LIGHT BULBS AND ELECTRICAL CIRCUITS 10

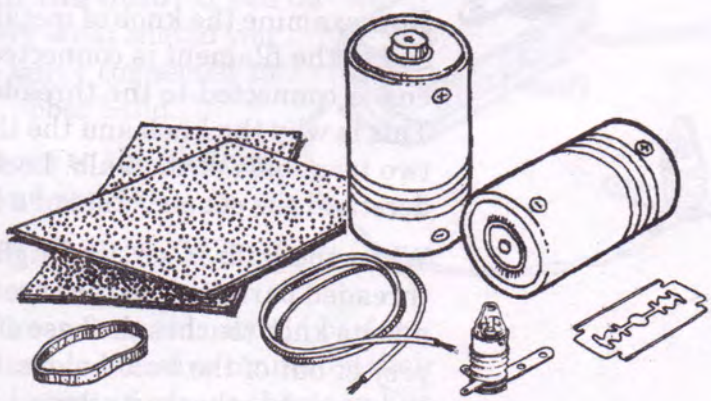
Sabiha's father was upset. He kept banging his torch on the ground, muttering to himself, "Arre, Chhuttan just put in new batteries today and this stupid torch still doesn't work."

Sabiha took the torch from her father, sat in a corner and examined it. The questions kept racing through her mind. "Perhaps, the bulb is fused," she thought as she began unscrewing the top. "Ooph, who screwed this on so tight? Hah, it's open at last. Let me check if the bulb is fused. It seems to be alright from the outside. Can there be anything wrong with the batteries? But they are new. Oh, what's this? One of the batteries has been put in the wrong way. This must be Chhuttan's doing."

Sabiha put the battery in the correct way, switched on the torch. It lit up. She gave the lit torch to her father. He was very pleased and patted her back in appreciation.

Can you also repair a torch? Do you know the correct way of placing the batteries in a torch?

You will learn this and other such things in this chapter. You will also learn answers to questions like: What is a switch? Which materials can electricity flow through? Which materials do not allow electricity to flow? You will find the answers by performing some experiments that you may find interesting. You will do more experiments with electricity in the higher classes as well.



WARNING

These experiments should only be performed with batteries used in a torch or radio. Do not, under any circumstance, make the mistake of performing these experiments with the electricity supply in your home, farm or school. Playing with the household electric supply can be extremely dangerous!

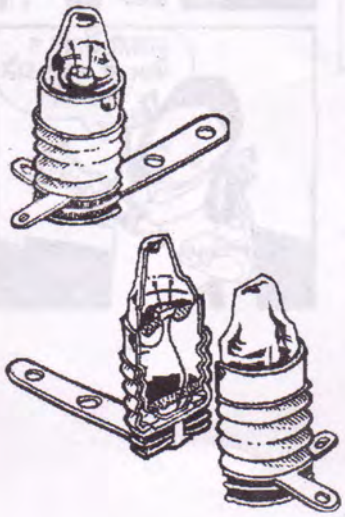


Figure 1

CONNECTING THE BULB TO THE BATTERY

EXPERIMENT 1

Take a battery, a torch bulb, a bulb holder, short lengths of electric wire and a rubber band cut from the inner tube of a bicycle. Do you know how to connect these together in a circuit so that the bulb will light? Let us do this, proceeding carefully, step by step.

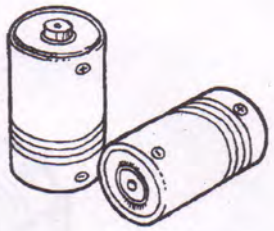
1. Clean the wire: Electric wires are often covered with plastic. First, remove about two centimetres of the plastic covering from both ends of the wire. Ensure that the naked wire is clean. If the ends are not clean, sandpaper them, or rub them on a stone or any other rough surface till they start to shine.

2. Check the bulb and bulb holder: There is a small coil or filament of very thin wire inside the bulb. Use a magnifying lens to examine it. If the coil is broken, the bulb is fused and will not light. We will need to replace such a bulb. A torch bulb is quite small but the bulbs we use in our homes are much bigger. It is much easier to see the filament in them.

Now examine the knob of metal at the base of the bulb. One end of the filament is connected to this knob and the other end is connected to the threaded metallic part of the bulb. This is why the knob and the threaded metal are called the two terminals of the bulb. Look at Figure 1 and try to understand the construction of a light bulb.

When the bulb is screwed tightly into the bulb holder, its threaded part fits into the threaded outer part of the holder and its knob touches the base of the holder. Two metal strips project out of the bulb holder. One strip is connected to its base and the other to its thread. Can you identify these strips

in Figure 1? These strips are called the terminals of the bulb holder. If the terminals of your holder are rusted, clean them with sandpaper. Then connect electric wires firmly to each terminal.



3. Identify the terminals of the battery: The battery also has two terminals. Look carefully at the small knob at the top of the battery. Is there a sign near this knob? This is the positive terminal of the battery and is indicated by a (+) sign. The flat bottom end of the battery is the negative terminal and is indicated by a (-) sign.

Protect your battery: Never connect the two terminals of a battery directly to each other with a wire. If you do so, the battery will get discharged (lose all its power) within a few minutes.

4. A simple battery holder: How will you connect wires to the battery? There is a simple way of doing this. Take an old inner tube of a bicycle and cut it into narrow bands. Each band should be wide enough to cover the knob of the battery. This is your cell (battery) holder.

Check that you have made all your preparations correctly. before proceeding further.

5. Your bulb will now light up: The two wires connected to the bulb holder should now be connected to the battery - one to its knob and the other to its flat bottom surface. Do this by carefully slipping the ends of the wires under the rubber band. Your bulb should light up. If it doesn't, clean the ends of the wires once again and make sure they are inserted properly under the rubber band. If the bulb doesn't light up even after this, consult your teacher.

6. How will you switch off the bulb? If you do not want to waste your battery what should you do? Just remove one of the wires connected to the battery from under the rubber band.

If you reverse the connections to the battery, what will happen? Try it and see. (1)

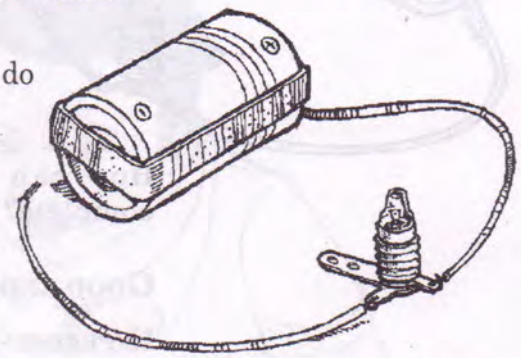


Figure-2

EXERCISE: YOU SUCCEEDED IN LIGHTING YOUR BULB.

Let us find out if you really know how this should be done. Mannu, Golu, Meena, Chhuttan and Gudiya connected their bulbs to batteries in different ways which are shown in Figure 3.

Which of these bulbs will light up and which won't? (2) Now make these connections yourself and check whether you answers are correct or not. (3)

Electrical circuit

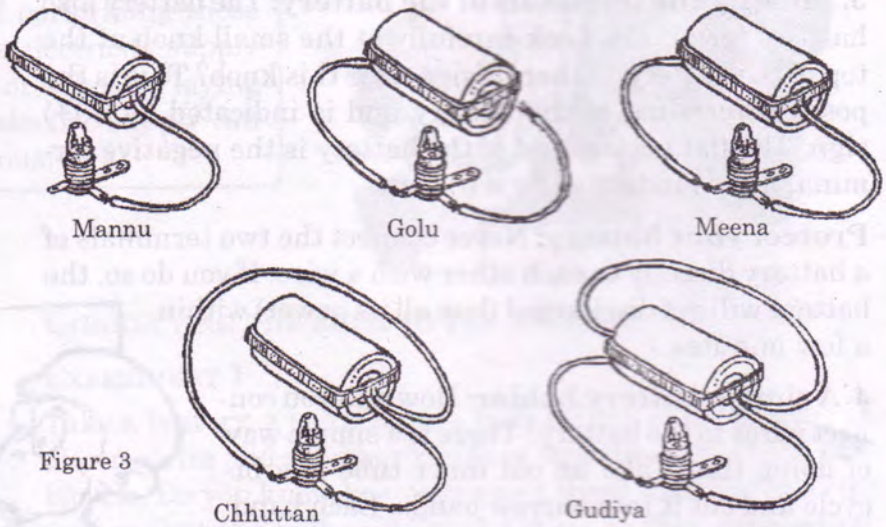
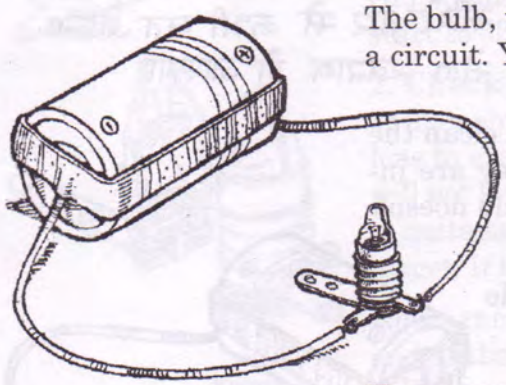


Figure 3

If a bulb lights up, this is an indication that electricity is flowing through it. But how does the electricity reach the bulb? It reaches the bulb through the wire. From the battery to the wire, from the wire to the bulb and from the bulb again to the battery through the other wire - a complete path. A complete path is necessary if electricity is to flow. The bulb, the wires and the battery make up what is called a circuit. You made a circuit to light your bulb. When electricity flows through a circuit, it is said to be a complete circuit. When electricity does not flow through a circuit, it is called an incomplete or broken circuit. For example, when you disconnected one wire from your circuit (Figure 2), it became incomplete.



Which circuits shown in Figure 3 are incomplete? (4)

How can we find out whether or not a circuit is complete? (5)

Good and bad conductors

Experiment 2

You switched off your bulb at the end of Experiment 1 by disconnecting one wire from the battery. There were two wires in the circuit then. Now connect a third wire as shown in Figure 4.

Is this circuit complete or incomplete? (6)
Will the bulb light up if the two open ends of wires are connected? Try it yourself and find out. (7)

To begin with, we will keep the ends of the wires open as shown in Figure 4. We will then connect the open ends to different materials and observe when the bulb lights up and when it does not. If the bulb lights up, the material connected to the wires is a good conductor. A good conductor offers very little resistance to the flow of electricity. That is why the bulb lights up. However, there are some materials which when placed in the circuit stop the bulb from lighting up. These materials are called bad conductors or poor conductors. These bad/poor conductors resist the flow of electricity so much that the bulb cannot light up.

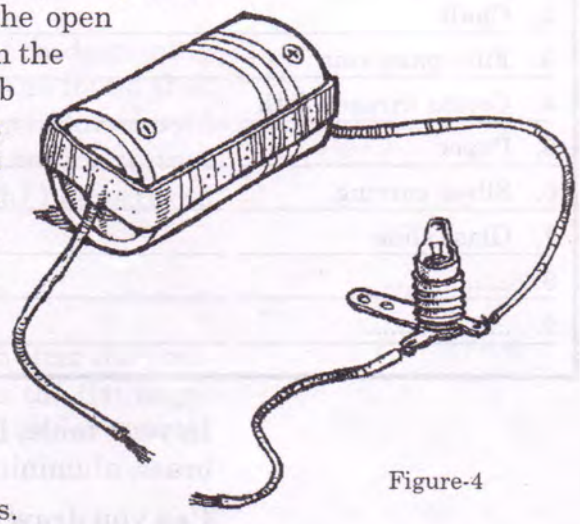


Figure-4

Let us now identify good and bad conductors.

Start with an iron nail. Place the nail between the open ends of the wires in such a manner that it touches both wires. Observe whether the bulb lights up or not. Copy Table 1 in your exercise book and note your observations in it. Show whether the nail is a good or bad conductor by placing a tick mark (✓) in the appropriate column.

Repeat this experiment with as many substances as you can find. The names of some substances are already entered in the table. Collect more substances like wood, rubber, copper wire, plastic, the tip of a screwdriver, its handle, black shellac (lac) from an electric bulb, aluminium foil, the divider from your compass box, a bit of lead from a pencil etc.

You checked whether an iron nail is a good conductor or not. Now try the same experiment with other iron objects like a pin, wire, blade etc.

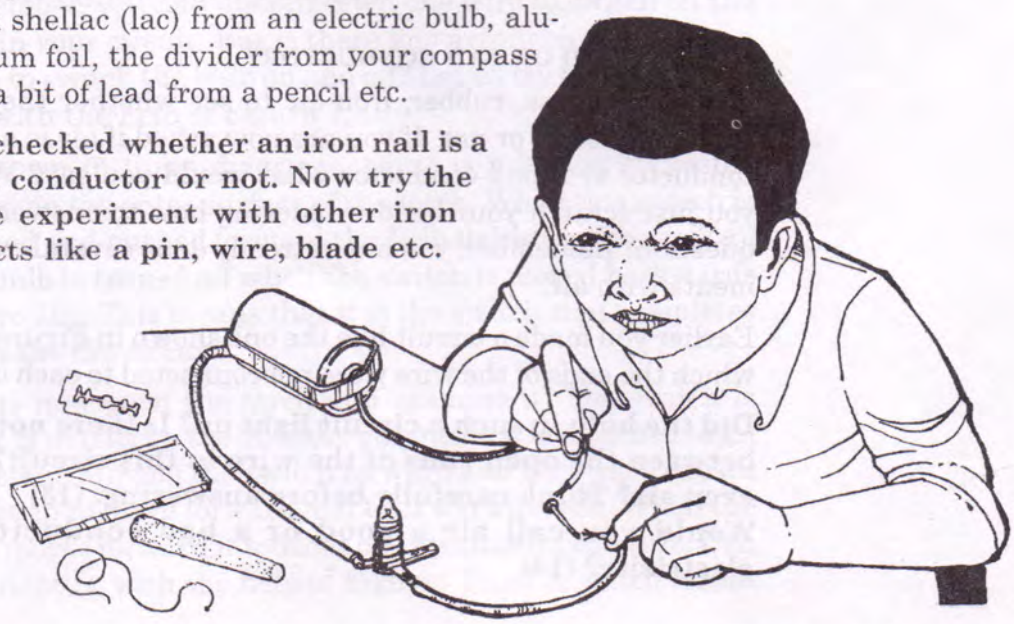


TABLE 1

No. Object	Good conductor	Bad conductor
1. Iron nail		
2. Chalk		
3. Fifty paise coin		
4. Cotton thread/Cloth		
5. Paper		
6. Silver earring		
7. Glass slide		
8.		
9.		

Do you get the same result? (8)
Now think back and explain why it was necessary to remove the plastic covering from the ends of the wire before making a circuit. (9)
Is the black lac found in a bulb a good or a bad conductor? Why is it used in the bulb? (10)

In your table, look at substances made of metal, like iron, brass, aluminium etc.

Can you draw any conclusions about metals on the basis of your observations? (11)

During Experiment 1 Sunita's group could not get their bulb to light. Sunita sought help from Soni who was sitting nearby. Soni took one look at Sunita's bulb holder and said, "Look at the amount of rust on the terminals of your bulb holder. Clean them with sand paper." Sunita did so and again connected the battery to the bulb holder. The bulb immediately lit up.

Explain in your own words why the bulb did not light when the terminals had rust on them. (12)

AIR : A GOOD OR BAD CONDUCTOR?

You tested glass, rubber, iron etc to see whether they are good conductors or not. If you are now asked if air is a good conductor or a bad conductor what would you say? Would you just scratch your head wondering how to answer that question? Remember, you have already done several experiments with air.

Earlier you made a circuit like the one shown in Figure 4, in which the ends of the wire were not connected to each other.

Did the bulb in such a circuit light up? Is there nothing between the open ends of the wire in this circuit? Not even air? Think carefully before answering. (13)
Would you call air a good or a bad conductor of electricity? (14)

Think how fortunate it is for us that air is a bad conductor. Imagine what would happen if air was not a bad conductor. List some possible dangers. (15)

THE CIRCUIT IN A TORCH

You read the story of Sabiha and Chhuttan at the beginning of this chapter. Sabiha examined the torch and found that Chhuttan had put one battery in the wrong way. How should two batteries be placed in the torch? How is the circuit from the batteries to the bulb completed in a torch? Let us try to understand this.

TORCH BATTERIES

The two batteries in a torch are placed such that the positive terminal or knob of one battery touches the flat negative terminal of the second battery (Figure 5) either directly or though another metal object.

What mistake do you think Chhuttan made?

Figure-5

Yes, he had not connected the batteries correctly. Since he had put one battery in the wrong way, its negative terminal was in contact with the negative terminal of the other battery (figure 6). That is why the torch did not light up.

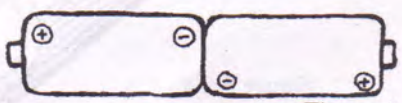


Figure-6

TORCH BUTTON OR SWITCH?

Now look carefully at the torch circuit that Sabiha made. Get hold of a torch and try to trace its internal circuit.

Remember, you had disconnected one wire to switch off the bulb in your circuit. But is there any arrangement within a torch to switch the bulb on and off? Let us try to understand this with the help of Figure 7.

As shown in these diagrams, there is a button or switch placed on the outer surface of the torch. When this switch is pressed and pushed forward the bulb lights up (Figure 7 a). The bulb is turned off when the switch is moved backwards (figure 7B). This means that it is the switch that completes or breaks the circuit.

Let us now open the torch and examine it. The switch is made of plastic on the outside, but inside it is attached to an iron strip. Moving the switch forward and backward causes this strip to move forward and backward as well. When the strip moves forward it touches one terminal of the bulb. Can you identify, with the help of Figures 7 and 8, which termi-

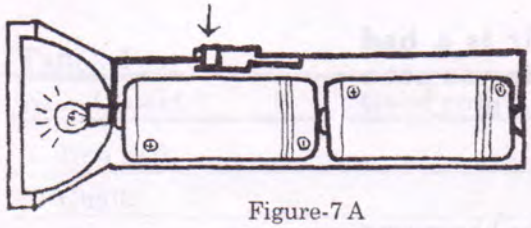


Figure-7 A

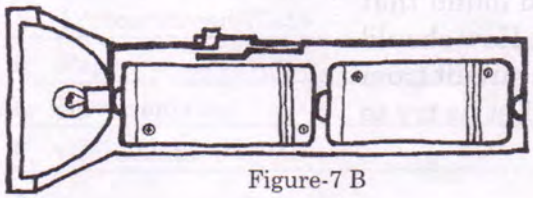


Figure-7 B

nal of the bulb the strip touches? The threaded portion or the knob?

Observe how the circuit is completed between the batteries and the bulb. When we screw the cap holding the bulb on to the body of the torch, the knob of the bulb directly touches the knob of the battery. This end of the bulb and the two batteries should press tightly against one another. To make this possible there is a thick spring in the lower cap of the torch. This spring keeps the batteries pressed against each other and the knob of the bulb. You should also notice that the wire connected to the spring goes along the side of the torch and is connected to the metal strip of the switch.

This is the circuit of the torch. When we push the switch upwards the strip moves up and touches one terminal of the bulb. When this happens the circuit is completed and the bulb lights up.

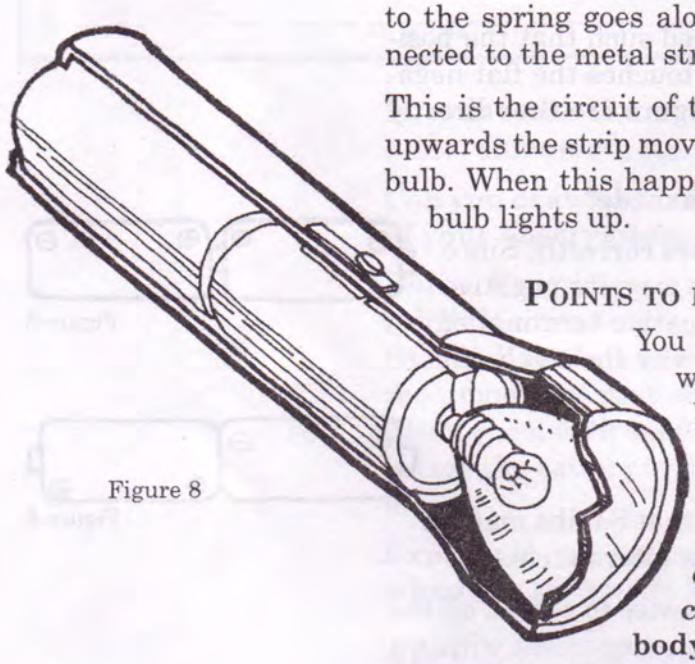


Figure 8

Points to ponder

You studied the circuit in Sabiha's torch whose body is made of plastic. But the body of Meena's torch is made of metal. There is no connecting wire from the lower cap.

How is the circuit from the bottom of the battery to the switch completed in a torch with a metal body? (16)

If you have a plastic torch, you should check to see that its construction is like Sabiha's torch. If it is not, try and find out how the circuit is completed in your torch.

What makes the bulb light up?

Have you ever thought about how a bulb gives out light? The petromax or kerosene lamp give light because of the fire burning inside them. But what happens in the coil of the bulb to cause it to glow? There is no fire there.

Lightly touch a lighted bulb. Does it feel warm?

You must have seen that a bulb which is lit for long becomes quite hot. We can barely touch its glass cover. If the glass cover itself gets so hot, imagine how hot the bulb's filament,

through which electricity is flowing, must be. Have you seen a blacksmith heating iron in his furnace? The iron becomes so hot that it gives out a reddish glow. Something similar happens in a lighted bulb. When electricity flows through the filament, the filament becomes so hot that it starts glowing and gives off light. The bulb shines brightly.

You can find out how the first bulb in the world was made from the following story.

Invention of the bulb: the story of Edison

The story of the invention of the bulb is very interesting. We may think that a bulb is a very simple gadget. Just press a switch and it lights up. But do you know that many scientists worked hard for many years before the first succesful bulb was made? The first attempts were made about a hundred and fifty years ago. By then scientists had found out that if electricity flows through a wire, the wire gets hot. Some wires become so hot that they begin to glow and give out light. But the problem was that they burnt out very quickly. It was not possible to make a bulb until this problem was solved.

This challenge was taken up by many leading scientists of the world. One of them was Thomas Edison who ultimately succeeded in making the first bulb.

Edison's life story is very interesting. He is considered one of the leading scientists and inventors of all times, but in his entire life he attended school only for three months.

From his childhood he was of an inquisitive nature and he learned science by performing experiments himself. He had an extraordinary genius for understanding a technical problem and finding a solution to it. You will be amazed to know that in his lifetime he made more than one thousand inventions.

Even a talented scientist like Edison had to work hard for many years before he could make a bulb that worked. First of all, he passed electricity through a thin, thread-like platinum wire. He noticed that the wire did give out light after being heated, but it burned out after only a few seconds. Edison then thought that if the air surrounding the wire coil was removed then, perhaps, the wire would not burn out so quickly.

He made a glass casing and fitted a filament of platinum wire in it. He then removed all the air from within the glass

casing. He passed an electric current through the wire and, to his delight, the bulb lit up and did not burn out for eight long minutes.

Edison knew he was on the right track. He began experimenting with different materials in search of a filament that would give out light for a long time and also be inexpensive.

He tried cotton thread coated with soot. This filament burned continuously for 45 hours. The result was encouraging but he felt a longer lasting filament was needed.

He tried different kinds of thread. One summer day he saw a man fanning himself with a bamboo fan and the idea came to his curious mind, "Well, why not try bamboo fibre for a filament?" He did and, amazingly, the bamboo filament burned continuously for a number of days. Finally, he succeeded in making a cotton filament that was even better than the bamboo one.

News of Edison's invention was first published in a newspaper in the United States of America in December, 1879. It caused a sensation across the whole world. Many people were not ready to believe that such a bulb could be made. But everyone was convinced after Edison demonstrated his invention in front of about 3,000 people.

Today we use the same kind of bulbs as were first made by Edison. The only difference is that our bulbs have a filament made of a metal called tungsten.

Questions for revision

1. Rahul purchased a new battery. It had a plastic seal covering its knob. Rahul placed the battery in his torch without removing the seal. Explain why Rahul's torch did not light.
2. We say a bulb is 'fused' when its filament is broken. Why does a fused bulb not light?

3. Kishan had a piece of wire. He connected one end of it to the metallic thread of a bulb and pressed the other end against the bottom of a battery. Then he pressed the bulb against the battery and the bulb lit up. Draw a picture of the arrangement in your exercise book and explain how he could complete the circuit with only one wire.
4. Explain in your own words why a bulb gives out light.

NEW WORDS

bulb holder	circuit	conductor	filament
platinum	switch	terminal	tungsten