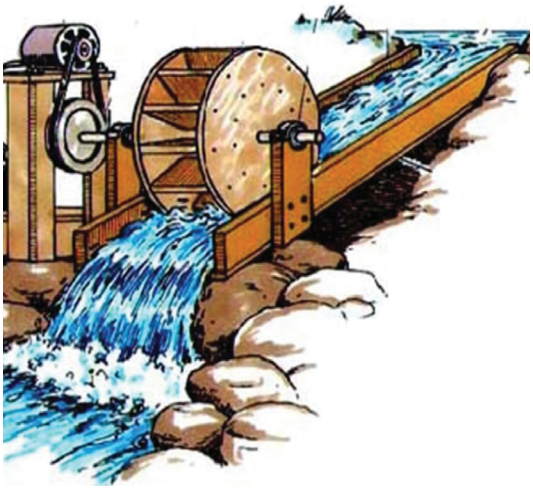
03 Generation of Electricity

From dawn to dusk, we are engaged in various tasks. Various equipment are used to carry out these tasks. As you know, most of these equipment that ease our work function by electricity.

Let us carry out Assignment 3.1 bearing in mind the facts we learnt on electricity in grade six.



Assignment 3.1

Complete Table 3.1, which gives information on electrical equipment used frequently.

Table 3.1

Name of the electrical equipment	Use	Method that electricity is supplied to the equipment
1. Clock	To know the time	Electric cells
2. Rice cooker	To cook rice	
3. Head lamp of bicycle		
4.		
5.		
6.		

3.1 Sources of electricity

Let us pay our attention to the last column of the Table 3.1. There are equipment that supply electricity for our day-to-day electrical needs. Equipment or appliances that generate electricity are called sources of electricity.

Let us carry out Activity 3.1, in the classroom as groups, to study further about the sources of electricity.

Activity 3.1

There are some sources of electricity, given in Figure 3.1, which are important to generate electricity in various occasions.

Figure :- 3.1 ▲ Various sources of electricity

- Discuss how electricity is generated in each equipment.
- Classify those sources of electricity, based on the way of generating electricity in them.
- Present the findings of your group to the class

- Electricity is generated by a chemical process in some sources of electricity. There are various chemicals in them.

e.g.:- Dry cells, simple cells, car batteries etc.

Let us do Activity 3.2 to identify the chemicals in a dry cell.

Activity 3.2

Examine the contents in a dry cell

You will need :- Some used dry cells, hacksaw blade, a pair of pliers, a sheet of paper, a pair gloves.

Method :-

- Cut a dry cell longitudinally using the hackshow blade.
- Observe the longitudinal section of the cell carefully.
- Remove the contents of the dry cell and place them separately on the sheet of paper.
- Identify the chemicals, that were in the dry cell, with the assistance of your teacher.
- Carefully dispose the chemicals, with the assistance of your teacher.

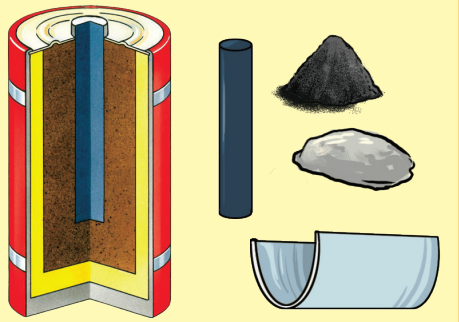


Figure :- 3.2 ▲ Contents of the dry cell

It is clear through the activity, that dry cells contain various chemicals. Thus, all the electrical cells and batteries contain chemicals.

- Some sources generate electricity by rotating or moving them.
  e.g.:- bicycle dynamo, electrical generators

Equipment that generate electricity can be grouped as given below, according to the way they generate electricity.

1. Electrical cells and batteries :- Equipment that generate electricity by a chemical reaction.
2. Dynamo :- Equipment that generate electricity by rotating or moving.
3. Solar cell :- Equipment that generate electricity by using solar energy

Cells and batteries

Generating electricity is an easy task. You can do it yourself even at home. Let us do Activity 3.3 for this.

Activity 3.3

Generating electricity using a lime fruit

You will need :-A lime fruit, a plate of copper, a plate of zinc, connecting wire, musical circuit in greeting cards or a milliammeter

Method :-

- Insert the pieces of copper sheet and zinc sheet into the lime fruit (without contacting each other).
- Connect a wire to each sheet.
- Remove the cell of the musical circuit in the greeting card, and connect the free ends of the above mentioned wires to the circuit or you can connect those wire ends to the milliammeter (copper sheet and zinc sheet should be taken as positive (+) and Negative (-) terminals, respectively)
- What can you observe?

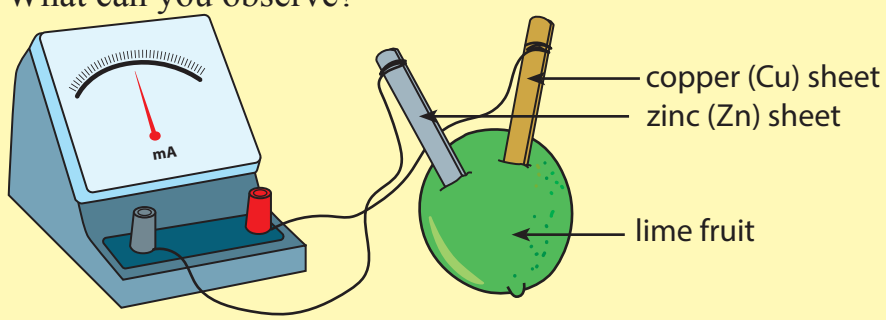


Figure :- 3.3

Now let us consider a more developed set-up.

Activity 3.4

Construction of a simple cell

You will need :- A small beaker (250 *ml*), copper and zinc sheets (3 cm x 5 cm), a torch bulb, a bulb holder, a small motor, an iron or nichrome wire which is about 30 cm long, a centre-zero ammeter, diluted sulphuric acid, few pieces of connection wire

Method :-

- Clean the copper and zinc sheets thoroughly and connect a piece of wire to one end of each sheet.
- Fill half of the beaker with diluted acid.
- Dip copper and zinc sheets into the acid without letting them come into contact with each other.
- Connect the torch bulb to the free ends of the wires and observe what happens.
- Connect the centre-zero ammeter to one end of the bulb as shown in the Figure 3.4 and observe.
- Connect the small motor instead of the bulb and observe.
- Wind the nichrome/iron wire round a plastic rod and connect this coil instead of the motor.

(Remove copper and zinc sheets from the acid and brush them before connecting each item to the set-up)

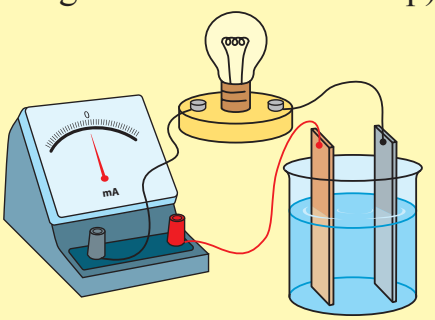


Figure 3.4

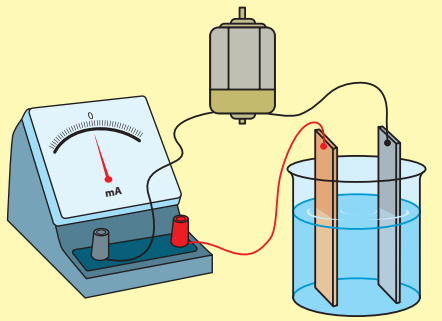


Figure 3.5

- Tabulate your observations in Table 3.2

Table 3.2

Observations when the bulb is connected	Observations when the motor is connected	Observations when the coil is connected	Observations when the ammeter is connected	Any other observations

- Constructed set-up is a simple cell.
- Illumination of the bulb and the moving of the indicator of the ammeter indicate that electricity is generated in the set-up.

Heating of the coil also indicates the flow of electrical current.

Do the Activity again using any other acid instead of diluted sulphuric acid.

For extra knowledge

Centre zero ammeter

An ammeter or a milliammeter with zero at centre, is used to detect the amount as well as the direction of electrical current, flowing through a conducter.

Ampere (A) is the standard unit to measure electrical current. The subunit, milliampere (mA) is also used to measure small current.

Activity 3.5

- Place all the simple cells, made by your groups on a table.
- Connect the copper sheet of one cell to the zinc sheet of the other and so on. Finally, you will get a set of cells connected together as shown in the Figure 3.6.
- Connect separately the torch bulb, the motor and a coil to the free wire ends (A and B) of the set of cells.
- Observe what happens and discuss reasons for your observations
- Suggest a name for this set-up.

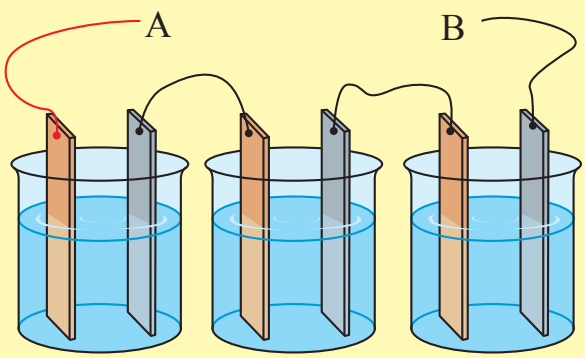


Figure :- 3.6

You will observe that the illumination of the bulb, the speed of the motor and heating effect of the coil are increased when several cells are

connected as above.

Let us make another set-up, using several dry cells.

Activity 3.6

You will need :- Four dry cells, connecting wire, a piece of card board, cellotape or rubber bands.

Method:-

- Connect four dry cells as shown in the Figure 3.7.
- Cellotape or rubber bands can be used to connect wires to dry cells
- Wrap the set of dry cells round using a piece of cardboard, to make it a handy pack.
- Take out the terminals from the pack

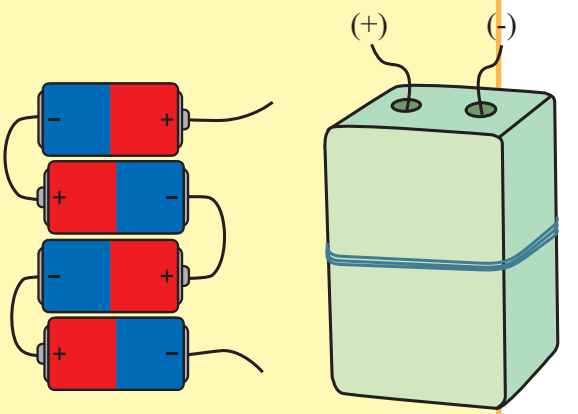


Figure :- 3.7

A setup constructed using several cells is known as a battery. More electric current can be obtained from a battery, than from a cell.

Now, can you tell the difference between a battery and a cell?

Self assesment 1

1. Mention three weaknesses of simple cells.
2. Write an advantage of a battery, compared to a cell
3. Give examples for instances when cells and batteries are used in day-to-day life.

Today, simple cells are not in use because of some weaknesses in them. Some of them are mentioned below.

- Difficulty of using them, because it contains liquids.
- Inability to obtain current for a longer period of time

Today there are cells and batteries which are easy to use and can supply more current.

For extra knowledge

Information on several types of cells and batteries, available in the market are given below.

Table 3.3 - Various types of chemical cells and batteries

Name	Material of make	Instances of uses
Dry cells 	zinc sheet, carbon rod, carbon powder and other chemicals	Electric torches, Radio sets, wall clocks etc.
Alkali cells 	Metals like nickel and cadmium, alkaline components	Telephones, cameras
Button cells 	Substances like lithium and mercury	wrist watches, calculators etc
Lead - acid accumulator (car battery) 	Lead and diluted sulphuric acid	Cars, buses, motor cycles and in rechargeable electric torches

For your special attention

Batteries and cells disposed after use, should be directed for recycling, without throwing them into the environment.

Disposed batteries and cells

Terminals of an electrical source

You may have heard that the terminals of dry cells should be connected correctly, when they are put to an electrical torch or to a toy car.

- There are terminals on an electrical source to draw out electricity
- In most electrical sources, there are two main terminals.

1. (+) ve terminal
2. (-) ve terminal

Activity 3.7

- Find various types of cells and batteries.
- Observe the data mentioned at their terminals.
- Discuss how their (+) ve and (-) ve terminals are marked.

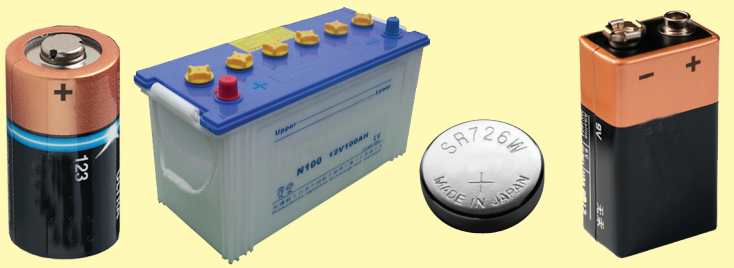


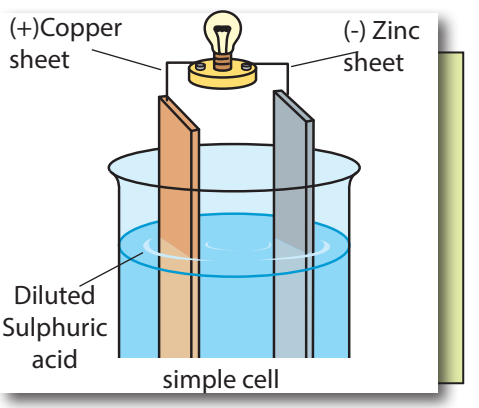
Figure :- 3.8 ▲ How the terminals of various cells and batteries are marked

Now, it may be clear to you that (+) ve and (-) ve terminals are marked in various ways on various types of cells and batteries.

It is very important that terminals of cells and batteries should be connected correctly to the electrical appliances.

For extra knowledge

Terminal on the copper sheet is considered as (+) ve and the one on zinc sheet is considered as (-) ve in a simple cell.



Standard symbol to denote a cell

Fig:- ▲ 3.9

Direction of current flowing from an electrical source

Let us connect the external wires of an electrical source to an electrical appliance (bulb).
Electric current flows from source through the wire and the appliance.
Then the appliance starts to work.

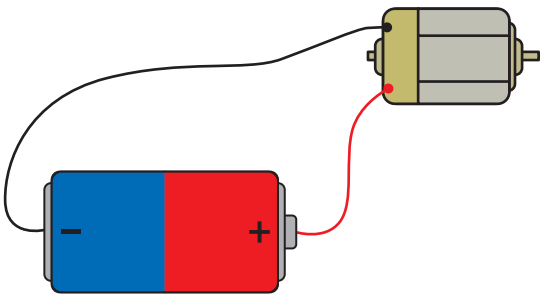


Fig:- ▲ 3.10 Running an electrical motor by electric current

Activity 3.8

You will need:- Two dry cells, pieces of wire, an electric motor, a centre-zero multimeter

Method:-

- Prepare the circuit as shown in Figure 3.11.
- Note the direction in which the motor turns, and the direction in which the indicator of milliammeter deflects.
- Change the terminals connected to the circuit and observe. Note down the observations

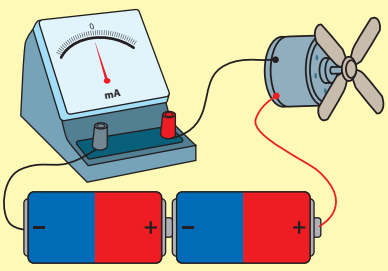


Fig:- ▲ 3.11 (a)

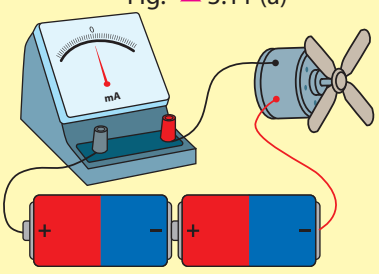


Fig:- ▲ 3.11 (b)

It is accepted that the electric current flows from the (+) ve terminal to (-) ve terminal of the source through the circuit.

When the terminals of cells are changed the direction in which the motor turns and the direction in which the indicater of milliammeter above change. The reason for this is the change of direction of current. Thus, it is clear that, there is a definite direction for the current to flow.

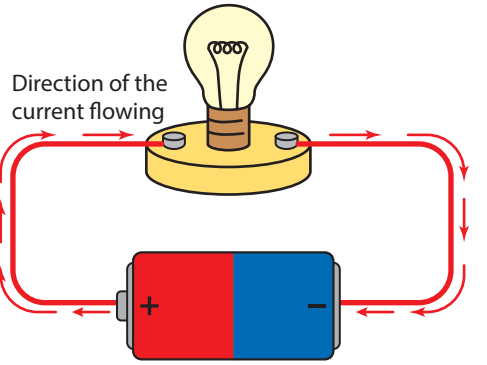


Fig:- ▲ 3.12 The direction of the current flowing from a dry cell

Solar panels

Solar energy reaches the earth as heat and light. Modern man uses solar energy for various purposes. The generation of electricity is one of those uses. Solar panel consist of several solar cells.

The equipment used to generate electricity using light, is known as a solar panel. Have you ever seen wrist watches, calculators and various toys powered with solar cells?

Let us do the Activity 3.9 to study the function of a solar cell.

Activity 3.9

Studying the function of a solar panel

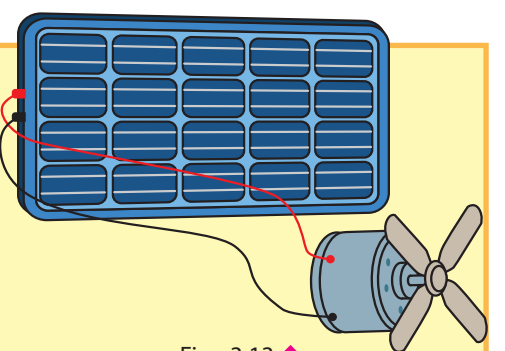


Fig:- 3.13 ▲

You will need:- A solar panel, a small Electrical motor, a torch bulb, connection wire

Method:-

- Connect the terminals of the electrical motor to the terminals of the solar panel.
- Expose the solar panel to light and observe.
- Change the terminals of the solar panel, which are connected to the motor. Observe whether the direction of turning of motor changes.
- Keep the solar panel in the dark and observe the running of motor.
- Repeat the activity using the torch bulb instead of the motor.
- Tabulate the observations.

Table 3.4

Instance	Electrical Motor	Torch bulb
When solar panel the is exposed to light		
When solar panel the is kept in dark		
When the terminals of solar panels are changed		

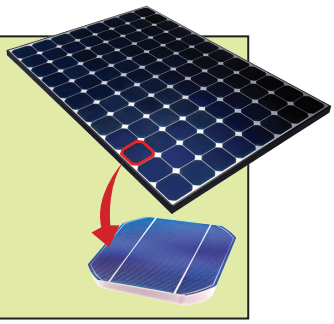
Positive (+) and negative (-) terminals are marked on solar cells also. Therefore, the terminals should be connected correctly, when solar panels are used.

Today solar panels are used for electrical needs in houses as well as in vehicles.

Electricity is generated in a solar panel, only when there is light. Electricity, thus generated should be stored in cells or batteries to use when there is no light.

For extra knowledge

Solar cells are manufactured using elements like silicon. A single solar cell can generate a minute current. Therefore a large number of solar cells should be connected together to obtain a large electrical current. Such a connection is known as a solar panel.



Dynamo

Bicycle dynamo is used in most of the bicycles to light lamps at night. Dynamo is another source, used to generate electricity.

Fig:- 3.14 ▲ How a dynamo is fixed to a bicycle

Assignment 3.2

List other instances where dynamo is used to obtain electricity, other than for bicycles.

Other than in bicycles; various types of dynamos are used in fuel-driven electric generators, hydropower stations, thermal power stations and vehicles to generate electricity.

Various types of dynamos

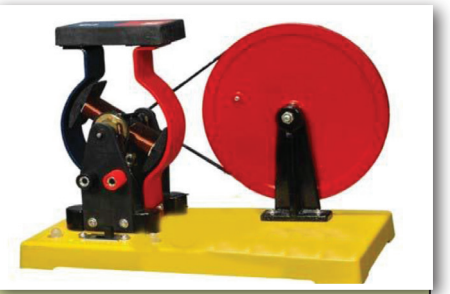
A fuel - driven electric generator

An electric generator in a hydro-power station

Fig:- ▲ 3.15

For extra knowledge

An equipment called dynamo model is used in laboratories to study about dynamos.



Dynamo model in laboratory

Let us consider how electricity is generated in a dynamo.

Activity 3.10

Identifying how electricity is generated in a dynamo

You will need:- One metre long insulated copper wire, a bar magnet, a galvanometer

Method:-

- Wind the insulated copper wire around a cylindrical tube to make a coil.
- Clean both ends of the coil well and connect them to the galvanometer.
- Move one end of the bar magnet into and out of the coil.
- Observe how the indicator of the galvanometer moves.
- Discuss the reason for the observation in the class.

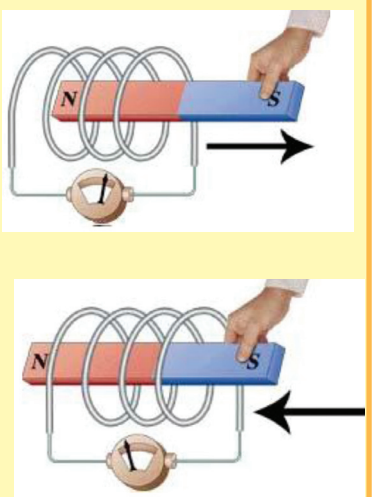


Fig:- 3.16

Generation of electricity in a conductor when magnetic field is cutting with the conductor is known as **electromagnetic induction**.

There is a conducting coil and a permanent magnet in between in a bicycle dynamo. The magnet in the dynamo rotates when the rear wheel of the bicycle rotates. Then, elecricity is generated in the conducting coil.

Thus, it will be clear to you, that electricity is generated in the bicycle dynamo, according to the principle of electromagnetic induction.

Let us carry out Activity 3.11 to study how a bicycle dynamo functions.

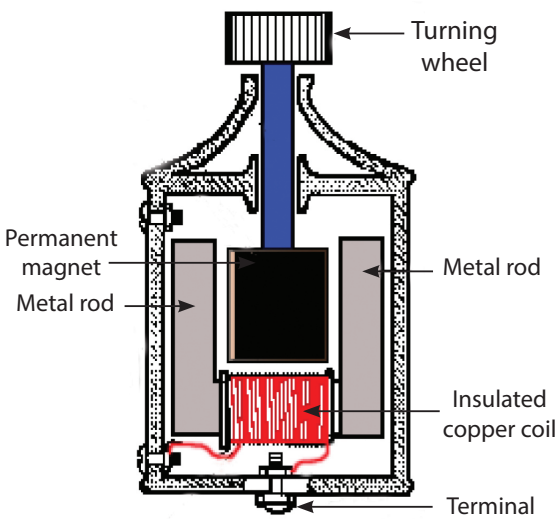


Fig:- 3.17 Inner view of a bicycle dynamo

Activity 3.11

Generation of electricity in a bicycle dynamo

You will need:- A bicycle dynamo or a laboratory dynamo model, a torch bulb, a few pieces of wire

Method:-

- Connect the torch bulb to the terminals of the dynamo.
- Turning the dynamo slowly and faster, observe the brightness of the bulb.
- Discuss the reason for the observation.

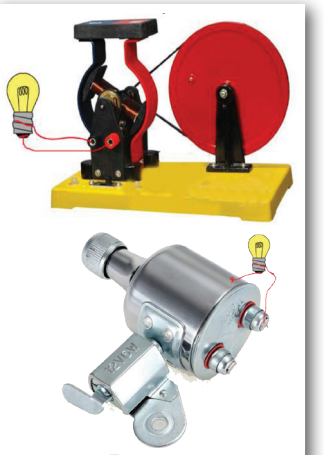


Figure 3.18

It will be clear that the amount of electricity generated increased with the rotating speed of the dynamo.

Activity 3.12

Making a simple dynamo

You will need:- About 4 m of insulated copper wire (32 SWG), a bar magnet, a large cork, about 10 pieces of iron rods (each 15 cm long), a galvanometer, cellotape, a bicycle spoke

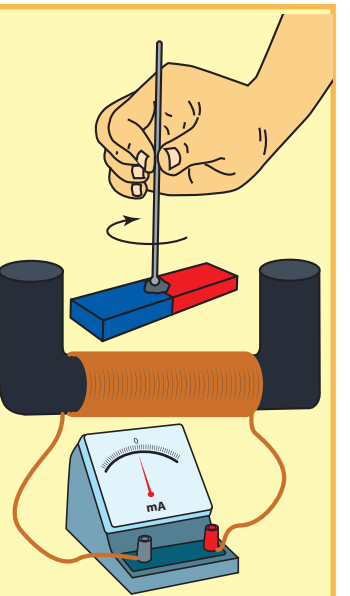


Figure 3.19

Method:-

- Bend all the 10 iron rods in U shape, where each arm is about 2 cm long.
- Keep all the bent rods in a single pile to make a bundle of them.
- Wind the insulated copper wire around the bundle of iron rods, as shown in the figure, to make a coil.
- Clean both ends of the coil and connect them to the galvanometer
- Place the bar magnet, fitted to the large piece of cork, near the coil and turn it.
- Observe the movement of the indicator of galvanometer.

What you made, is a simple dynamo. Let us consider how to develop it further.

Make the following changes in the dynamo you made.

1. Increase the number of turns of the coil. Turn the magnet and note down the amount of movement of the galvanometer indicator.
2. Use a more powerful magnet and repeat the activity.

Can you give reasons for your observations?

The efficiency of the dynamo can be increased by increasing the number of turns of the coil and the power of the magnet.

3.2 Alternating current and direct current

Electric current flows from the (+) ve terminal to the (-) ve terminal of a source.

What will happen if the (+) ve and (-) ve terminals of an electrical source are being changed constantly?

Let us do Activity 3.13 to study this.

Activity 3.13

You will need:- Two dry cells, a small fan, a bicycle dynamo, a few pieces of connecting wire, a small DC motor

Method:-

- Connect the two dry cells to the small DC motor as shown in the figure below. Fit the small fan to the motor.
- Record the observations.
- Connect the dynamo instead of the dry cells.
- Record the observations.

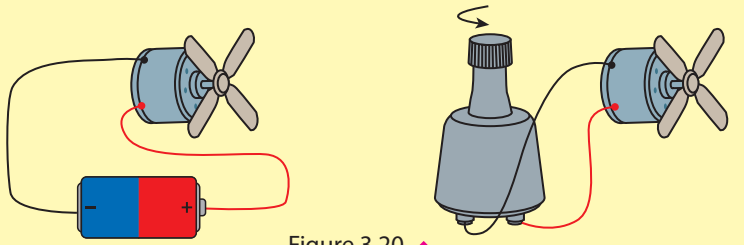


Figure 3.20

You may observe that the small fan rotates when dry cells are connected; When the dynamo is connected the fan vibrates only (does not rotate).

Activity 3.14

You will need :- Two dry cells, two LEDs of different colours, a center-zero milliammeter, a bicycle dynamo, a few pieces of connecting wire

Method:-

- Connect two LEDs and the milliammeter as shown in the figure 3.21.
- Connect two dry cells to X and Y ends as shown in the figure.
- Record the observations.
- Change the terminals of the dry cells.
- Record the new observations.
- Instead of the dry cells, connect the dynamo to X and Y ends.
- Record the observations when the dynamo is rotated.
- Discuss the conclusions that you can arrive, according to the observations.

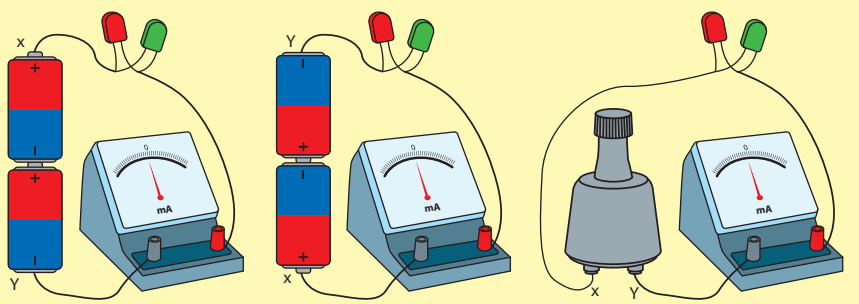


Figure 3.21

Discuss the answers for the following questions, based on the Activity 3.14.

1. Why only one LED illuminates and the indicator of milliammeter deflects only in one direction in all instances when dry cells are connected?
2. Discuss the reason, why two LEDs illuminate alternately and the direction of the movement of milliammeter indicator changes constantly, when dynamo is connected and in rotating?

The current has flown to the same direction only, when dry cells are connected. But the direction of the current has changed alternately, when dynamo is connected.

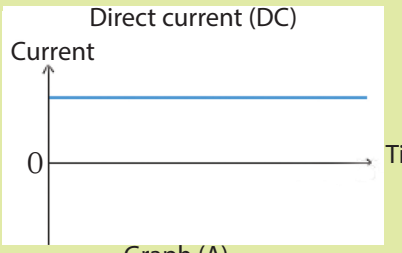
- The current that flows to one direction is known as direct current (DC)
- The current that changes the direction alternately with time is known as alternating current (AC)

A center-zero ammeter or a galvanometer can be used to identify the direction of the current.

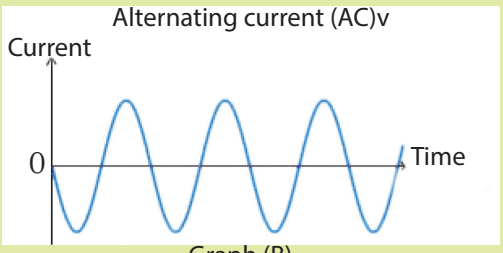
All types of electrical cells and batteries generate direct current (DC)
Most of the dynamos and electric generators generate alternating current (AC)

For extra knowledge

The pattern of the graphs, when direct current and alternating current are plotted against time are given below.



Graph (A)



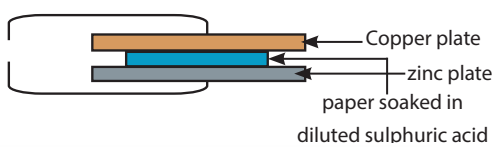
Graph (B)

Summary

- Various types of electrical sources are used in day-to- day life to obtain electricity. They can be mainly named as chemical cells (batteries), dynamos and solar cells.
- Simple cells and dry cells are examples for chemical cells.
- A battery can be constructed by connecting several chemical cells.
  e.g.:- Lead-acid battery (Car battery)
- More current can be drawn from a battery than from a single cell.
- Terminals of an electrical cell are named as (+) ve and (-) ve. Current flows from (+) ve terminal to (-) ve terminal.
- Dynamo consists of a magnet and a conducting coil.
- Current is generated in the dynamo according to the principle of electromagnetic induction.
- Various types of dynamos are used to generate electricity in motor vehicles, bicycles, electric generators and hydro-power stations.
- Electricity that flows to the same direction is known as direct current (DC) and that change direction with time is known as alternating current (AC).
- All electrical cells generate direct current. Bicycle dynamos, power stations and electrical generators generate alternating current (AC).
- Accidents due to electricity and the toxicity of diposed chemical cells to man and environment create a number of issues. Disposed chemical cells should be directed for proper recycling.

Exercise

1. A student constructed the following set-up using copper and zinc sheets of same size. A piece of paper soaked in dilute sulphuric acid was kept between a copper sheet and a zinc sheet. Pairs made thus, were placed one over the other as shown the figure above.



(I) Suggest a name for this set-up.

(II) Name the (+) ve and (-) ve terminals of this.

(III) What can be observed when a coil is connected to terminals A and B ? Give reason for the observations.

(IV) Is it a direct current or an alternating current, that can be obtained from the set-up?

(V) Describe briefly, an experiment to confirm your answer for part IV

(VI) Draw the diagram in figure above, using symbols.

2.

(I) Mention three sources of electricity that can be used to overcome present electricity crisis.

(II) Is the main electricity supplied to houses, a direct current or an alternating current?

(III) Complete the following table which is about electrical sources.

	Instance	Source	Type of current supplied	
			Direct current	Alternating current
1	Lighting the head lamp of a bicycle	Dynamo		✓
2	Wall clock working on electricity			
3	Generating electricity in a hydropower station			
4	Calculator that works when light falls on it			
5	Starting a car			

Technical Terms

Cell	-	කෝෂය	-	கலம்
Battery	-	බැටරිය	-	பற்றரி
Dynamo	-	ඩයිනමෝව	-	டைனமோ
Electric current	-	විද්‍යුත් ධාරාව	-	மின் ஓட்டம்
Electric generator	-	විදුලි ජනක යන්ත්‍රය	-	மின் பிறப்பாக்கி
Direct current (D.C)	-	සරල ධාරාව	-	நேர் மின்னோட்டம்
Alternating current (A.C)	-	ප්‍රත්‍යාවර්තක ධාරාව	-	ஆடலோட்டம்
Bulb holder	-	බල්බ හෝල්ඩරය	-	மின்குமிழ் தாங்கி
Electromagnetic induction	-	විද්‍යුත් චුම්බක ප්‍රේරණය	-	மின்காந்தத் தூண்டல்
Lines of magnetic force	-	චුම්බක බල රේඛා	-	காந்த விசைக் கோடுகள்
Solar cell	-	සූර්ය කෝෂය	-	சூரியக் கலம்
Coil	-	දඟරය	-	சுருள்