Based on the latest CBSE syllabus

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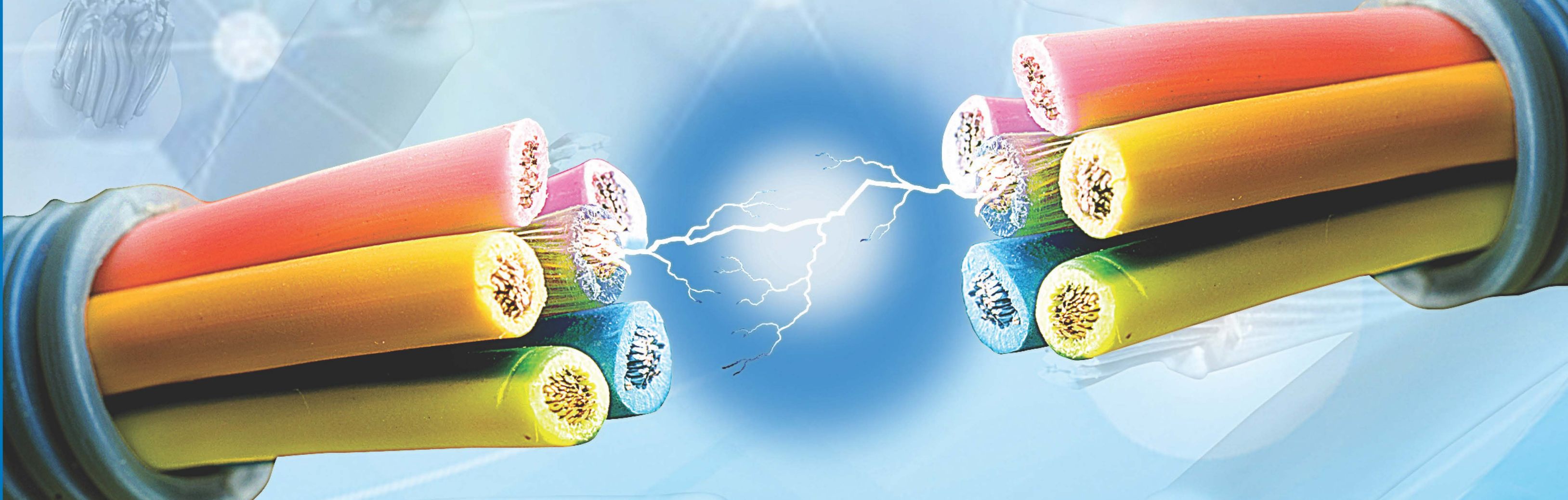
LIVING SCIENCE PHYSICS

Dhiren M Doshi



Ratna Sagar

Based on the latest syllabus and guidelines issued
by the Central Board of Secondary Education (CBSE)

LIVING SCIENCE
PHYSICS

10

Dhiren M Doshi

Ratna Sagar

ABOUT THE AUTHOR

Dhiren M Doshi is a well-known author of a number of Physics textbooks for schools. He has classroom teaching experience of more than 25 years. As a Physics resource person and a part of the In-service Teachers' Training Programme, he has conducted hundreds of 'Effective Science Teaching' workshops for teachers all over India.

His interactive, interesting and innovative style of writing books as if the 'Teacher-is-in-the-Book' helps students understand the fundamental concepts of Physics clearly and logically, for lifelong learning.

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Preface

It has been a real pleasure to note the response with which the first revised edition has been received. It gives me immense pleasure in presenting the revised edition of Living Science Physics for Class X written strictly in accordance with the latest NCERT syllabus woven with the latest CBSE guidelines aimed at the holistic assessment of the learners. While presenting the revised edition, the basic user-friendly structure of the previous edition has been retained.

Salient Features of the Book

- This book contains Check Your Progress, activities, chapter-end exercises, etc. in each chapter to develop cognitive, psychomotor and affective domains of learning and lays emphasis on scientific thought process.
- **Exercises:** Each chapter has exercises at the end. It measures or 'sums-up' how much a student has learnt from the chapter. It is a graded assignment consisting of the questions based on knowledge, understanding, application, analysis, synthesis and evaluation type of questions.

  The following types of questions have been included in exercises:

  - Very Short Answer Type (VSA) questions (one-mark each)
  - Short Answer Type-I (SA-I) questions (two-marks each)
  - Short Answer Type-II (SA-II) questions (three-marks each)
  - Long Answer Type (LA) questions (five-marks each)

  Due weightage has been given to

  - Questions asked in CBSE Board Examinations
  - Higher Order Thinking Skills (HOTS) questions
  - Value-Based Questions
  - Questions Based on Practical Skills in Science

I sincerely hope that this book will serve its intended purpose and be received enthusiastically by both, the students and the teachers. Constructive criticisms and valuable suggestions from both teachers and learners are welcome for the improvement of the book.

With warm regards

Delhi **Dhiren M Doshi**

Remodeled Assessment Structure

(Based on CBSE Circular No.: Acad-05/2017 dated 31/01/2017)

1. SCHOLASTIC AREA

<table>
<tr><td></td><td colspan="4">Total 100 marks
(Syllabus for assessment will be only Class-X)</td></tr>
<tr><td rowspan="3">Subjects</td><td rowspan="3">80 Marks
(Board Examination)
Student has to secure 33% marks out of 80 marks in each subject</td><td colspan="3">20 Marks
(Internal Assessment)
Students has to secure 33% marks out of overall 20 marks earmarked in each subject</td></tr>
<tr><td>Periodic Test
(10 Marks)</td><td>Notebook Submission
(5 Marks)</td><td>Subject Enrichment Activity
(5 Marks)</td></tr>
<tr><td>(i)</td><td>(ii)</td><td>(iii)</td></tr>
<tr><td>Language 1</td><td rowspan="5">Board will conduct Class-X Examination for 80 marks in each subject covering 100% syllabus of the subject of Class-X only.
Marks and Grades both will be awarded for individual subjects.
9-point grading will be same as followed by the Board in Class XII.</td><td rowspan="5">Periodic written Test, restricted to three in each subject in an Academic Year.
Average of the best two tests to be taken for final marks submission.</td><td rowspan="5">This will cover:
❖ Regularity
❖ Assignment Completion
❖ Neatness & upkeep of notebook</td><td>Speaking and listening skills</td></tr>
<tr><td>Language 2</td><td>Speaking and listening skills</td></tr>
<tr><td>Science</td><td>Practical Lab work</td></tr>
<tr><td>Mathematics</td><td>Maths Lab Practical</td></tr>
<tr><td>Social Science</td><td>Map Work and Project Work</td></tr>
</table>

(i) Periodic Test (10 marks)

The school should conduct three periodic written tests in the entire academic year and the average of the best two will be taken. The schools have the autonomy to make its own schedule. However, for the purpose of gradient learning, three tests may be held as one being the mid-term test and other the two being pre-mid and post mid-term with portion of syllabus cumulatively covered. The gradually increasing portion of contents would prepare students acquire confidence for appearing in the Board examination with 100% syllabus. The school will take the average of the best two tests for final marks submission.

(ii) Notebook Submission (5 marks)

Notebook submission as a part of internal assessment is aimed at enhancing seriousness of students towards preparing notes for the topics being taught in the classroom as well as assignments. This also addresses the critical aspect of regularity, punctuality, neatness and notebook upkeep.

(iii) Subject Enrichment Activities (5 marks)

These are subject specific application activities aimed at enrichment of the understanding and skill development. These activities are to be recorded internally by respective subject teachers.

For Languages: Activities conducted for subject enrichment in languages should aim at equipping the learner to develop effective speaking and listening skills.

For Mathematics: The listed laboratory activities and projects as given in the prescribed publication of CBSE/NCERT may be followed.

For Science: The listed practical works/activities may be carried out as prescribed by the CBSE in the curriculum.

For Social Science: Map and project work may be undertaken as prescribed by the CBSE in the curriculum.

2. CO-SCHOLASTIC ACTIVITIES

Schools should promote co-curricular activities for the holistic development of the student. These activities will be graded on a 5-point grading scale (A to E) and will have no descriptive indicators. No upscaling of grades will be done.

Activity	To be graded on a 5-point scale (A–E) in school	Areas and Objectives (as prescribed in the Scheme of Studies for Subjects of Internal Assessment)
Work Education or Pre-Vocational Education	By the concerned Teacher	Work education is a distinct curricular area for students for participation in social, economic and welfare activities. Student gets a sense of community service and develops self-reliance. (for Pre-Vocational Education as per Scheme of Studies)
Art Education	By the VA/PA or the concerned teacher	Art Education constitutes an important area of curricular activity for development of wholesome personality of the students. Students will select one or more forms of creative arts.
Health & Physical Education (Sports/ Martial Arts/Yoga/ NCC, etc.)	By the PE Teacher	Health & Physical Activity preferably sports must be given a regular period. Students should be provided opportunities to get professionally trained in the area of their interest. Indigenous sports, yoga and NCC must be encouraged in the schools creating a sense of physical fitness, discipline, sportsmanship, patriotism, self-sacrifice and health care.

3. DISCIPLINE (Attendance, Sincerity, Behaviour, Values)

Discipline significantly impacts career shaping and it helps build character. Sincerity, good behaviour and values develop strength and foster unity and cooperation. Therefore, the element of discipline has been introduced. Class teacher will be responsible for grading the students on a Five-point scale (A to E).

The internal assessment comprising 20 marks (10 + 5 + 5) entails objectivity and a structured approach. For a holistic assessment, the teachers are expected to make it an effective tool.

B. DOCUMENTATION

Records pertaining to the internal assessment of the students done by the schools will be maintained for a period of three months from the date of declaration of result for verification at the discretion of the Board. Subjudiced cases, if any or those involving RTI/Grievances may however be reatined beyond three months.

C. ASSESSMENT SCHEME FOR CLASS VI TO IX IN THE CBSE AFFILIATED SCHOOLS

The CBSE affiliated schools, for the purpose of uniformity in classes VI to IX may, replicate the same assessment model as described above for Class X.

The above scheme must be implemented in letter and spirit.

Contents

"Electricity is not a thing, like Saint Paul's cathedral, it is a way in which things behave."

— BERTRAND RUSSELL

CHAPTER 1

Electricity

Learning Objectives

- Electric charges
- Electric current
- Continuous flow of electric current
- Basic components of an electric circuit and their symbols
- Ohm's law
- Electrical resistance
- Electrical resistivity
- Conductors, resistors and insulators
- Combination or grouping of resistors
- Heating effect of electric current
- Electric power

In today's world, electricity is an important source of energy. Actually, electricity provides us with a form of energy called **electrical energy**. It is a controllable and convenient form of energy. Electricity is used in our homes, in industry and at many other places. For example, electricity is used in our homes for lighting tubes and bulbs, operating fans, heating purposes and for other various purposes as well. In industry, electricity is used to run various types of machines.

Electric charges

We know that all the objects around us are made up of tiny particles called **atoms**. **Every atom contains two types of charged particles – protons and electrons.** Protons carry a positive (+) charge whereas electrons carry a negative (–) charge. A body gets positively charged if it loses electrons and negatively charged if it gains electrons. For example, when a glass rod is rubbed with silk, it loses electrons and becomes positively charged. Silk, on the other hand, gains an equal number of electrons and becomes negatively charged, i.e. electrons are transferred from glass to silk on rubbing. So, it has been found by experiments that there are two types of electric charges: positive charges and negative charges. The SI unit of electric charge is coulomb (C), which is equivalent to the charge contained in 6.25×10^{18} electrons.

Properties of electric charges

1. **Unlike** (or opposite) charges attract each other. For example, a positive charge attracts a negative charge.
2. **Like** (or similar) charges repel each other. For example, a positive charge repels a positive charge and a negative charge repels a negative charge.

Nature of electric current

When the two terminals of a cell are connected by a copper wire (containing a torch bulb), then electrons start flowing out from the negative terminal of the cell into the wire (and bulb) and then enter into the positive terminal of the cell as shown in Figure 1.1. This flow of **electrons in a definite direction in a conductor constitutes an electric current**. The force which makes the electrons move comes from the cell.

Direction of electric current

The electrons were not known at the time when the phenomenon of electricity was first discovered. Electric

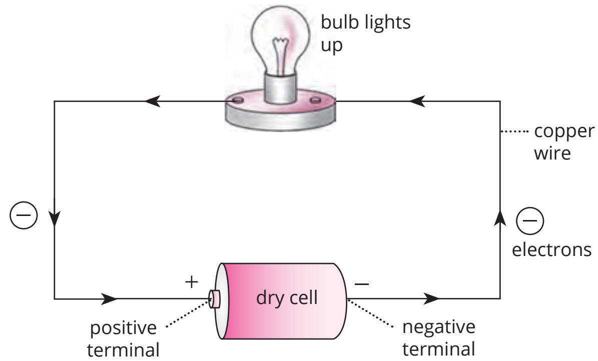


Fig. 1.1 The flow of electrons in a wire is electric current.

current was considered to be the flow of positive charges and the direction of **flow of positive charges** was taken to be the direction of electric current. Thus, **the conventional direction of electric current is from the positive terminal of the source of electric current (cell or battery) to its negative terminal**. So, in all our circuit diagrams, we put the arrows on the connecting wires pointing from the positive terminal of the cell (or battery) towards the negative terminal of the cell (or battery) to show the direction of conventional current.

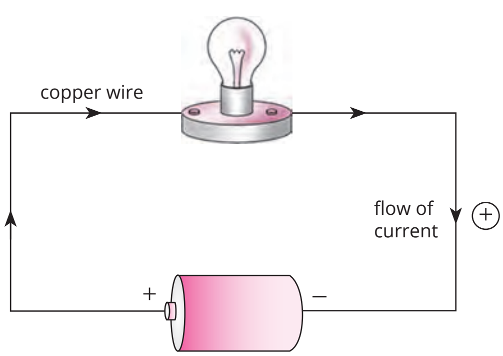


Fig. 1.2 The arrows show the direction of current.

We now know that **electric current is the flow of electrons in a conductor**. Since the electrons are negatively charged, the flow of electrons is from the negative terminal of the source of electric current (cell or battery) to its positive terminal which is opposite to the direction of conventional current.

Even today we consider the flow of conventional current to be from positive to negative terminal, i.e. opposite to the flow of electrons (Fig. 1.3).

Potential difference and electric current

Let us study the meaning of potential and potential difference to know what makes the electric charge to

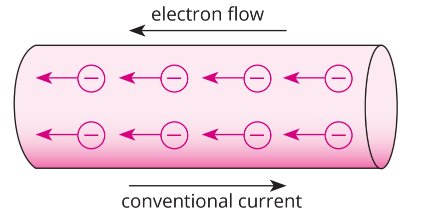


Fig. 1.3 The direction of electron flow and conventional current

flow. Let us consider the analogy of flow of water. Two water tanks A and B which are full of water are kept at the same level and connected by a perfectly horizontal tube. We will observe that water in this horizontal tube does not flow (Fig. 1.4a).

Now if the water tank A is kept at a higher level and water tank B kept at a lower level and connected by a tube, what will you observe? You will observe that water starts flowing from tank A to B. Why?

The water in tank A is at a higher level and water in tank B is at a lower level. It is the difference in the levels of water or the difference in water pressure between the two ends of the tube which determines its direction of flow. So, water level is a condition which determines the direction of flow of water. So, we conclude **if two vessels containing water at different levels**

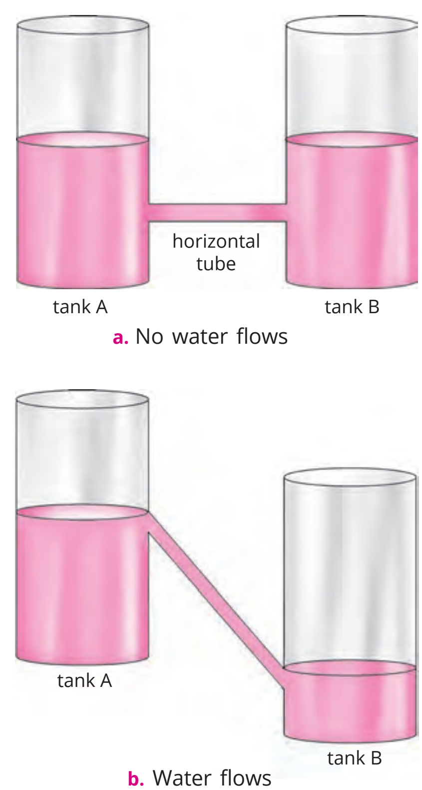


Fig. 1.4 Flow of water

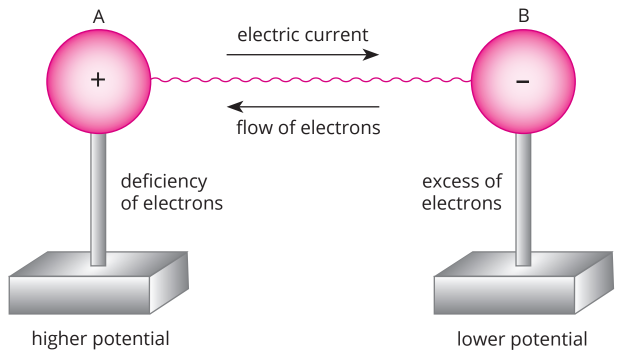


Fig. 1.5 Conventional current flows from A to B. Electronic current flows from B to A.

are connected together, the water flows from the vessel containing water at a higher level to the vessel containing water at a lower level irrespective of the quantity of water contained in the two vessels. This flow of water continues till both the vessels have water at the same level.

In a similar manner, if two charged conductors are joined by a metallic wire (or they are placed in contact), then the direction of flow of electrons is determined by a quantity called the **potential of the conductor**.

The conductor having excess of electrons is negatively charged and said to be at a lower potential, while the conductor having deficiency of electrons is positively charged and said to be at a higher potential. Keeping the convention of flow from the higher to the lower level, the electric current is said to flow from the region of higher potential to the region of lower potential (conventional direction of electric current), i.e. in the direction opposite to the direction of flow of electrons which actually constitutes the electric current (Fig. 1.5).

The movement of electrons (or the flow of current) continues as long as there is a difference in potential between the two conductors. Once the two conductors have the same potential, the flow of electric current stops.

Electric potential

As we know, like charges repel each other and unlike charges attract each other, hence work is involved in moving a charge in the vicinity of another charge. Therefore, quantitatively, potential is measured in terms of the work done in moving the charge against the forces of repulsion.

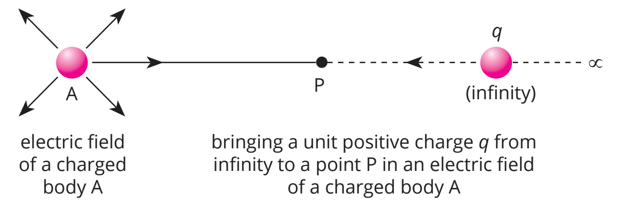


Fig. 1.6 Electric potential at a point P

The electric potential (or potential) at a point in an electric field is defined as the amount of work done in bringing a unit positive charge from infinity to that point. Potential is denoted by the symbol V and its unit is volt.

If W is the amount of work done in bringing a unit positive charge q from infinity to a point, then the electric potential (V) at that point is given by,

$$\text{Electric potential } (V) = \frac{\text{Work done}}{\text{Charge}} = \frac{W}{q}$$

The SI unit of work is joule (symbol J) and that of electric charge is coulomb (symbol C). The SI unit of electric potential is volt. A potential of 1 volt at a point means that 1 joule of work is done in moving 1 coulomb of positive charge from infinity to that point.

So, if $W = 1$ joule and $q = 1$ coulomb, then SI unit of electric potential = 1 volt

$$= \frac{1 \text{ joule}}{1 \text{ coulomb}} = \frac{1\text{ J}}{1\text{ C}} = 1\text{ J C}^{-1}$$

$$1\text{ V} = 1\text{ J C}^{-1}$$

Potential difference

The potential difference (p.d.) between two points in an electric circuit is defined as the amount of work done in moving a unit charge from one point to the other point.

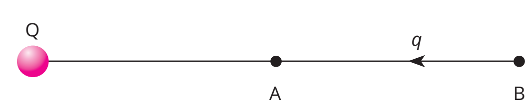


Fig. 1.7 Potential difference is the amount of work done in moving a unit charge q from point B to point A in an electric field created by the charge Q.

If W is the amount of work done in bringing a unit charge (Q) from one point to the other point, then the potential difference (V) between two points is given by

$$\text{Potential difference } (V) = \frac{\text{Work done } (W)}{\text{Charge } (Q)}$$

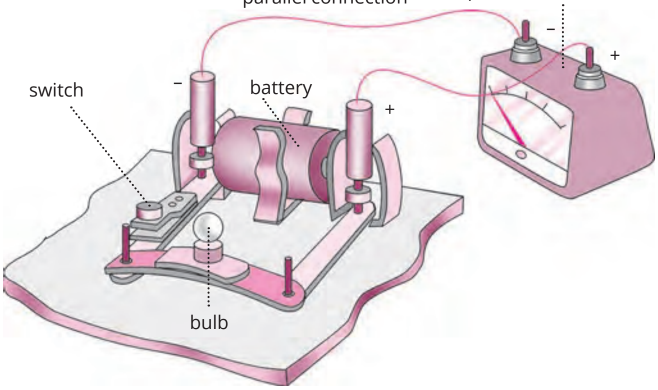


Fig. 1.8 Voltmeter is always connected in parallel.

$$V = \frac{W}{Q}$$

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

$$\therefore \quad 1 \text{ V} = \frac{1 \text{ J}}{1 \text{ C}} = 1 \text{ J C}^{-1}$$

The SI unit of potential difference is volt (V), named after **Alessandro Volta** (1745–1827), an Italian physicist.

One volt is the potential difference between two points in a current-carrying conductor when 1 joule of work is done to move one coulomb of electric charge from one point to the other.

The potential difference is measured by means of an instrument called the **voltmeter**. The voltmeter is always connected in parallel across the points between which the potential difference is to be measured (Fig. 1.9).

Study Tip

Voltmeter is always connected in parallel with the resistor. Voltmeters have a very high resistance.

EXAMPLE 1 How much work is done in moving a charge of 3 C across two points having a potential difference 15 V? **(Textbook Question)**

SOLUTION We know,

$$\text{Potential difference} = \frac{\text{Work done}}{\text{Charge}}$$

$$V = \frac{W}{Q}$$

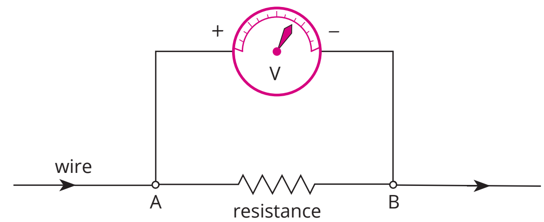


Fig. 1.9 Measuring the potential difference between two points A and B by using a voltmeter

$$\text{Potential difference } (V) = 15 \text{ V}$$

$$\text{Charge } (Q) = 3 \text{ C}$$

Putting the values in the above formula, we get

$$15 \text{ V} = \frac{W}{3 \text{ C}}$$

$$W = 15 \text{ V} \times 3 \text{ C}$$

$$W = 45 \text{ J}$$

Thus, work done in moving the charge is 45 J.

EXAMPLE 2 How much energy is given to each coulomb of charge passing through a 6 V battery? **(Textbook Question)**

SOLUTION We know,

$$\text{Potential difference} = \frac{\text{Work done}}{\text{Charge}}$$

$$V = \frac{W}{Q}$$

$$\text{Potential difference } (V) = 6 \text{ V}$$

$$\text{Charge } (Q) = 1 \text{ C}$$

Putting the values in the above formula, we get

$$6 \text{ V} = \frac{W}{1 \text{ C}}$$

$$W = 6 \text{ V} \times 1 \text{ C}$$

$$W = 6 \text{ J}$$

Thus, work done on each coulomb of charge is 6 J. 6 J of energy is given to each coulomb of charge.

EXAMPLE 3 80 J of work is done in moving a charge of 4 C from one terminal of the battery to another. What is the potential difference of the battery?

SOLUTION We know, $V = \frac{W}{Q}$

Here, $\text{Work done } (W) = 80 \text{ J}$

$$\text{Charge } (Q) = 4\text{ C}$$

Putting the values in the above formula, we get

$$V = \frac{80\text{ J}}{4\text{ C}}$$

$$V = 20\text{ V}$$

Thus, the potential difference of the battery is 20 V.

Example 4 If 3×10^{-3} J of work is done in moving a particle carrying a charge of 15×10^{-6} C from infinity to a point P, what will be the potential at the point P?

Solution We know,

$$V = \frac{W}{Q}$$

Here, $\text{Work done } (W) = 3 \times 10^{-3}\text{ J}$

$$\text{Charge } (Q) = 15 \times 10^{-6}\text{ C}$$

$$V = \frac{3 \times 10^{-3}\text{ J}}{15 \times 10^{-6}\text{ C}}$$

$$V = \frac{3 \times 10^{3}}{15}\text{ V}$$

$$V = 200\text{ V}$$

Thus, the potential at the point P is 200 V.

Check Your Progress

A. Class Response

ORAL QUESTIONING/QUIZ

1. Name the most convenient and widely used form of energy.
2. What constitutes an electric current?
3. What is the conventional direction of an electric current?
4. In which direction do we put arrows in the circuit diagrams?
5. What determines the direction of flow of electrons when two charged conductors are joined by a metallic wire?
6. Name the SI unit of electric potential.
7. Name the instrument used to measure potential difference.
8. Name a device that helps to maintain potential difference across a conductor.
9. Which conductor is said to be at
   a. lower potential b. higher potential?
10. Define potential difference.
11. Name the SI unit of potential difference. After which scientist is it named?

WORKSHEET

Tick (✓) the most appropriate answer (Q.1 to Q.3)

1. An electric current is constituted by the flow of
   a. neutrons. b. electrons.
   c. protons. d. any one of them.
2. If two conductors have the same potential, there will be
   a. flow of electrons. b. no flow of electrons.
   c. flow of protons. d. no flow of protons.
3. The SI unit of electric potential is
   a. ampere. b. volt.
   c. joule. d. ohm.
4. Define one volt.
5. How much work is done in moving a charge of 4 C across two points having a potential difference 10 V?

B. Home Assignment

1. Define electric potential. How is it denoted?
2. How is the voltmeter connected in a circuit? Show with the help of a diagram.
3. How much energy is given to each coulomb of charge passing through a 9 V battery? [**Ans.** 9 J]
4. An amount of 100 joules of work is done in moving a charge of 5 coulombs from one terminal of the battery to another. What is the potential difference of the battery? [**Ans.** 20 V]
5. If 4×10^{-3} joules of work is done in moving a particle carrying a charge of 16×10^{-6} coulombs from infinity to a point P, what will be the potential at point P? [**Ans.** 250 V]

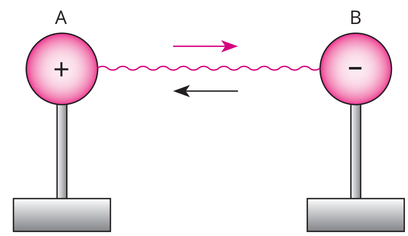
6. How much work is done in moving a charge of 3 C across two points having a potential difference 15 V? **[Ans.** 45 J]

7. A battery of 12 V supplies a charge of 1000 C to an electric device. How much work is done by the battery in moving the charge? **[Ans.** 12,000 J]

8. 40 coulombs of charge is brought from infinity to a given point in an electric field when 60 joules of work is done. What is the potential at that point? **[Ans.** 1.5 V]

9. A charge of 3 C is moved in an electric field from infinity to two points A and B. If the work done in bringing the charge to point A is 15 J and in bringing it to point B is 21 J, calculate the potential difference between points A and B. **[Ans.** 2 V]

10. In the given diagram, electric current is flowing from conductor A to conductor B when both conductors are connected by metallic wires. Label the diagram marking the following
    - **a.** conductor at higher potential,
    - **b.** conductor at lower potential,
    - **c.** direction of conventional current and
    - **d.** direction of flow of electrons.



ELECTRIC CURRENT

We know that if the electric charge flows through a conductor (for example, through a metallic wire), we say that there is an electric current in the conductor. In a torch, we know that the battery (group of cells when placed in proper order) provides flow of charges or an electric current which enables the torch bulb to glow. The torch gives light only when switch is on. When the switch of the torch is turned off, no current flows and the bulb does not glow. How do we express electric current?

Electric current is expressed by the amount of electric charge flowing through a particular area per second. In circuits using metallic wires, electrons constitute the flow of charges. In other words, it is the rate of flow of electric charges in a circuit. It is denoted by the letter *I*.

If *Q* is the net charge which is flowing through any cross section of a conductor in time *t*, then current *I* is given by

$$\text{Current } I = \frac{Q \text{ (Charge flow)}}{t \text{ (Time)}}$$

The SI unit of current is ampere, named after the French scientist, **Andre-Marie Ampere** (1775–1836) and it is denoted by the letter A.

The SI unit of electric charge (Q) is coulomb and that of time (t) is second. Thus, the SI unit of electric current is

$$\frac{1 \text{ coulomb}}{1 \text{ second}} = 1 \text{ A}$$

Thus, **when 1 coulomb of charge flows through a conductor in 1 second, then the current flowing through it is said to be 1 ampere**.

Sometimes smaller units of current are also used.

$$1 \text{ milliampere} = \frac{1}{1000} \text{ ampere}$$

or $$1 \text{ mA} = 10^{-3} \text{ A}$$

Again

$$1 \text{ microampere} = \frac{1}{1000000} \text{ ampere}$$

or $$1\ \mu\text{A} = 10^{-6} \text{ A}$$

The electric current in a circuit is measured by

Study Tip

Ammeter is always connected in series and has a very low resistance.

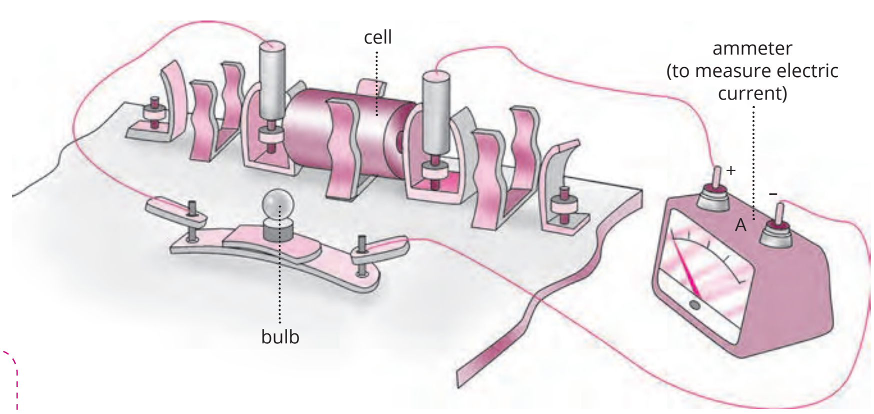


Fig. 1.10 Ammeter is always connected in series.

means of an instrument called **ammeter**. An ammeter is always connected in series in a circuit through which current is to be measured. We know that the SI unit of charge is coulomb (C). Let us calculate the number of electrons constituting one coulomb of charge.

EXAMPLE 5 Calculate the number of electrons constituting one coulomb of charge. **(Textbook Question)**

SOLUTION Here,

Charge on an electron $(e) = 1.6 \times 10^{-19}$ C

Charge $(Q) = 1$ C

Number of electrons $(n) = ?$ (to be calculated)

We know $Q = ne$

Putting the values in the above equation, we get

$$1\text{ C} = n \times 1.6 \times 10^{-19}\text{ C}$$

$$n = \frac{1\text{ C}}{1.6 \times 10^{-19}\text{ C}}$$

$$n = 6.25 \times 10^{18}$$

The number of electrons which constitute one coulomb of charge is 6.25×10^{18}. (The SI unit of electric charge is coulomb. 1 C is equivalent to the charge contained in 6.25×10^{18} electrons.)

EXAMPLE 6 A current of 0.2 A is drawn by the filament of an electric bulb for 30 minutes. Find the amount of electric charge that flows through the circuit.

SOLUTION Here,

Electric current $(I) = 0.2$ A

Time $(t) = 30$ minutes

$= 1800$ s

Amount of electric charge

$(Q) = ?$ (to be calculated)

We know, $I = \dfrac{Q}{t}$

Putting the values in the above equation, we get

$$0.2\text{ A} = \frac{Q}{1800\text{ s}}$$

$$Q = 0.2\text{ A} \times 1800\text{ s}$$

$$Q = 360\text{ C}$$

Thus, the amount of electric charge that flows through the circuit is 360 C.

EXAMPLE 7 A charge of 5 C flows through any cross section of a conductor in 10 seconds. What is the current flowing through the conductor?

SOLUTION Here,

Charge flowing $(Q) = 5$ C

Time taken $(t) = 10$ s

Current flowing $(I) = ?$ (to be calculated)

We know,

$$I = \frac{Q}{t}$$

Putting the values in the above equation, we get

$$I = \frac{5\text{ C}}{10\text{ s}} = 0.5\text{ A}$$

Thus, the current flowing through the conductor is 0.5 A.

Continuous flow of electric current

We have learnt that when two charged bodies at different potentials are brought in electrical contact with each other, an electric current flows from higher potential to lower potential till the two potentials become the same. The moment, the potential difference becomes zero the flow of charges stops. But for various practical applications, we need a continuous flow of electric current. Now the problem arises as to how to have a continuous flow of current through a circuit. Let us again consider the analogy of flow of water in this case (Fig. 1.11). The pump (P) builds up and maintains pressure by lifting water from the tank (B) to the reservoir (A) through the pipe (R). When the valve (V) is open, water would start flowing into the reservoir.

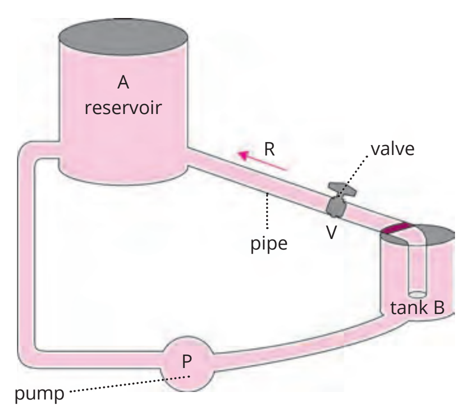


Fig. 1.11

In the same manner, electrons will move along a wire only if there is a difference of electric pressure known as potential difference along the conductor. This difference of potential is produced by the cell or a battery, which acts like a water pump in the circuit. **An electric cell maintains a constant potential difference between its terminals by virtue of chemical reactions going on inside the cell, i.e. by converting chemical energy into electrical energy**. In this way, the cell creates an electromotive force (e.m.f.) which acts on the electrons present in the wire. This e.m.f. sets the electrons in motion. This flow of electrons constitutes the electric current in the wire.

The chemical action within a cell generates the potential difference across the terminals of the cell. When the cell is connected to a conducting circuit element, the potential difference sets the charges in motion in the conductor and produces an electric current. In order to maintain the current in a given electric circuit, the cell has to expend the chemical energy stored in it.

BASIC COMPONENTS OF AN ELECTRIC CIRCUIT AND THEIR SYMBOLS

For making an electric circuit, some components like a cell (or a battery), a plug key, connecting wires, some meters, etc. are required. A continuous conducting path consisting of wires, resistances and a switch between the two terminals of a battery or cell through which an electric current flows, is called a **circuit**. Conventional symbols are used to represent some of the most commonly used electrical components. They are given in Table 1.1.

Closed and open circuits

Activity 1

Apparatus required: A cell of 1.5 V, a bulb, a key, connecting wires.

Procedure:

1. Join one end of a connecting wire to the negative terminal of the cell.
2. Join its other end to one end of the socket of the bulb.
3. Join the other end of the socket with wire to one end of the key.
4. Join the other end of the key to the positive terminal of the cell.
5. The electric circuit is ready (Fig. 1.12). Close the key.

Observation: You will observe that the bulb glows due to the flow of current in it.

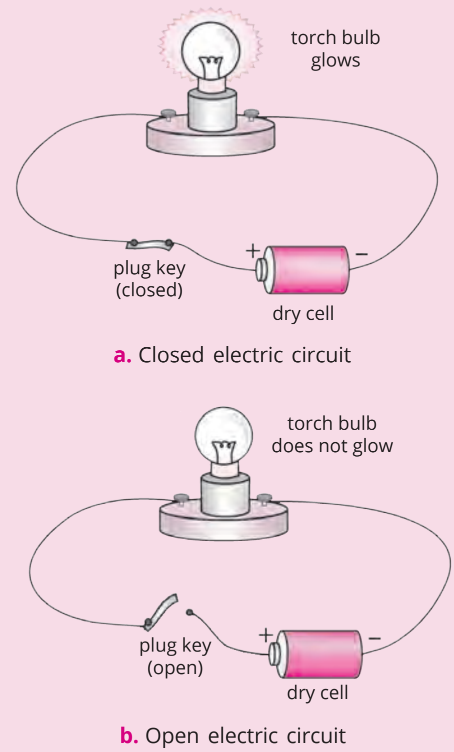


Fig. 1.12 Electric circuit

From Activity 1, the following conclusions can be drawn.

1. A continuous and closed path along which an electric current flows is called an **electric circuit**.
2. The circuit in which electric current flows is called a **closed circuit**. The bulb in this activity glows because the circuit is complete. It is said to be a closed circuit.
3. The circuit in which electrical contact at any point is broken (or the switch of the torch is turned off) and hence no current flows is called an **open circuit**. When the key in this activity is opened, the bulb does not glow, because the circuit is incomplete. It is said to be an open circuit.

Study Tip

A circuit converts electric energy to heat, light or some other useful output.

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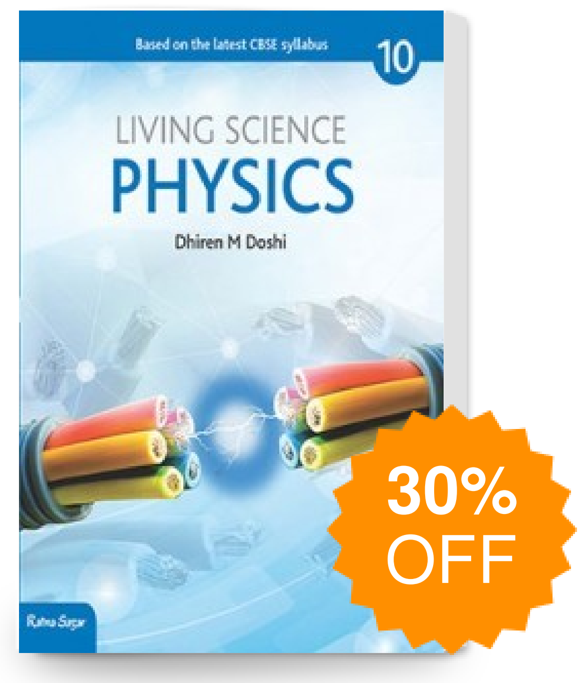

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