10 Electricity

You may have used an electric torch when you are going out at night. You can get more light when using an electric torch with more cells.

You can use a line of bulbs to illuminate the environment in ceremonial occasions. In such occasions, colour bulbs can be used to increase the attraction. The bulbs illuminate because an electric source sends a flow of electrical charges through them. Such a flow of electrical charges is known as an **electric current.** The path of an electric current is called an **electric circuit.** A voltage should be supplied to a circuit for the flow of current. Voltage is supplied by an electric source.

Electric current flows only when an electrical source is connected in a closed circuit with conductors. A switch can be used to open or close a circuit when necessary.

Let us find out about making circuits using various electric components and how they work.

10.1 Various methods of connecting cells and bulbs

- **Series cell system**

Let us find out methods of illuminating a bulbs, using several 1.5 V dry cells.

Activity 10.1

You will need:- Three identical filament bulbs (6.0 V), six dry cells (1.5 V), a switch, connecting wires, a voltmeter

Method:-

- First connect one dry cell with the bulb and the switch as shown in Figure 10.1. Connect the voltmeter to measure the voltage across the bulb.

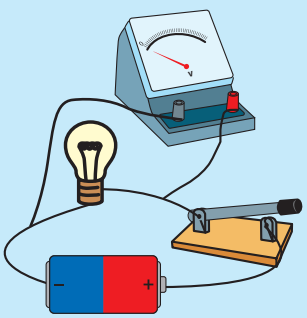


Figure 10.1

- Then connect two dry cells with the bulb and the switch as shown in Figure 10.2.

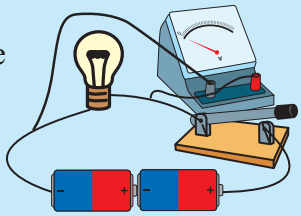


Figure 10.2

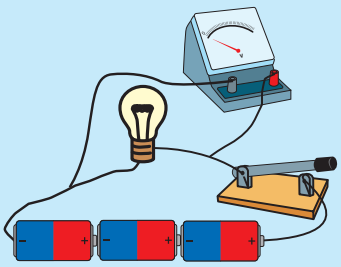


Figure 10.3

- After that connect three dry cells with the bulb and the switch as shown in Figure 10.3.
- Now close the switches of three circuits at the same time.
- Compare the brightness of the bulbs and record the voltmeter reading.
- Fill Table 10.1 according to your observation above.

Table 10.1

Occasion	Number of cells connected	Voltmeter reading	Brightness (comparatively)
Circuit in Figure 10.1			
Circuit in Figure 10.2			
Circuit in Figure 10.3			

It can be observed that the brightness of bulb increases when the cells are connected as in Figure 10.1, 10.2 and 10.3 respectively. When the number of cells are increased, the voltage is increased, hence the current is also increased.

When the required voltage for an electrical equipment cannot be supplied by a single cell, several cells are connected as in Figure 10.4.

Figure 10.4

In this connection the negative terminal of one cell is connected to the positive terminal of the next one. The negative terminal of the second cell is connected to the positive terminal of the third one and so on.

When two or more cells are connected one after the other it is called series connection.

Therefore, such a cell system is known as series cell system. Such a series cell system is known as a battery. Hence, the connection of two or more cells are known as a battery (Figure 10.4).

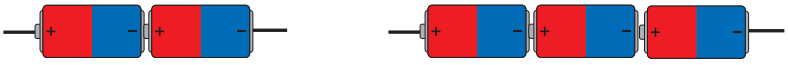


Figure 10.5 A battery of two or more cells

• Parallel cell system

Another method of connecting the cells in a cell system is shown in Figure 10.6 (a) and 10.6 (b).

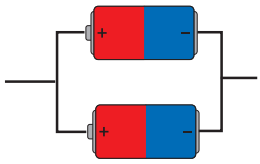


Figure 10.6 (a)

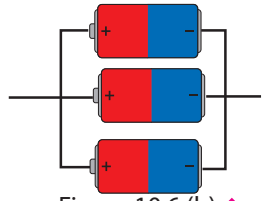


Figure 10.6 (b)

In this connection, positive terminals of all the cells are connected to one point and the negative terminals of them are connected to an another point. A connection like this is called a parallel connection. Such a cell system is known as a **parallel cell system.**

Let us do Activity 10.2 to study about parallel cell systems.

Activity 10.2

You will need:- Six dry cells (1.5 V), three identical filament bulbs (2.5 V), three switches, connecting wires

Method:-

- First, connect one dry cell with a bulb and a switch as shown in Figure 10.7.
- Close the switch and observe the brightness of the bulb.

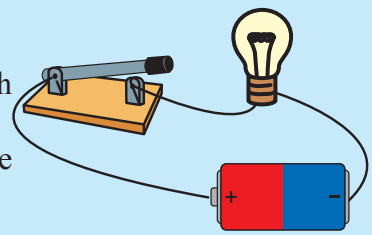


Figure 10.7

- Then, connect the cells to bulbs and switches as shown in Figure 10.8 and 10.9. Close the switches in each instance and observe the brightness of the bulbs.

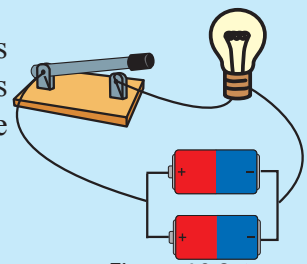


Figure 10.8

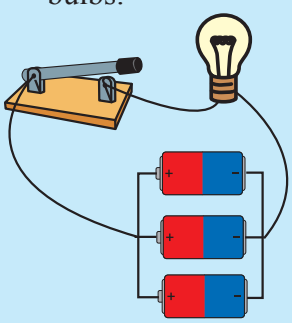


Figure 10.9

- Close the switches of the circuits as shown in Figure 10.7, 10.8 and 10.9 .
- At the same time compare the brightness of the bulbs.

The bulbs illuminate in, more or less the same brightness in all the three instances mentioned above. Thus the current flowing through the bulbs is equal. When cells are connected in this manner, each cell supplied less current. But, the collection of current supplied by cells is equal to current supplied by one cell. Therefore, bulb can be lighted for a longer time when cells are connected parallely.

When current should be supplied for a long time to an electrical equipment parallel cell systems are used.

Systems of bulbs

Two simple methods of connecting several bulbs to a circuit are given in Figure 10.10 (a and b) below.

When bulbs are connected as in Figure 10.10 (a) it is called a **series** connection. When the connection is as in Figure 10.10 (b) it is a **parallel** connection.

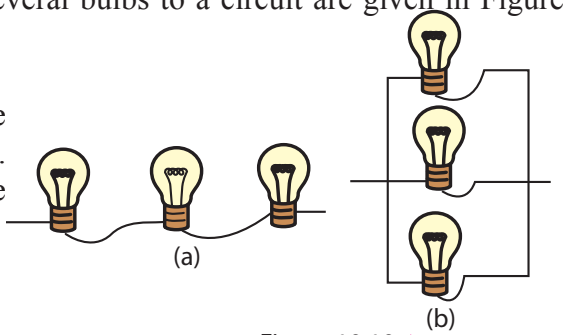


Figure 10.10

Series bulb system

Let us do Activity 10.3 to study about series bulb systems.

Activity 10.3

You will need:- Five filament bulbs (2.5 V), four dry cells, three switches, connecting wires

Method:-

- Connect one bulb with a switch and a cell as shown in Figure 10.11.

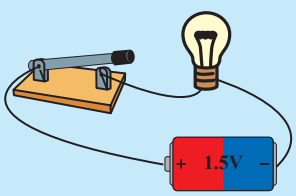


Figure 10.11

- Connect two bulbs with a switch and a cell as shown in Figure 10.12.

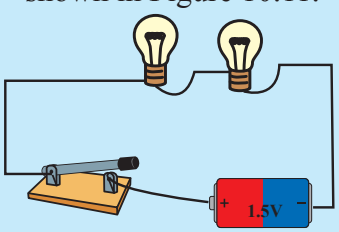


Figure 10.12

- Connect two bulbs, joined in series to a switch and two cells as shown in Figure 10.13.
- Switch on all the three circuits at the same time and observe the brightness of the bulbs.

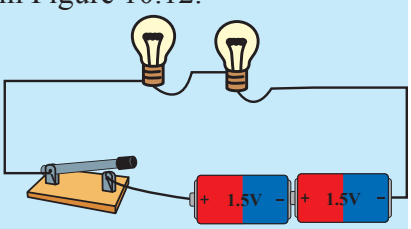


Figure 10.13

- Discuss with the teacher about the conclusion that you can come to, according to the observations.

According to Activity 10.3 it is clear that the brightness of the bulbs decreases, with the increase of bulbs connected in series across a voltage supply. But the initial brightness can be obtained by increasing the number of cells. Thus, several low voltage bulbs can be lighted from a high voltage supply, when they are connected in series.

Parallel bulb system

Let us do Activity 10.4 to study about parallel bulb systems.

Activity 10.4

You will need:- Six filament bulbs (2.5 V), three dry cells (1.5 V), three switches, connecting wires

Method:-

- First, connect one bulb to a cell and a switch as shown in Figure 10.14.

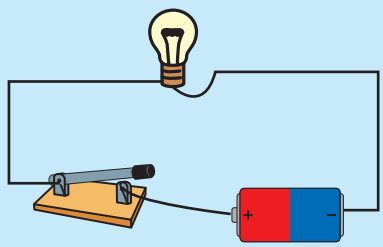


Figure 10.14

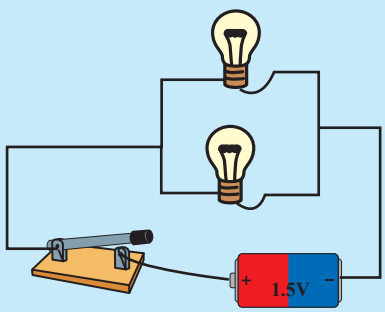


Figure 10.15

- Connect two parallelly connected bulbs to a switch and a cell as shown in Figure 10.15.
- Connect three parallelly connected bulbs to a switch and a cell as shown in Figure 10.16.

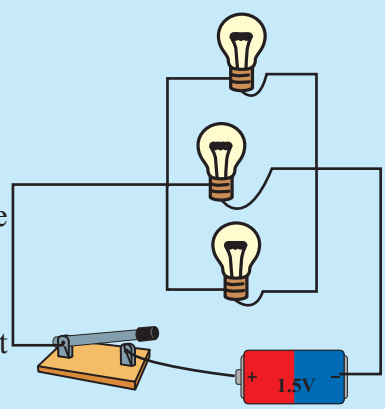


Figure 10.16

- Now switch on all the three circuits at the same time.
- Observe the brightness of the bulbs.
- Discuss with your teacher, the conclusions that you can make according to the observations.

The brightness does not change even though the number of bulbs, connected in parallel are increased. They all light in the same brightness.

10.2 Simple electric circuits

• Electric torch

Electric torch is an essential equipment when we are going in dark at night and when we are in search of something in dark.

There are electric torches with only one dry cell or with several dry cells connected in series. The Figure 10.17 shows such an electric torch.

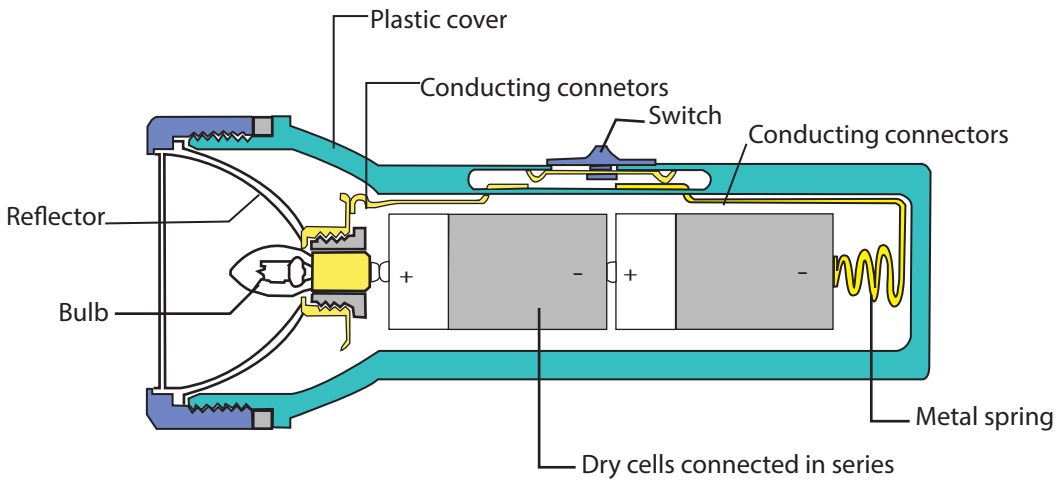


Figure 10.17 ▲ Electric torch

As shown in Figure 10.17, dry cells, bulb, metal spring and conducting connectors of this torch are connected with each other. But the circuit is opened because of the switch. Therefore, the bulb does not light. When the switch is pushed forward, the gap between the conducting connecters is closed and the bulb lights.

Assignment 10.1

- Using the circuit symbols for bulb, electric cell, switch and connecting wires, draw the circuit diagram for electric torch in Figure 10.17.
- Explain the advantages of using a reflector in an electric torch.

• Light decoration

You may have seen that light decorations are used to decorate various ceremonial occasions.

Let us do Activity 10.5 to make a light decorating circuit.

Activity 10.5

You will need:- Power supply (6 V) or four dry cells, six colour LEDs (two red, two blue and two green), connecting wires, copper strips

Method:-

- Draw a diagram for the circuit shown in Figure 10.18. Indicate where the switches should be connected to light blue LEDs, only red LEDs, only green LEDs, and both blue and green LEDs at the same time.
- Make the circuit on a board. Take all switches to one place of the board. Supply power to the circuit.
- By opening and closing the switches, try to build a simple pandol.

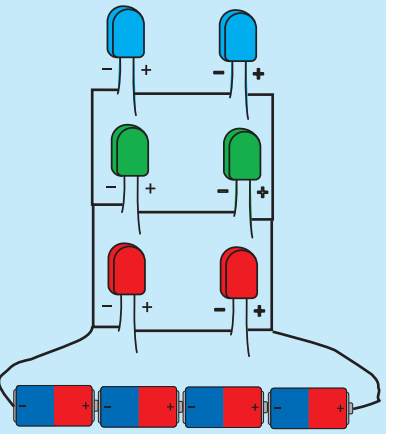


Figure 10.18

Assignment 10.2

- Make some light decorating circuits using dry cells, LEDs, switches and connecting wires. Get the assistance of your teacher for this.

10.3 Current controlling components

In various occasions it is necessary to control the current, flowing through an electric circuit. There are several components that can be used for this purpose. We can use those components according to the situation. Let us consider, how some of such components can be used.

Switches / Keys

Switches or keys are used to let an electric current flow through a circuit when necessary, and to stop it when unnecessary. There are various types of keys. Some simple keys are mentioned below.

Tap key

Diagram of a Tap key is shown in Figure 10.19 (a). P and Q are the terminals connected to the circuit. When the B end of the metal strip is pressed with your finger, X and Y ends contact each other. Then, the circuit between P and Q is completed. When the finger is released B end of the AB metal strip lifts up as a spring. Hence, circuit is disconnected.

This is called one-way tap key because it is used to let the current to flow one direction.

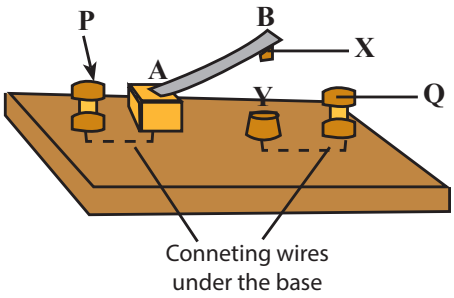


Figure 10.19 (a) ▲ Tap key

Plug key

Diagram of a Plug key is shown in Figure 10.19 (b). P and Q are the terminals connected to the circuit. There is a gap between the metal blocks made of brass. When the plug rod is inserted into the hole between the gap, the circuit is closed. When the plug rod is removed, circuit is disconnected.

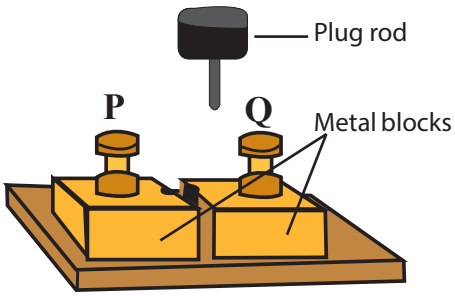


Figure 10.19 (b) ▲ Plug key

Permanent resistors

Obstacle to flow an electric current through a conductor is called the **resistance**. Components that have the property of resistance are known as **resistors**.

Copper wires are used to connect circuits because their resistance is very low. Resistance of wires made of nichrome and manganin is very high. Therefore, wires made of metals like nichrome and manganin are used to make resistors.

There are resistors made to certain fixed values in the laboratory. They are known as **fixed resistors**.

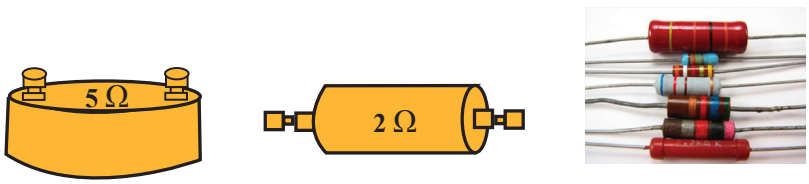


Figure 10.20 ▲ Serveral types of fixed resistors

Every electric component has an exact resistance value. Therefore, they also can be considered as permanent resistors.

Activity 10.6

You will need:- A permanent resistor of 2 Ω, a permanent resistor of 5 Ω, a Filament bulb of 2.5 V, two dry cells, an ammeter or milliammeter, a switch, connecting wires

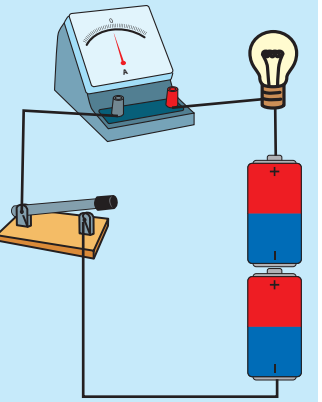


Figure 10.21

Method:-

- Connect the bulb, the switch, the ammeter or milliammeter and dry cells as shown in Figure 10.21.
- Close the switch and record the ammeter reading. Observe the brightness of the bulb also.
- Then, connect the extra fixed resistor of 2 Ω to this circuit as shown in Figure 10.22.

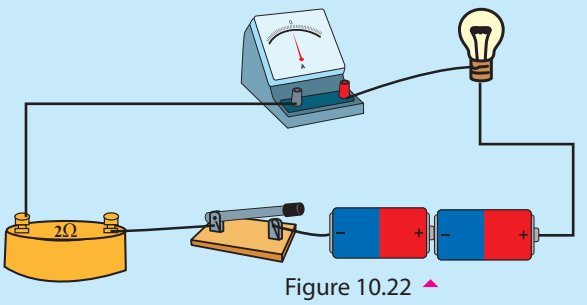


Figure 10.22

- Close the switch, observe the brightness of the bulb and record the ammeter reading.
- Open the switch of the circuit shown in Figure 10.22 and replace the fixed resistor of 5 Ω instead of 2 Ω resistor
- Close the switch again. Then, observe the brightness of the bulb and record the ammeter reading.
- Complete Table 10.2 according to the observations you made

Table 10.2

Instance	Brightness of the bulb	Ammeter reading
Without permanent resistor		
With permanent resistor of 2 Ω		
With permanent resistor of 5 Ω		

- What is the conclusion that you can make according to your observations?

When an extra resistor is connected to an electric circuit, electrical current flowing through is reduced. When the resistance of the circuit increased further current flowing decreases. Therefore, it is clear that the current flowing through a circuit can be reduced by connecting fixed resistors to increase the resistance.

Variable resistor

The above mentioned fixed resistor has a definite resistance. There are resistors made by connecting several resistors to vary the current flowing through a circuit. They are called variable resistors. Figure 10.23 shows such a variable resistor.

Figure 10.23 ▲ Variable resistor

Activity 10.7

You will need:- A Filament bulb, two dry cells, a switch, a milliammeter, a variable resistor, connecting wires

Method:-

- Connect the bulb, the switch, the dry cells, the milliammeter and the variable resistor as shown in Figure 10.24.
- Turn the adjustable key of the variable resistor to the maximum value.
- Close the switch and let the current flow through the circuit.
- Observe the brightness of the bulb and record the milliammeter reading.
- Shift the adjustable key of the variable resistor to decreasing resistance values. Observe how the brightness of the bulb and the milliammeter reading change.

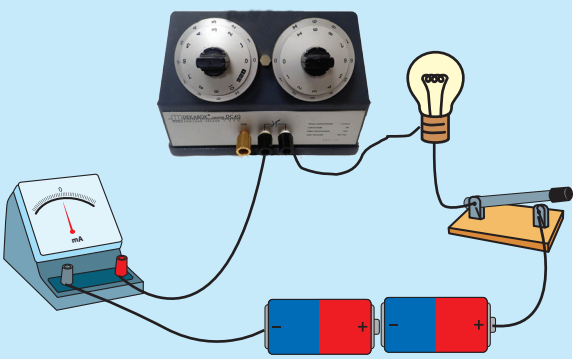


Figure 10.24 ▲

According to the observations of Activity 10.7, current flowing through the circuit decreases when the resistance is increased.

Rheostat

It is revealed in the activity above, that the current flowing through a circuit can be changed using a variable resistor.

But the electic current can not be changed to a definite value that we require, using a variable resistor.

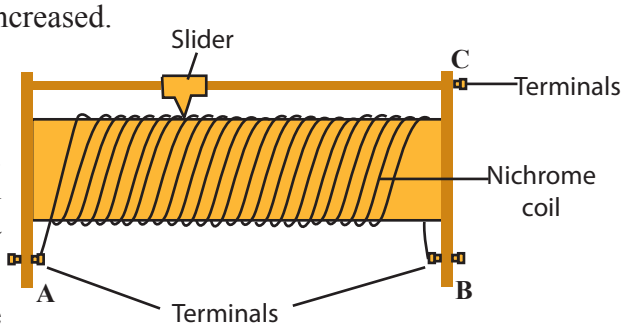


Figure 10.25 ▲ Rheostat

But the current can be changed to a value that we require using a rheostat. Such a rheostat is shown in Figure 10.25.

This is connected to the circuit by the terminals A and C or B and C. Necessary value of the resistance can be adjusted by moving the slider.

Activity 10.8

You will need:- A rheostat, a filament bulb, two dry cells or any other current supply, a switch, an ammeter or a milliammeter, connecting wires

Method:-

- Connect the bulb, the rheostat, the switch, the milliammeter and the cells to construct the circuit as shown in Figure 10.26.
- Close the switch. The bulb illuminates and the milliammeter shows the reading relevant to the current flow.

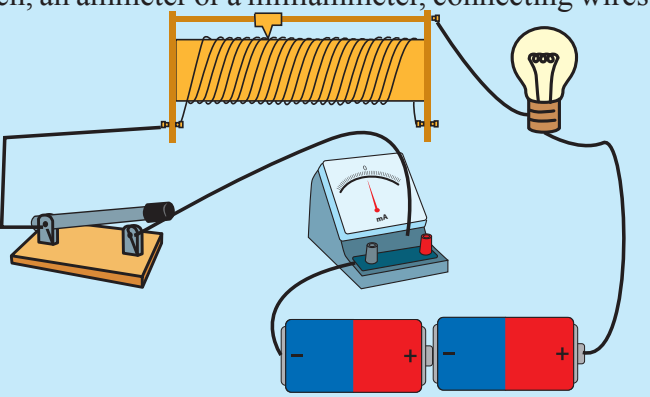


Figure 10.26

- Then, shift the slider of the rhesotat to and fro. You can observe the change of the brightness of the bulb and milliammeter reading.
- Now, shift the slider of the rheostat to read the values of current you selected, in milliammeter (such as 100 mA, 200 mA, 500 mA)
- According to this activity, it is clear that the current flowing through a circuit can be changed to our requirement using a rheostat.

Light dependent resistor

There are resistors that change their resistance when light falls on them. The resistance changes with the change of light intensity. Such resistors are known as **Light dependent resistors (LDR).**

Figure 10.27 shows light dependent resistor.

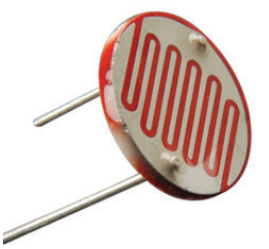


Figure 10.27 Light dependent Resistor

Activity 10.9

You will need:- A light dependent resistor, a filament bulb, a milliammeter, two dry cells (1.5V), a switch, an electric torch

Method:-

- Construct the circuit connecting the bulb, the milliammeter, the light depentent resistor, the switch and the dry cells as shown in Figure 10.28.
- First, cover the light dependent resistor, so that no light falls on it. Record the observations.

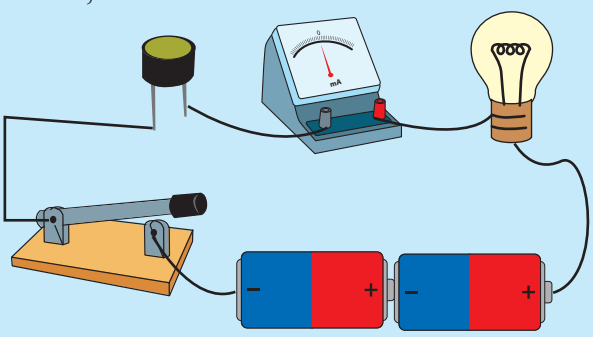


Figure 10.28

- Then, remove the cover and let light in the environment falls on the light dependent resistor. Record the observations.
- Next, light the electric torch and direct its light on the light dependent resistor. Record the observations.
- Discuss the reasons for your observations.

When light falls on a light dependent resistor its resistance decreases. Therefore, current flowing through the circuit increases.

When the intensity of light falling increases, the resistance decreases. Therefore, current flowing through the circuit increases further.

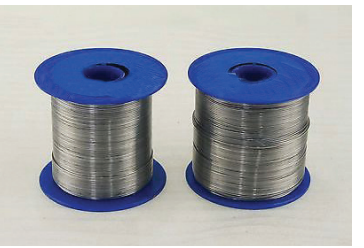
Hence, the light dependent resistor can be used to control the electric current flowing through a circuit.

Soldering tools

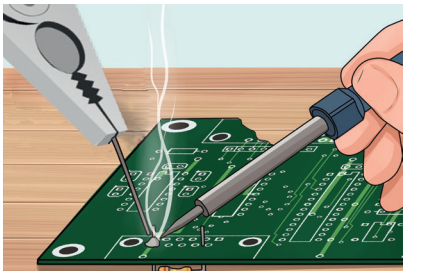
Have you ever constructed an electrical circuit? In those instances what is the method you used to connect the components to the circuit. Most probably you may have used a type of adhesive tape. Sometimes the joints are not properly contacted when adhesive tapes are used. Then, the circuit does not work properly. As a solution to those problems, the joints are soldered when componets of circuits are assembled.

Let us find out how this soldering is done. A tool, shown in Figure 10.29 (a) is used for this purpose. When electricity is supplied the tip of this tool gets heated. So, the melted soldering lead is applied to the joints of the circuit. Then joints are firmly connected by soldering lead and are not disconnected.

(a) Soldering tool (Electric bouth)



(b) Soldering lead



(c) Soldering

Figure 10.29 ▲ How soldering is done

For your attention

The tip of the soldering tool gets highly heated, the things close-by may burn. Therefore, soldering tool should not be kept on things that are damaged by heat. So this equipment should be carefully handled.

10.4 Household electrical appliances

Electricity is very important for various day-to-day work. Electricity is one of the ways used to gain energy. Electrically powered equipment can be used to ease our work and do it efficiently and economically. Those electrically powered equipment are known as **electrical appliances**.

For your attention

The voltage in volts (V) that should be supplied and the power in watts (W) of an appliance at that voltage is mentioned on it. If a voltage, higher than that is mentioned is supplied, the appliance will be damaged.

Assignment 10.3

- List out the electrical appliances used in your home and in your school.
- Tabulate those appliances according to their use.

Table 10.3

Use	Name of the appliance	Voltage (V) used	Power (W)
Lighting	1.		
	2.		
	3.		

Cooking	1.		
	2.		
	3.		
	4.		
Air conditioning	1.		
	2.		
Communication	1.		
	2.		
	3.		
Other (mention the use)			

There are some important facts that should be considered when using electrical appliances.

1. Selection of an appliance to suit the need

e.g. 1 :-When reading books at night, you can use a table lamp with a bulb of 5W/ 10W instead of 40 W bulb.

e.g. 2 :- A rice cooker of 240 V/ 700 W is suitable to cook rice for a few people, and a rice cooker of 240V/ 2000W is suitable to cook rice for a group.

The number of electrical units used, can be reduced by selecting appliances appropriately. Hence, the expenses for household electric bill can be reduced.

2. Selection of an efficient appliances

The efficiency of appliances is indicated on them. Thus it is suitable to select more efficient appliances.

e.g.:- CFL of 240 V/15 W gives an intensity of light equal to a filament bulb of 240V/ 60 W or LED of 240V/ 11W. Therefore, it is suitable to use a 240 V / 15 W of CFL or 240V/ 11W of LED instead of the other.

3. Safe usage of appliances, so that user and the others are out of danger

Some examples are given below.

e.g.1:- It is suitable to use electrical appliances away from water taps, places of leaking water, hearths and fire.

e.g.2:- Test whether the connecting wires are damaged before using the appliances.

e.g.3:- Refrain from wrong practices when connecting plug tops to plug bases.

4. Usage of household electric circuit and the appliances without damaging them

Household electric circuits may be short circuited when they are being used. Then, the circuit may fuse and the components may be damaged. Therefore, care should be taken before using electrical appliances.

It is not suitable to use several high power electrical appliances when they are connected to the same socket. For instance, when several appliances like electric iron, refrigerator, electric ovens, washing machine and grinder are connected to the same socket it draws a large current from the household electric circuit. This causes heating of the connecting wires and as a result they can catch fire. Usage of such a high current is called over loading.

10.5 Heating effect of electric current

When an electric current is flowing through a wire, electric energy is tranformed to heat. Therefore, the conducting wires get heated. This is called the **heating effect** of electric current.

Activity 10.10

You will need:- A filament bulb (2.5 V), two electric cells, a switch, connecting wires

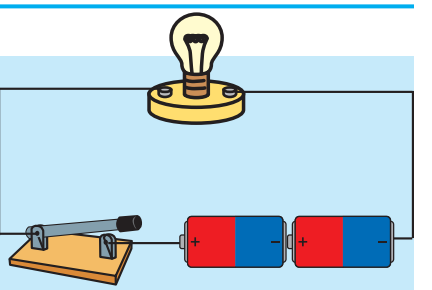


Figure 10.30

Method:-

- Connect the bulb, two electric cells and the switch as shown in Figure 10.30.
- Touch the glass cover of the bulb.
- Close the switch and let electric current flow for few seconds.
- Touch the glass cover of the bulb again. (As it is dangerous to touch an electric bulb or a part of a circuit, refrain from touching electric circuit without the teacher's instructions.)

It is felt that the bulb is heated after the flow of electricity for some time. This reveals the heating effect of current.

Activity 10.11

You will need:- A nichrome wire and a copper wire of same length (30 cm) and thickness, a piece of plank, three nails, a dry cell, a switch, connecting wires, a hammer

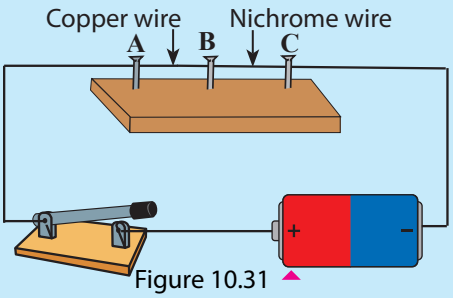


Figure 10.31

Method:-

- Fix the three nails A,B and C on the plank, keeping 30 cm gap between each other as shown in Figure 10.31.
- Tie the copper wire between A and B nails and nichrome wire between B and C nails. Both wires should be well stretched.
- Then, connect the nails A and C of the plank to the switch and the dry cell with connecting wires as shown in Figure 10.31.
- Touch the copper and nichrome wires. Then, close the switch for about one minute to allow current to flow and touch the two wires again. (As it is dangerous to touch a part of a circuit, refrain from touching electric circuits without the teacher's instructions.)
- Discuss the observations.

Here, same electric current flows through both wires. But nichrome wire is heated more than the copper wire.

For extra knowledge

Resistance of wires made of nichrome and manganese is higher than that of wires made of copper or aluminium.

Heating effect of an electric current depends on the resistance and the current flowing through a conductor.

When the resistance of the conductor is high, more heat is generated. When the current flowing through the conductor is high, more heat is generated.

Resistance of a conductor depends on the material it is made of, its length and its thickness (area of cross section).

Therefore, very thin, long nichrome wires are used in electrical appliances in which, heat is generated using heating effect of electricity. In our day-to-day life there are electrical appliances that use heating effect of electricity as well as the appliances where the same effect is disadvantageous.

Assignment 10.4

- List out some day-to-day appliances in which the heating effect of electricity is effectively used.
- Tabulate the appliances, you identified according to their use.

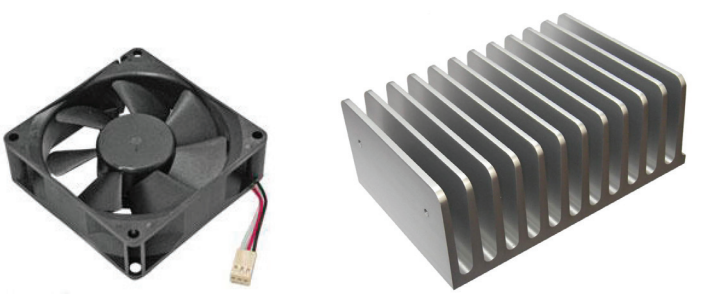
Table 10.4

Name of the appliance	Purpose

Heating effect of electricity is a disadvantage in some electrical appliances. Various methods are used to avoid damages that happen due to the heat generated in them.

e.g.:-

- Heating effect of electricity is a disadvantage in some electrical appliances such as computers. Cooling fans are used to cool such appliances.
- Heavy duty semi conductors such as transistors produce heat. Therefore, heat sink is used to cool the appliance.



Cooling fans Heat sink

Figure 10.32

For extra knowledge

Nichrome is an alloy. It is made by mixing nickel, chromium and iron.

10.6 Light effect of electric current

Junctions of most junction diodes get heated when electric current flows through them. It happens because part of the electric energy is emitted as heat energy at the junction.

In some junction diodes, part of the electric energy is emitted as light energy at the junction. Then, the junction is illuminated. Likewise part of the electric energy is emitted as light energy is known as the **light effect** of electric current. Such diodes that emit light are known as **Light emitting diodes (LED)**.

Activity 10.12

You will need:- Several LEDs of various colours (red, green, blue), a multicolour LED, connecting wires, a switch, two dry cells

Method:-

- Prepare the circuit by connecting an LED, the switch and two dry cells using connecting wire as shown in Figure 10.33.
- Close the switch and observe the LED.
- Connect each LED to the circuit and observe the colour of light emitting.

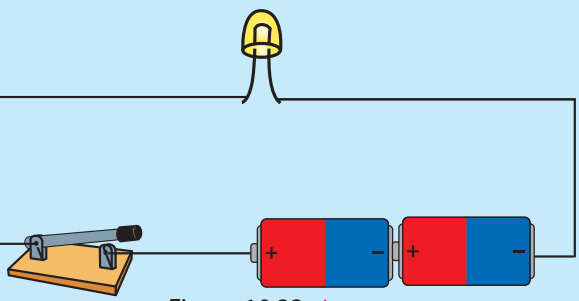


Figure 10.33

Various light emitting diodes

Light emitting diodes emit various colours of light. Colour of the light emitted depends on the compound used to make the junction of LED.

Some LEDs emit several colours. They are known as multi colour LEDs.

LEDs are used for light decorative purposes as well as indicators to show whether circuit equipments are in active mode.

There is a high demand for lamps made of LEDs than for other types of electric lamps and bulbs because of the prevailing energy crisis. The reason for this is the higher efficiency of LED lamps, than the other types of lamps.

Figure 10.34 shows an LED and its circuit symbol.

When an LED is being connected to a circuit the positive and negative terminals should be connected correctly.

There is a minimum voltage that should be supplied to an LED to light it. Voltage supplied should exceed that minimum value for the LED to light it up.

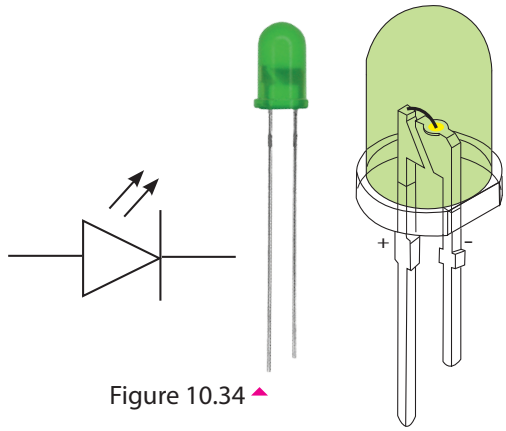


Figure 10.34

10.7 Magnetic effect of electric current

You may have seen that iron nails and pins are attracted to a magnet. Same way you can see that the indicator is deflected when a compass is brought colser to a magnet.

When a compass is kept closer to a current carrying conductor also, its indicator deflects. It happens because a magnetic field is generated by a current carrying conductor. This phenomenon is known as the **magnetic effect** of electric current. When the current flowing through the conductor is stopped, indicator of the compass returns to its initial position.

Activity 10.13

You will need:- A compass, a piece of plank 20 cm x 5 cm, two iron nails, copper wire, a dry cell, a bulb, a switch

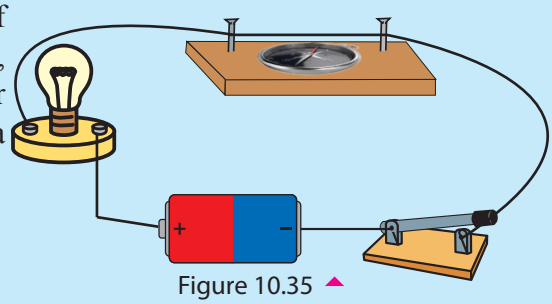


Figure 10.35

Method:-

- Fix two iron nails at the corners of the piece of plank as shown in Figure 10.35.
- Stretch well and tie the copper wire to the nails. Connect the two ends of the copper wire to the bulb to the dry cell and to the switch as shown in Figure.
- Place the compass under the stretched copper wire. Turn the wire to north-south direction of the earth. So, that the copper wire and the compass needle will be parallel to each other.

- Now, close the switch. The bulb will light and a deflection of the compass needle can be observed.
- Open the switch again. The bulb will not illumintate and the compass needle will turn back to its initial position.

It is confirmed by this activity that a magnetic field is generated by a conductor which carries current and such a conductor acts as a magnet. In the chapter about magnets, it is magnetic effect of eletricity that you used to make temporary magnets.

Activity 10.14

You will need:- Two iron nails of 10 cm length, enamal plated copper wire, two dry cells, an ammeter, a switch, some pins

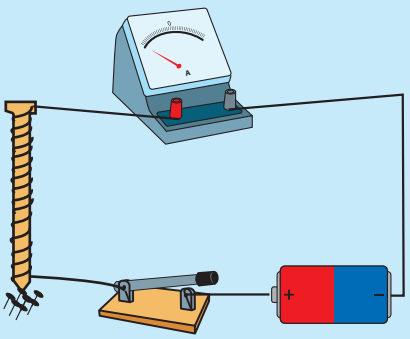


Figure 10.36

Method:-

- Make a coil by winding enamal plated copper wire round a nail.
- (Step 1) Connect the coil to the ammeter, switch and one dry cell in series as shown in Figure 10.36. Close the switch. Bring the coil close to the pins. You will find that the pins are attracted to the coil. Count the number of pins attracted and record.
- (Step 2) Open the switch and remove the iron nail from the coil carefully as shown in Figure 10.37. Then, close the switch and bring the coil closer to pins. The pins will be attracted. Count the number of pins attracted and record.
- (Step 3) Connect two dry cells in series to the circuit as shown in Figure 10.37, instead of one cell. Then, close the switch and bring the coil closer to the pins. It will be observed that the ammeter reading is increased and more pins are attracted. Count the number of pins attracted and record.

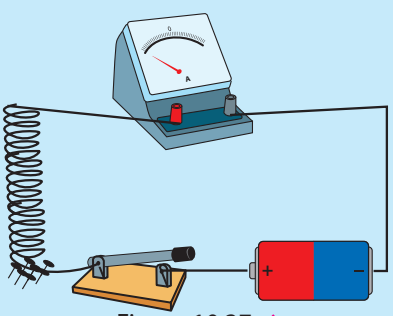


Figure 10.37

- (Step 4) Make another coil by winding more number of turns of copper wire round an iron nails as shown in Figure 10.38. Connect this coil with the nail to the circuit as before. Connect only one dry cell as shown in Figure 10.38. Close the switch and bring the nail closer to the pins. Count the number of pins attracted and record. Record the ammeter reading also.

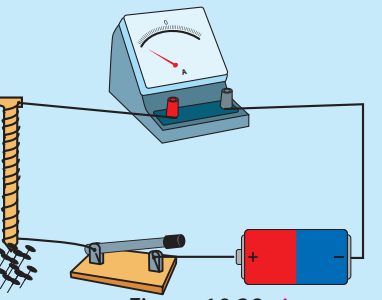


Figure 10.38

Table 10.5

Occasion	Number of pins attracted	Ammeter reading
Step 1		
Step 2		
Step 3		
Step 4		

- Identify the factors affecting the strength of an electromagnet by comparing the number of pins attracted.

According to the activity above, it is revealed that the strength of an electromagnet depends on;

- The type of core in the coil
- The electric current flowing through the coil
- The number of turns of the coil

Thus, the strength of an electromagnet;

- increases when there is a conducting medium as the core of the coil.
- increases when the electric current flowing through the coil is increased.
- increases when the number of turns of the coil is increased.

Uses of electromagnets

Have you ever dismantled any electrical appliances which are out of use? With the guidance of your teacher or an adult, do so and examine what is inside.

In some electrical appliances, electro magnets are used.

e.g.:- Electric fans, electric bells, electric grinders, electric water pumps, washing machines, some automatic switches

Electromagnets are used to separate iron from metal wastes. Such an instance is given in Figure 10.39.

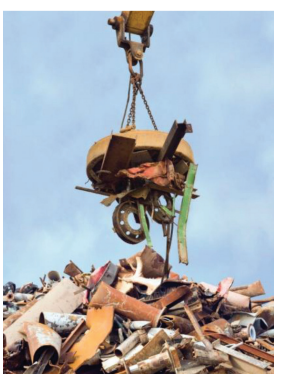


Figure 10.39
Usage of an electromagnet

Assignment 10.5

- A bell cup, a hacksaw blade, a bolt of 1 cm with a nut, metal rods of 4 cm length, enamal plated copper wire, a wooden strip to the size 12 cm x 10 cm x 1cm, Two bolts of the length of 1.5 cm, conducting wires, two dry cells, a sand paper
- Make an electric bell using the above items. Get the assistance of your teacher when necessary.

10.8 Chemical effect of electric current

You can see a gas bubbling around a piece of zinc, dipped in diluted hydrochloric acid. It happens because of the chemical reaction between zinc and hydrochloric acid.

Acidulate about 200 ml of water in a beaker with few drops of hydrochloric acid. Dip two copper plates or rods which are connected to the terminals of a dry cell into this beaker. You can see a gas bubbling near the plates. Here the electrical energy is converted to chemical energy. This phenomenon is known as the **chemical effect** of elctric current.

Activity 10.15

You will need:- A beaker of 250 ml, two dry cells, two carbon rods with metal caps taken from worn out dry cells, 150 ml of acidulated water, connecting wires

Method:-

- Clean the carbon rods using a sand paper.
- Connect two wires to the caps of cleaned carbon rods securely.
- Connect the other ends of the wires to the set of two dry cells joined in series.
- Then, dip the carbon rods in the beaker of acidulated water, as shown in Figure 10.40.
- Bubbling of a gas can be observed near the carbon rods.

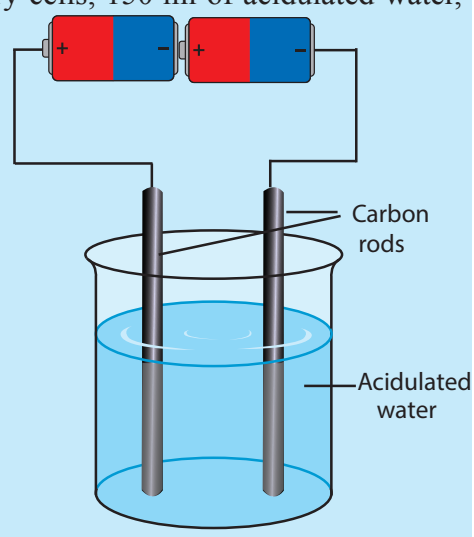


Figure 10.40

- When the dry cells are removed and both ends of the wires are connected together while the rods are still in acidulated water, no bubbling can be observed.

This activity reveals that when an electric current flows, a chemical reaction occurs at the electrodes (carbon rods).

Electroplating

A metal can be plated on metallic object, using the chemical effect of electric current. This is known as electroplating. Some examples of its usage are given below.

- Plating gold or silver on jewellery
- Plating metals like chromium or nickel on equipments like spoons, forks, knives, bath room sets made of iron to prevent rusting and to give them an attractive appearance
- Plating tin inside iron containers, used for canning food

Activity 10.16

You will need:- A beaker of 250 ml, two dry cells, 100 ml of concentrated copper sulphate solution, a cleaned copper plate of 6 cm x 1cm, an iron spoon

Method:-

- Add copper sulphate solution to the beaker.
- Connect two connecting wires to the coppper plate and iron spoon securely. Connect the free ends of the two connecting wires to a set of two dry cells joined in series.
- Then dip the copper plate and the spoon in the beaker of copper sulphate solution, at the same time.
- Observe the spoon after about 10 minutes.

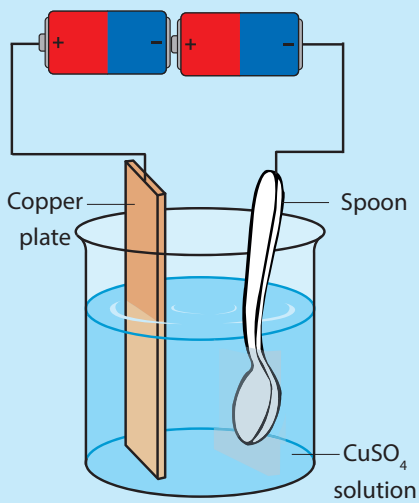


Figure 10.41

It can be seen that the part of spoon dipped in copper sulphate solution has turned copper colour. Thus, a thin layer of copper is deposited on the spoon. This is known as electroplating.

Summary

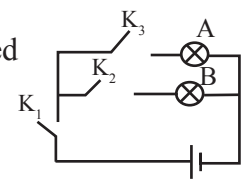
- Bulbs can be connected in series type or in parallel type in circuits.
- Cells can be connected in series or in parallel type to supply electricity to the circuits.
- There is a simple eletric circuit in the electric torch.
- Switches and resistors are current controlling components.
- Tap key and plug key are two types of switches.
- Fixed resistors, variable resistors, rheostat and light dependent resistors are also current controlling components.
- Equipments used to perform work using electricity are called electric appliances.
- Some electrical appliances use heating effect of electric current to generate heat.
- Light emitting diode is a component that use the lighting effect of electric current
- Electromagnet is a component that uses the magnetic effect of elecric current.
- The strength of an electromagnet depends on the type of core in the coil, the electric current flowing through the coil and the number of turns of the coil.
- Electroplating is an instance, where the chemical effect of electric current is used.

Exercise

Multiple choice questions

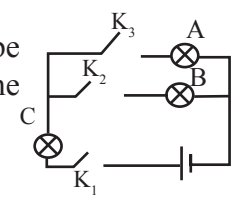
1) Select the most suitable answer.

1. What are the keys (switch) in the circuit that should be closed to light bulb A only?



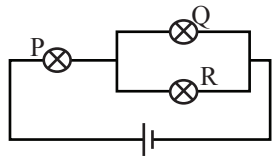
1. K_3 only
2. K_3 and K_2 only
3. K_1 and k_3 only
4. K_1, K_2 and K_3 keys

2. There are four answers about the switches that should be closed to light the bulb C in the given diagram. What is the **false** answer out of those?



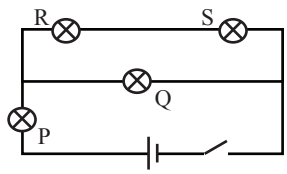
1. All the keys
2. K_1 and K_2 only
3. K_1 and K_3 only
4. K_1 only

3. P, Q and R are identical bulbs in the circuit given in the diagram. Which bulb/ bulbs give the brightest illumination?



1. Bulb P
2. Bulb Q
3. Bulb R
4. Bulbs Q and R

4. What is the correct answer about the brightness of bulbs, when circuit is closed?



1. P gives the brightest illumination.
2. Q gives the brightest illumination.
3. R and S give the brightest illuminaion.
4. Any bulb does not illuminate.

5. The equipment, that can be used to control electric current of circuit to a known value is;

1. Switch
2. Variable resistor
3. Rheostat
4. Fixed resistor

6. Which one below, is a heating effect of electric current?

1. Light emitting when an electric current is flowing through a LED.
2. Heating of the bulb, when a current is flowing through a filament bulb.
3. Heat emitting when a candle is burning.
4. Heating of a metal plate when sun light falls on it.

7. Several phenomena are given below.

A. Emission of light when electric current flows through a LED.
B. Attraction of pins to a copper coil when a current is flowing through it.
C. Flow of an electric current when sunlight falls on an LDR of a circuit.
D. Plating gold on jewellery in electroplating.

Which one above is **not** an effect of electric current?

1. A
2. B
3. C
4. D

8. When the electric current flowing through a conductor is reduced the strength of the magnetic field generated;

1. Increases
2. Decreases
3. First decreases and then increases
4. Does not change

9. What are the factors below, on which the strength of the magnetic field, generated in a current - flowing coil, depends?

A. Amount of electric current flowing
B. Type of core in the coil
C. Number of turns of the coil
D. Direction of the current flowing

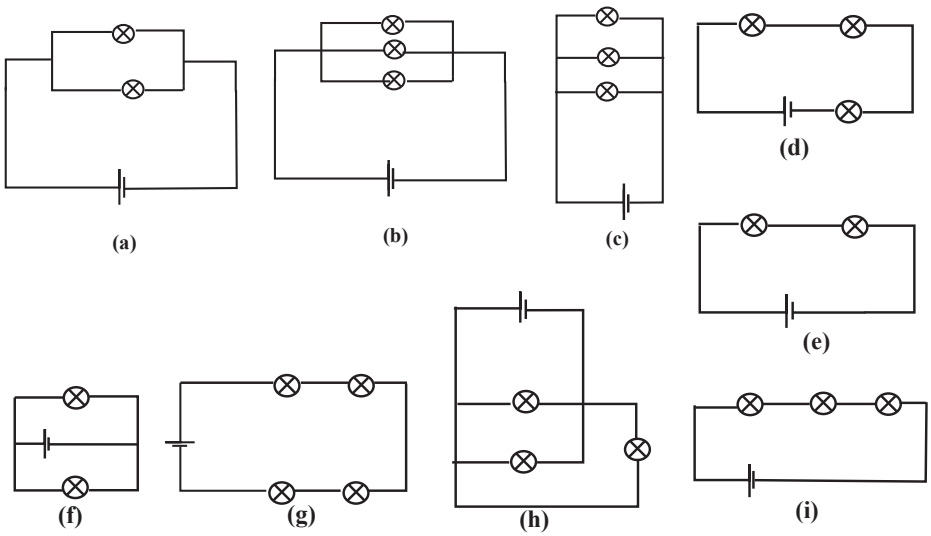
1. A and B only
2. B and C only
3. C and D only
4. A, B and C only

10. Which electrical appliance does **not** use an electromagnet?

1. Electric bell
2. Electric fan
3. Immersion heater
4. Hand drill

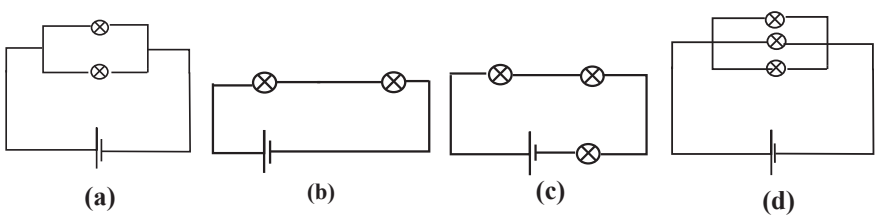
Essay questions

1) Circuits below show the different ways of connecting several bulbs with a cell.



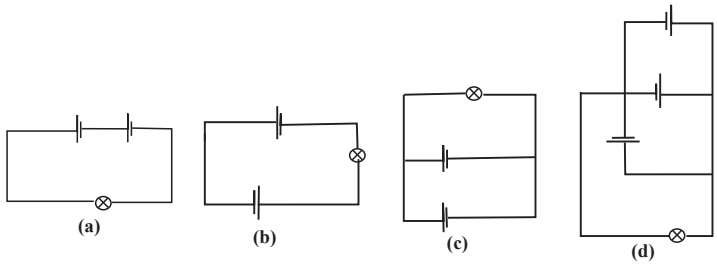
a) What are the circuits here, in which the bulbs are connected in series?
b) What are the circuits here, in which the bulbs are connected in parallel?

2) In the circuits below all the cells are identical and all the bulbs also are identical.



a) Out of those given above, in which circuits have the bulbs with maximum brightness?
b) In which circuits have the bulbs with minimum brightness?

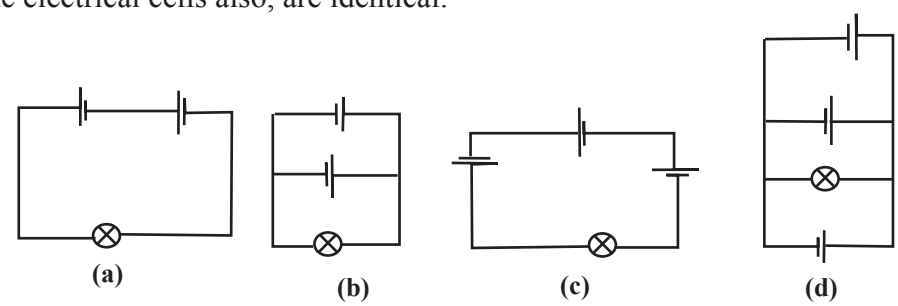
3) Circuits given below, show different ways of connecting several cells with a bulb.



a) Out of those given above, which circuit contains dry cells connected in a series manner?

b) Select the circuits in which dry cells are connected in parallel?

4) Several electric circuits are given below. All bulbs used, are identical and all the electrical cells also, are identical.



a) Which circuits have the bulbs with maximum brightness?

b) Which circuits have the bulbs with minimum brightness?

Write down the answers for the following questions.

5) What are the components, which can be used to control the electric current?

6) Explain briefly, how the electric current is controlled by a light dependent resistor in a circuit.

7) What are the points that attention should be paid when using electrical appliances?

8) i. What are the effects of electric current?

ii. State the energy transformation that occurs in each effect you mentioned.

iii. Mention one electrical appliance found in daily usage with using each effect of electric current mentioned above?

9) i. Using diagrams describe briefly, the way of making a simple electromagnet.
ii. What are the factors on which the strength of an electromagnet depends?

10) i. What are the effects of electric current used in the LED and in the filament bulb?
ii. Discuss the importance of using an LED instead of a filament bulb.

Technical Terms

Series circuit	-	ශ්‍රේණිගත පරිපථ	-	தொடர்ச்சுற்று
Parallel circuit	-	සමාන්තරගත පරිපථ	-	சமாந்தரமான சுற்று
Electrical appliance	-	විද්‍යුත් උවාරණ	-	மின்சாதனம்
Tap key	-	ටකන යතුර	-	தட்டு சாவி
Plug key	-	පේනු යතුර	-	செருகு சாவி
Resistance	-	ප්‍රතිරෝධය	-	தடை
Resistor	-	ප්‍රතිරෝධකය	-	தடையி
Rheostat	-	ධාරා නියාමකය	-	இரையோதற்று
Light dependent resistor (LDR)	-	ආලෝක සංවේදී ප්‍රතිරෝධකය	-	ஒளிஉணரித்தடையி
Compact fluorescent lamps	-	සංඝනිත ප්‍රදීපන පහන්	-	புளோரசன் விளக்கு
Short-circuit	-	පරිපථ ලුහුවත් වීම	-	மின்கசிவு
Overloading	-	අධිභරණය	-	மிகையோட்டம்
Nichrome	-	නික්‍රෝම්	-	நிக்குரோம்
Electromagnet	-	විද්‍යුත් චුම්බක	-	மின்காந்தம்
Electroplating	-	විද්‍යුත් ලෝහාලේපනය	-	மின்முலாமிடுதல்
Magnetic field	-	චුම්බක ක්ෂේත්‍රය	-	காந்தப் புலம்
Heating effect	-	තාපන ඵලය	-	வெப்ப விளைவு
Light effect	-	ප්‍රකාශ ඵලය	-	ஒளி விளைவு
Magnetic effect	-	චුම්බක ඵලය	-	காந்த விளைவு
Chemical effect	-	රසායනික ඵලය	-	இரசாயன விளைவு
Light emitting diode (LED)	-	ආලෝක විමෝචක ඩයෝඩ	-	ஒளிகாலும் இருவாயி
Electric bell	-	විදුලි සීනුව	-	மின்மாணி
Compass	-	මාලිමාව	-	திசைகாட்டி
Deflection	-	උත්ක්‍රමණය	-	திரும்பல்
Electrode	-	ඉලෙක්ට්‍රෝඩය	-	மின்வாய்
Terminal	-	අග්‍රය	-	முடிவிடம்