

# 7 Measurements Associated with Electricity



Electricity is one of the main sources of energy used in day-to-day life. Recalling what we have studied about electricity in lower grades let us do Activity 7.1.



## Activity 7.1

**You will need:-** Two dry cells, a torch bulb, a switch, a bulb holder, connecting wires

**Method:-**

- Prepare a circuit to light the torch bulb using the given items.
- Switch on your set-up and observe what happens.
- Draw the set-up you prepared using circuit symbols.
- Mention the positive and negative terminals of the cells correctly on the diagram you draw.
- Discuss the reason for the illumination of bulb.

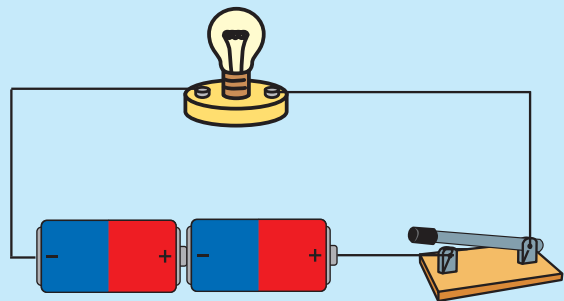


Figure 7.1 ▲

The electric current produced in the cells when the switch is closed flows through the conductors of the circuit. The bulb is illuminated because current flows through it.

Flow of electrical charges through a closed circuit is known as an electric current.

## 7.1 Electric current

Let us do Activity 7.2 to study the flow of electric current through a conductor.

## Activity 7.2

**You will need:-** Two dry cells, a switch, a small motor, connecting wires

**Method:-**

- Prepare the circuit as shown in Figure 7.2
- Connect the parts as indicated in Table 7.1 and switch on the circuit.
- Record your observations.

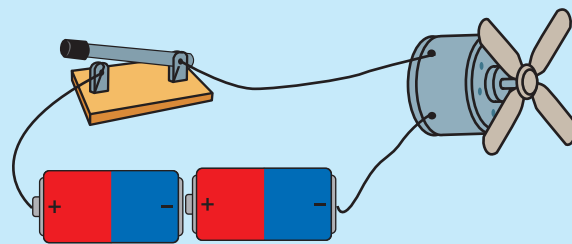


Table 7.1

Figure 7.2 ▲

Step	Observations	Observations after changing the terminals of cells
1. Connect the electric motor	It rotates to one direction	..... ...

- What happens when terminals of cells are changed?
- What can be concluded according to your observations?

The direction of the current flow, changes when the terminals of the cells are changed. The reason for the change of rotational direction of the motor is the change of the direction of current.

- There is a definite direction for the flow of electric current.
- Conventionally, it is considered that current flows from the positive terminal to the negative terminal.

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



Figure 7.3 ▲ A galvanometer



Figure 7.4 ▲ A milliammeter

Let us do Activity 7.3 to study further about the direction of current.



### Activity 7.3

**You will need:-** An ammeter or center-zero milliammeter, an electric motor, a dry cell, a switch

**Method:-**

- Prepare the circuit as in Figure 7.5.
- Operate the circuit and observe what happens.
- Inter change the terminals of the cell and observe again.
- Draw diagrams for each instance and mark the direction of the current flow.
- Discuss the reason for your observations.

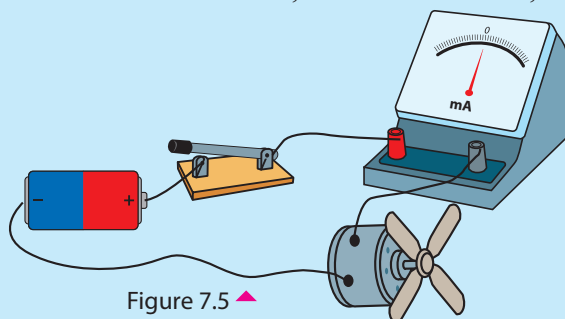


Figure 7.5 ▲

It is clear that, when changing the connecting terminals to the battery, the direction of motion of ammeter-indicator and the rotational direction of the motor are changed. The reason for this is the change of the direction of current.

### Measuring the electric current

Physical quantities are measured in various instances. For this purpose various measuring equipments and various units are used. Electric current is also a physical quantity. Let us investigate how electric current is measured.

Symbol for electric current	-	I
International unit (SI) for electric current	-	Ampere
Symbol	-	A

Sub units are used to measure small currents. Two such sub units are given below.

- Milliampere - mA
  - Microampere -  $\mu\text{A}$
- |      |               |   |      |
|------|---------------|---|------|
| 1000 | mA            | - | 1 A  |
| 1000 | $\mu\text{A}$ | - | 1 mA |

Equipment used to measure current	-	Ammeter
Symbol	-	$\text{---} \text{+} \text{A} \text{---}$

Milliammeter or microammeter can be used to measure small electric currents.

There are two terminals, positive and negative, in ammeter and milliammeter. Usually the positive terminal is red and negative terminal is black.

- When an ammeter is used in a circuit the terminals should be connected correctly.
- To measure the current, ammeter or milliammeter is connected **in series** to the circuit.



Figure 7.6 ▲ Ammeter



Figure 7.7 ▲ Milliammeter

Let us do Activity 7.4 to measure the current flowing through a circuit.



### Activity 7.4

**You will need:-** Two dry cells, six torch bulbs, bulb holders, connecting wires, switches, an ammeter, a milliammeter

**Method:-**

- Prepare the circuit as in Figure 7.8.
- Connect the milliammeter to the circuit.
- Measure the current flowing through the bulb while it is illuminating.
- Draw the circuit, to which the milliammeter is connected, using symbols.
- Connect the ammeter instead of the milliammeter and take the readings again.
- Connection of which instrument makes easier to take the readings? Is it ammeter or milliammeter?
- Discuss the reason for your answer in the classroom.

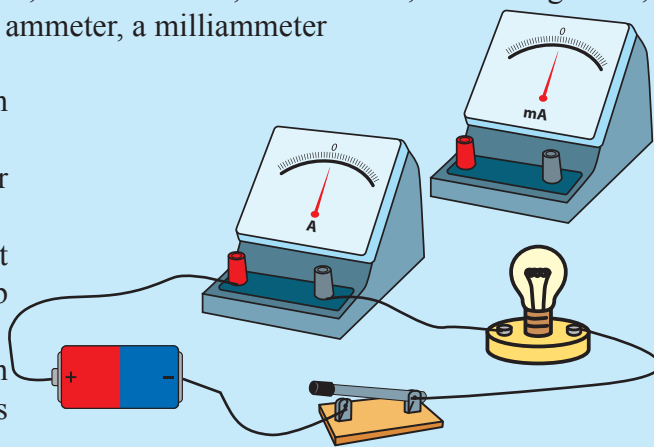


Figure 7.8 ▲

The electric current flow through the above circuit is lesser than one ampere (1A). Therefore, it is suitable to use milliammeter to measure small currents. Ammeter is suitable to measure large currents, while milliammeter is suitable to measure small currents.

Let us consider another factor, essential for flowing of electric current through a conductor.

## 7.2 Potential difference

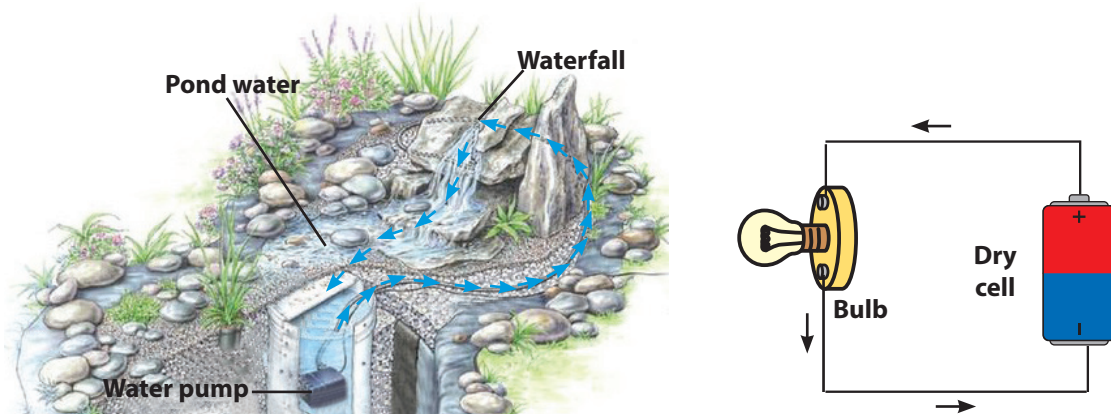


Figure 7.9 ▲

You may have seen ponds and waterfalls designed in modern houses, which function with the help of water pump. Pond water has less potential energy. But when water is pumped up to the waterfall more potential energy is stored.

The process of electric circuit takes place in the same manner. Dry cell provides electric potential energy to electric charges. At positive (+) terminal potential energy is higher than the negative (-) terminal.

This difference of electric potential energy between the two terminals of the cell is called voltage or potential difference.

Electric current flows from a higher electric potential to a lower electric potential. The voltage between positive terminal and negative terminal of electric cells and batteries is marked on them.





## Activity 7.5

**You will need:-** Several dry cells, a button cell, a voltmeter, connecting wires

**Method:-**

- Observe how the voltages are marked on the cells and batteries you collected.
- Connect the cells or batteries to the circuit you made as shown in Figure 7.12
- Measure the voltage between the terminals of the cells or batteries using the voltmeter.
- Compare the values obtained by measuring and the values mentioned.
- Tabulate your observations.

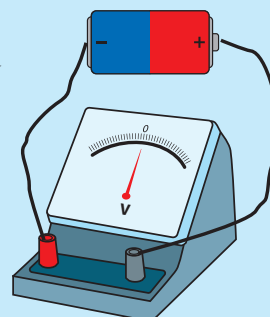


Figure 7.12 ▲

Table 7.2

Cell/ Battery	Voltage (V)
Dry cell	
Lead acid accumulator	
Button cell	

The voltage of a normal dry cell is 1.5 V. The voltage between the terminals of a car battery containing six cells is 12 V.

Let us do Activity 7.6 to measure the potential difference between two points of a circuit, using a voltmeter.



## Activity 7.6

**You will need:-** Two dry cells, a torch bulb, a bulb holder, A small electrical motor, a voltmeter, connecting wires, a switch

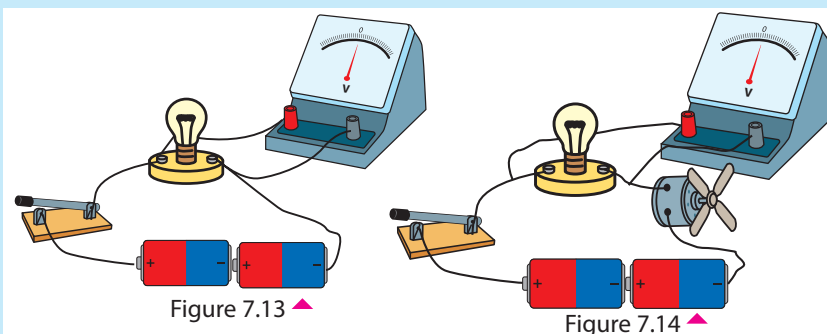


Figure 7.13 ▲

Figure 7.14 ▲

### Method:-

(A)

- Build a circuit to light the bulb, using the bulb, two dry cells, and a switch.
- Connect the voltmeter correctly to measure the potential difference between the two ends of the bulb.
- Measure and record the potential difference between two ends of the bulb
- Draw the diagram of the circuit you built using symbols.

(B)

- Remove the bulb and connect the electrical motor to the circuit.
- Switch on the circuit and measure the potential difference between the terminals of the motor.

(C)

- Connect both, the bulb and the motor to the circuit as shown in Figure 7.16
- Measure separately the potential difference between the terminals of the bulb and the motor, using the voltmeter.

Now you have the ability of measuring the potential difference between two points of a given electrical circuit.

There are instances, in day-to-day life that accurate measurements of current and voltage have to be taken. Some such instances are given below.

1. To make sure, voltages, supplied to houses and factories are of the accurate voltage.
2. To detect defects of electrical appliances by measuring the current they consume.
3. To take measurements associated with electricity in power houses and electrical generators.
4. To identify whether the parts of electrical appliances are functioning properly when repairing.

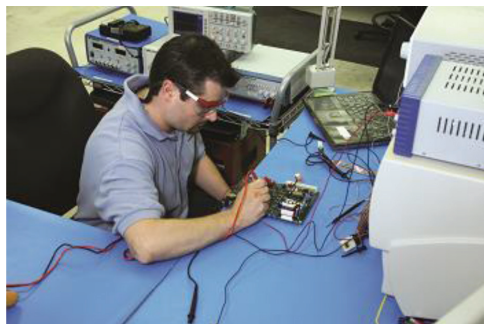


Figure 7.15 ▲ Repairing electrical appliances



Figure 7.16 ▲ Measuring electricity in power houses and electrical generators





## For extra knowledge

Very sensitive voltmeters and ammeters, assembled using digital technology, are in use currently. They are very high in sensitivity.



Modern voltmeters and ammeters assembled using digital technology

## 7.3 Resistance of a conductor

We have already observed that a current flows when a potential difference is applied to the ends of a conductor. Let us find out further, whether there are any other factors affecting the flow of current through a conductor.



### Activity 7.7

**You will need:-** Two dry cells, an ammeter, a torch bulb, a bulb holder, a switch, three wires of iron, nichrome and copper of the same length (about 50 cm) and same diameter

**Method:-**

- Prepare a circuit as shown in the figure.
- Connect each piece of wire, separately to A and B terminals and switch on the circuit.
- Record the observations in Table 7.3
- Discuss the reasons for your observations in the classroom.

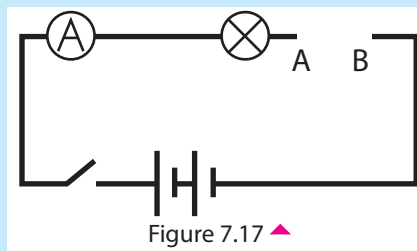


Table 7.3

Type of wire	Nature of illumination of the bulb	Ammeter reading (Ampere)
1. Copper	Illuminate brightly	.....
2. Iron	.....	.....
3. Nichrome	.....	.....

The reason for the difference in illumination of the bulb is because of the current flowing through the circuit changes depending on the type of conductor used.

- Electric current flowing through a conductor depends on the material that it is made of.
- The reason is that the obstacle for flowing of electric current is different from conductor to conductor.

The obstacle caused by a conductor to the flowing of current through it is called the resistance of that conductor.

Symbol used to denote resistance - (R)

Unit of measuring resistance - Ohm ( $\Omega$ )

When the resistance of a conductor increases the current flowing through it decreases.



### For your attention

- Resistance is a very useful factor to control the current flowing through a conductor.
- Current flowing through a conductor can be controlled by changing its resistance.
- Components called resistors, produced to various values of resistance are connected to circuits to control the current flow.
- Mostly the value of a conductor is mentioned on it according to a colour code system.

Electrical parts that possess the property called resistance are known as resistors. Some of those components are given in Figure 7.18.

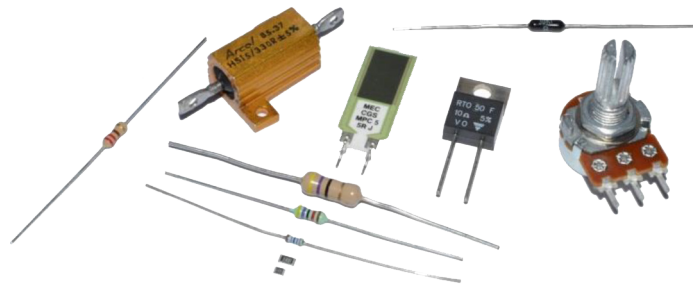


Figure 7.18 ▲ Various types of resistors

Symbols for resistors



Now you may understand that the current flowing through a circuit can be reduced by connecting resistors to increase resistance of the circuit.



## Summary

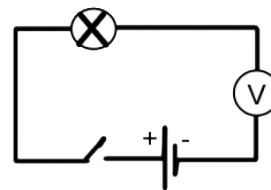
- The flow of electrical charges through a conductor is known as an electric current.
- Unit of measuring current is Ampere. The equipment used for that is ammeter.
- Ammeter should be connected in series to the circuit. The terminals also should be connected correctly.
- There should be a potential difference between two points of a circuit, for the flow of current.
- Potential difference between the two terminals of an electric source is known as its voltage.
- Unit of measuring potential difference is Volt and the equipment used is voltmeter.
- To measure the potential difference across a part of a circuit the voltmeter should be connected in parallel to it.
- Obstruction of electric current flow through a conductor is known as its resistance.
- Unit of measuring resistance is Ohm.
- Resistors of various values can be used to change the current flowing through a circuit.

## Exercise

1) Complete the following paragraph using suitable terms for the blanks.

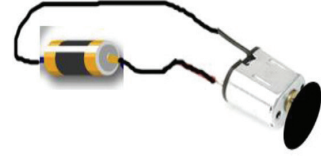
Electric current is a flow of ..... through a closed circuit. Always electric current flows from a high ..... to a ..... electric potential. .... terminal is the place of a cell, where electric potential is high and ..... terminal is the place where it is low.

2) Figure below shows a set-up prepared by a student to measure the potential difference between two ends of a bulb.



1. Is the circuit suitable for the purpose?
2. Give reasons for your answer.
3. If there is any defect, correct it and draw the circuit again.
4. Mention two facts, that should be considered when connecting a voltmeter to a circuit.

3) Given below is a circuit prepared by a student to rotate a cardboard discussing an electric motor. To decrease the rotational speed of this motor;



1. What property of the circuit should be increased?
2. Suggest a method to do it.

4) List out three instances in day-to-day life where measuring voltage and current is important.

## Technical Terms

Electric current	-	விடயக் டாராவ	-	மின்னோட்டம்
Electricity	-	விடயகய	-	மின்சாரம்
Electric potential	-	விடயக் விதவ	-	மின் அழுத்தம்
Voltage	-	வோல்டீயகாவ	-	வோல்ட்டு
Resistance	-	புரிவோடு	-	தடை
Resistor	-	புரிவோடு	-	தடையி
Circuit	-	பரிபுட	-	சுற்று
Conductor	-	சந்தாயக	-	கடத்தி
Voltmeter	-	வோல்ட்டீமீட்டர்	-	வோல்ட்டுமானி
Switch	-	சீவிவ	-	ஆளி