
5. Electric wires have a coating of insulating material.

**B. Distinguish between:**

1. Temporary magnet and Permanent magnet
2. Alternating and Direct current
3. Open and Closed circuits
4. Circuits in Parallel and Series

C. Answer the following questions.

1. Name the branch of physics that deals with effects produced by electricity and magnetism
2. What is electromagnetic induction?
3. What are temporary magnets?
4. Name any two uses of electromagnets.
5. Name the main parts of an electric bell.
6. What is the frequency of alternating current in mains in India?

## III. Long Answer Questions.

1. What are conductors? Give examples.
2. Write a note on secondary cells.
3. How does electric current flow in wires and conductors?
4. With the help of a neat diagram, explain in detail, the construction and working of a dry cell.
5. What is the sure test for a magnet?

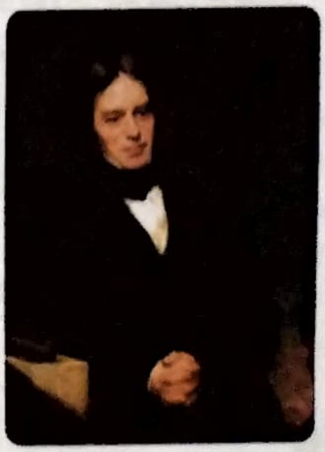
## IV. Challenge

1. Why don't we have any current flow in a circuit, if it is broken?
2. Why is it suggested not to touch or try repairing any electrical equipment or circuits with wet hands?
3. What kind of arrangement of bulbs is there in holiday/decorative light strands that we use on New Year and other special occasions?
4. How is it that decorative lights still work, even if one of the bulbs is not working in the strand?
5. What causes the flow of electricity? What is the source of electricity?
6. How many poles does a magnet have? Where is the strength of a bar magnet maximum and minimum?

## V. Enrichment

### A. Know your Scientist: Michael Faraday

Michael Faraday was a British chemist and physicist born on 22 September 1791 in London. His father was a poverty-stricken blacksmith who lived in a small village of England. Due to money constraints, he left his studies at the age of 13. He used to run errands for different people to earn money. He had also worked as a book-binder in London. He attended several lectures of Humphry Davy and later started assisting the scientist. In 1813, he was appointed as chemical assistant at the Royal Institution. In 1831, Faraday discovered the electromagnetic induction, and used the relevant principle to study the electric transformer and generator. His discovery was crucial in allowing electricity to be transformed from a curiosity into a new powerful technology. Some other discoveries of Michael Faraday include benzene and Bunsen burner. He has created the first dynamo. He was the one who coined terms like cathode, ion, anode and electrode.



Michael Faraday

Life Connect

Subject Connect