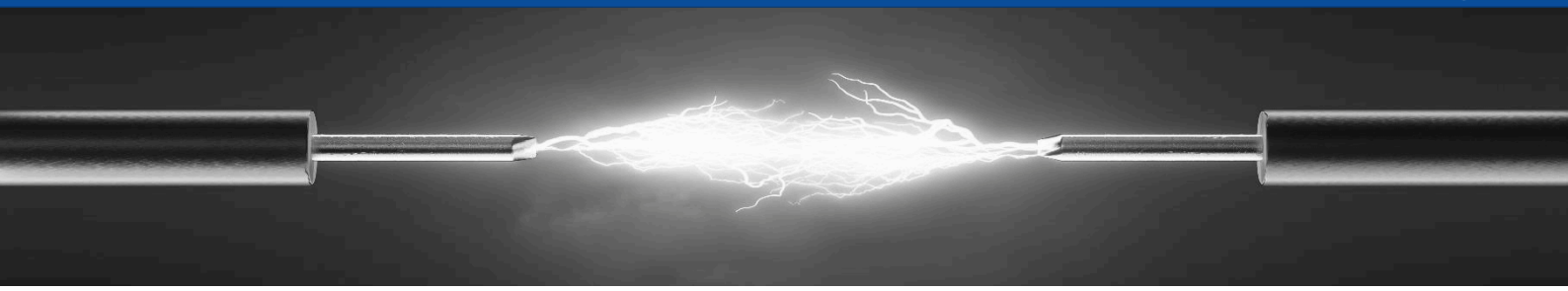


SIMPLE ELECTRIC CIRCUITS

Concepts Covered

- Electricity
- Electric Circuits and its Types
- Electric Cells and its Types
- Difference between Cell and Battery
- Bulb
- Symbols of Electric Components and Circuit Diagram
- Electric Switch
- Working of Torch
- Conductors and Insulators

Electricity

Electricity is a form of energy. We use it for many purposes to make our life easier. For example, we use electricity to operate pumps that lift water from wells or from ground level to the rooftop tank. Electricity makes it possible to light our homes, roads, offices, markets and factories even after sunset.

It can be divided into two parts:

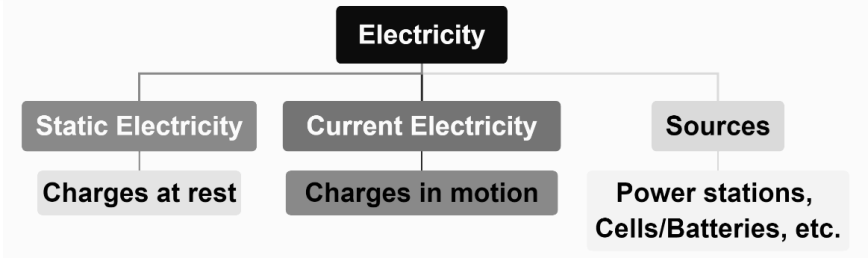
Static Electricity: Electric charges at rest produce static electricity and its study is known as **Electrostatics**.

Current Electricity: Electric charges in motion produce current electricity. It is also known as **Dynamic Electricity**.

Sources of Electricity: Mainly two types of Sources of Electricity are used:

1. **Power Station:** It is the main source of electricity. It produces and supplies a huge amount of electricity to all the high voltage equipments.
2. **Electric Cells (Batteries):** It supplies a small amount of electricity.

Mind Map



Check Your Concept - 1

(i) Moving charges produce_____.
(A) static electricity (B) heat
(C) current electricity (D) None of these

Electricity travels at the speed of light, about 3,00,000 kilometers per second.

Electric Circuit

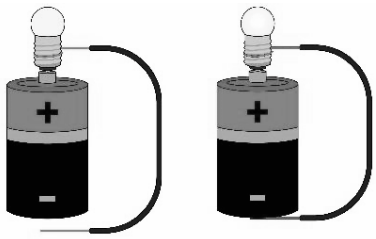
The path of flow of electricity starting from one terminal of a cell and returning to the other terminal is called an electrical circuit.

In other words, an electric circuit is a closed loop or path, connecting a network of electrical components where electrons can flow. It consists of conducting wires and other resistances (like lamps etc.) between the terminals of a battery, along which an electric current flows.

There are two types of electric circuits:

(a) Open Electric Circuit: An electric circuit through which no electric current flows is known as open electric circuit. A circuit will be open, if the plug of the key is removed or if the connecting wires break at any point.

(b) Closed Electric Circuit: An electric circuit through which electric current flows continuously is known as closed circuit.



Open circuit Closed circuit

Electric Cells

A cell is a device which is used to generate electricity.
It consists of two components:
1. Electrolyte - This is the chemical component that conducts electricity.
2. Electrodes - There are two electrodes in a cell. One is the positive electrode called the **anode** and the other is the negative electrode called **cathode.**

When electrodes come in contact with electrolyte, a chemical reaction takes place inside the cell to produce electricity. Thus, it converts chemical energy into electrical energy. When electrodes are connected to the wires in a circuit, electricity passes through them.

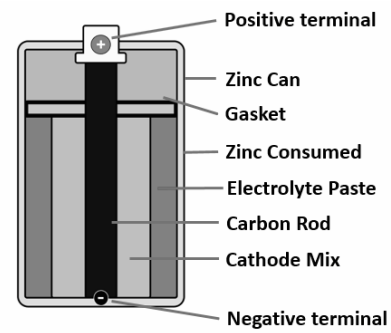
Different types of Cells

Alkaline Cell Lithium Cell Button Cell Dry Cell

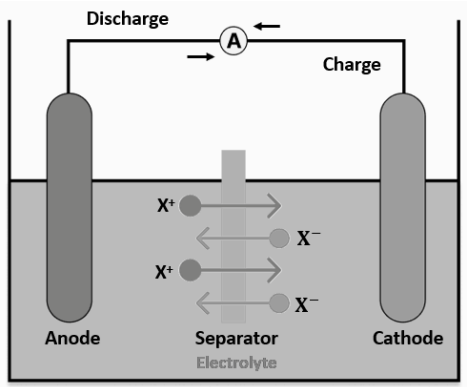
Primary Cell
The cells which cannot be charged repeatedly are known as primary cells.
Example: Voltaic, Daniel, Leclanché and Dry cells.

Secondary Cell
The cells which can be charged are known as secondary cells.
Example: Edison cell, Lead-Acid Accumulator.

Note: Combination of cells is known as a battery.

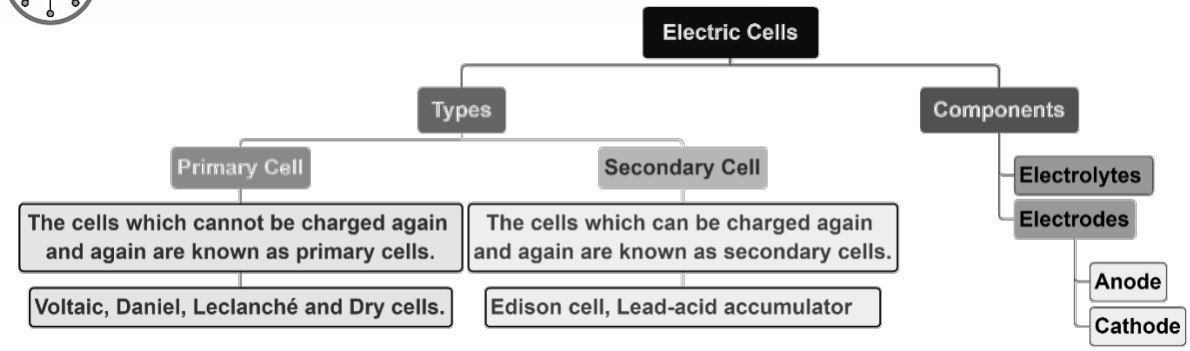


Primary Cell



Secondary Cell

Mind Map

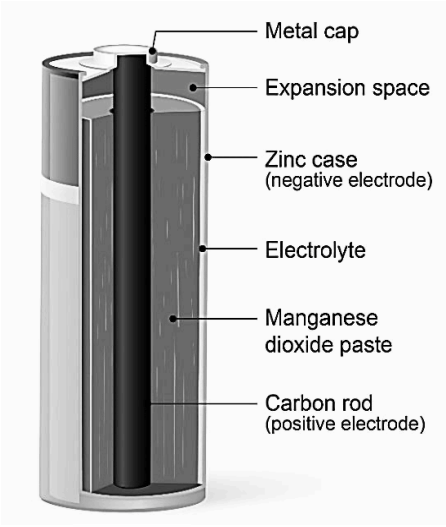


Activity:

What do you observe inside the dry cell?

- The cell consists of a container made of zinc metal. The container works as the negative terminal (- ve).
- A carbon rod with a metal cap works as the positive terminal (+ ve).
- The positive and negative terminals are called electrodes.
- The carbon rod is surrounded by a mixture of carbon powder and a chemical called ammonium chloride. This mixture acts as an electrolyte. The cell is sealed from the top.
- The cell can supply electricity in a circuit for some time. After that, chemicals present inside it get exhausted and it cannot produce electricity.

Electricity was first discovered in 600 BC.

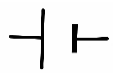


Dry Cell

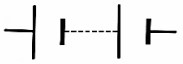
Difference Between Cell and Battery

When the positive terminal of one cell is connected to the negative terminal of the other cell, such a combination of two or more cells is called a battery.

Note: Strength of a cell is measured in **volts (V)**.



CELL



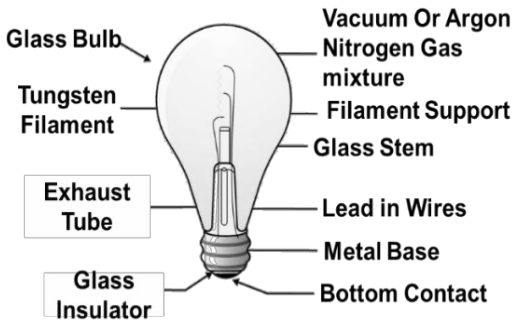
BATTERY

Cells connected in series form a battery. If two or more cells are connected in series as in the above case 2, their combined strength is the sum of their respective strengths.

Example: If two cells, each having a strength of $1.5\ \text{V}$, then the combined strength is $1.5\ \text{V} + 1.5\ \text{V} = 3\ \text{V}$. Similarly, if three identical cells, each of strength $1.5\ \text{V}$, are connected in series, their combined strength will be:
$1.5\ \text{V} + 1.5\ \text{V} + 1.5\ \text{V} = 4.5\ \text{V}$.

Bulb

A bulb is a simple device consisting of a filament resting upon or somehow attached to two wires. The wires and the filament are conducting materials that allow charges (electric current) to flow through them and the filament of the bulb glows. When its filament is broken, the bulb gets fused (circuit gets open). In bulb, one wire is connected to the ribbed sides of the bulbs. The other wire is connected to the bottom base of the bulb.

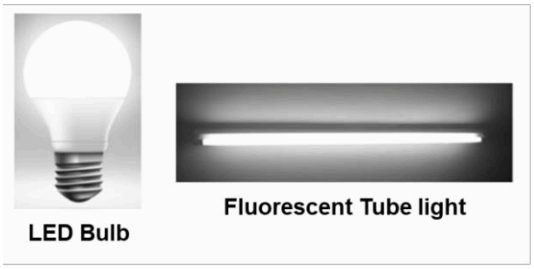


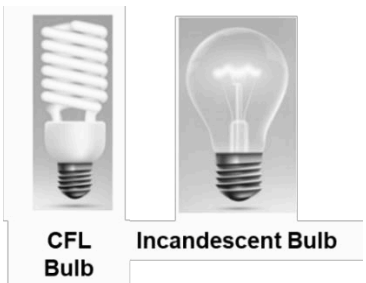
Electric Bulb

Different types of bulbs: In our daily life, we use different types of bulbs. Some of them are incandescent bulb, Fluorescent bulb (tube light), CFL (Compact Fluorescent Lamp), LED (Light emitting diode) bulb etc.,

The ordinary bulb we use gives us light and heat. Heat is not desirable, and results in wastage of electricity. This can be reduced by replacing it with a Fluorescent tube light, CFL or LED because they consume less electricity and produce less heat than an ordinary bulb. To compare the consumption of electricity we have to know the efficiency of the bulbs.

Star symbols are marked on electric appliances. The number of stars on them indicates the energy efficiency of that device.





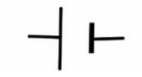
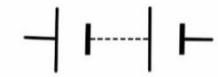
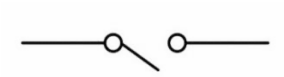
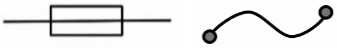
Symbols of Electric components and Circuit diagram

The diagrams which show the arrangement of electric components in a circuit are called circuit diagrams.

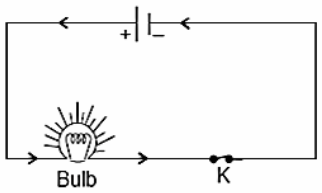
A circuit diagram is a symbolic representation of an electrical circuit. It shows how the electric components are connected together. Electricians and engineers draw circuit diagrams to design the actual circuits.

A circuit generally has:

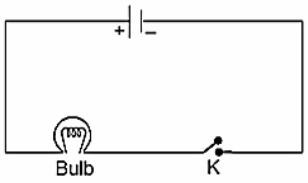
- a source of electric current- cell or battery.
- connecting wires for carrying current.
- a device which consumes electricity- a bulb etc.
- a key or a switch- This may be connected anywhere along the circuit to stop or allow the flow of current.

Electric cell		
Battery		
Bulb		
Glowing bulb		
Switch in the 'off mode'		
Switch in the 'on mode'		
Fuse		
Connecting wire		

An electrical circuit with symbols:



Circuit diagram when Switch is ON



Circuit diagram when Switch is OFF

Activity:

Observing different arrangements of a cell and a bulb.

- Take four lengths of electric wire with differently coloured plastic coverings.
- Remove a little of the plastic covering from each length of wire at the ends. This would expose the metal wires at the ends of each length.
- Fix the exposed parts of two wires to the cell and the other two to the bulb, as shown in figure 1 and 2.

Electric cell with two wires attached to it

Figure 1

Bulb connected to two wires

Figure 2

- You can stick the wires to the bulb with the tape used by electricians.
- Use rubber bands or tape to fix the wires to the cell. Now, connect the wires fixed to the bulb with those attached to the cell in six different ways as shown in figure 3[(a) to (f)].
- Now, carefully look at the arrangements in which the bulb glows.
- Compare these with those in which the bulb does not glow.

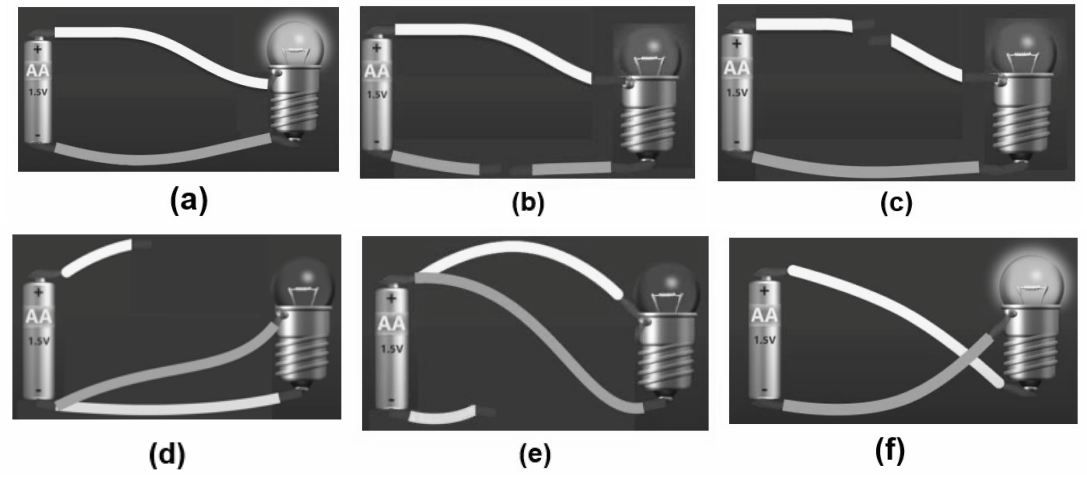
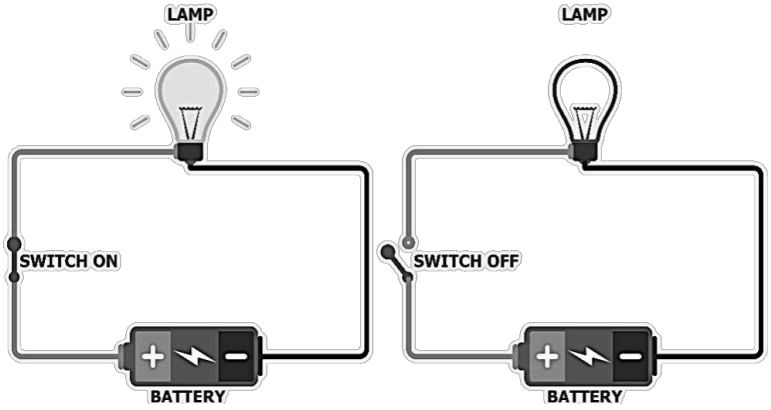


Figure 3

Electric Switch

A switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit.

When the switch (key) K is closed, the circuit is complete; current flows through the circuit and the bulb glows. When the switch (key) K is open, the circuit is not complete; current does not flow through the circuit and the bulb does not glow. A switch is a simple device that either breaks the circuit or completes it.



Switch ON **Switch OFF**

Activity:

Make a switch at home.

Materials required: Two drawing pins, a safety pin (or a paper clip), two wires and a small sheet of thermocol or a wooden board.

Procedure:

- Insert a drawing pin into the ring at one end of the safety pin and fix it on the thermocol sheet. Make sure that the safety pin can be rotated freely.
- Now, fix the other drawing pin on the thermocol sheet in such a way that the free end of the safety pin can touch it.
- And now you can make a circuit by connecting an electric cell and a bulb with this switch.

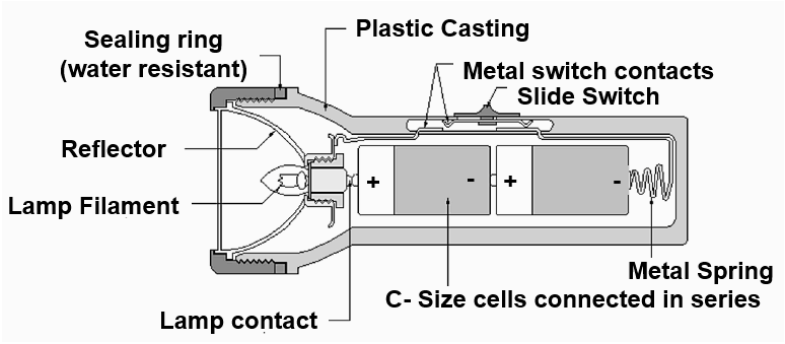
Observation: The safety pin covered the gap between the drawing pins, when you made touching both of them. In this position, the switch is said to be 'ON'. Since, the safety pin allows the current to pass through it, the circuit is complete. Hence, the bulb will glow.

A switch in 'OFF' position **A switch in 'ON' position**

- On the other hand, the bulb did not glow when the safety pin was not in touch with the other drawing pin. The circuit was not complete as there was a gap between the two drawing pins. In this position, the switch is said to be 'OFF' as shown in the figure.

How does an Electric Torch Work?

An electric torch has one or more dry cells inside, which act as the source. These cells are connected through a switch to a small bulb. When the switch is pushed to the 'on' position, the circuit is complete and the bulb glows. When the switch is pushed to the 'off' position, the circuit is incomplete (broken) and bulb doesn't glow.

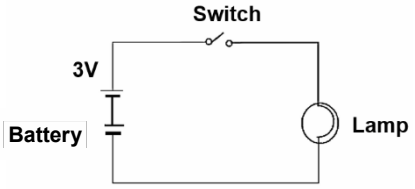


Electric Torch

Extended Learning

Circuit diagram of Torch

There are two electric cells, a switch and a lamp (the torch bulb). The lines in the diagram represent the metal conductors which connect the system together. A circuit is a closed conducting path. In the torch, closing the switch completes the circuit and allows current to flow.



Circuit diagram of Torch

Conductors and Insulators

Conductors: The materials which allow electric current to pass through them are called Conductors.
Example: Metals like Copper, Iron, Silver etc.
Note: Silver is the best conductor of electricity.

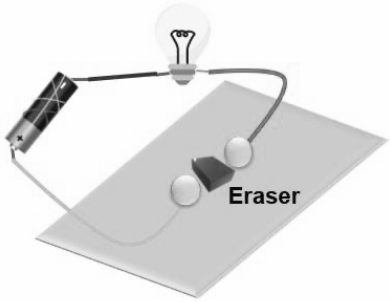
Insulators: The materials which do not allow electric current to pass through them are called Insulators.
Example: Plastic, Wood, Rubber and Glass etc.

Activity:

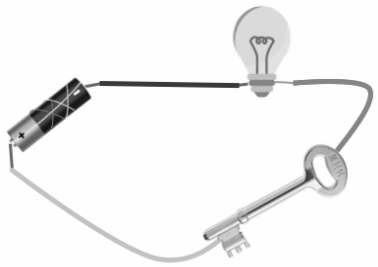
How to check whether the material is Conducting or Non-conducting?

Would the bulb glow after completing the circuit shown, if instead of safety pin we use an eraser and key?

(i) No, the bulb will not light up because eraser is a non-conducting material.
(ii) Yes, the bulb will light up because key is a conducting material.



(i) Electric Circuit with Eraser



(ii) Electric Circuit with key

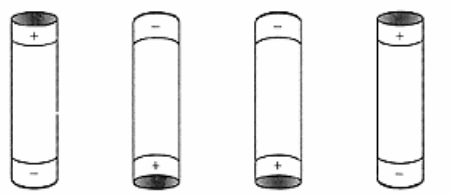
Solved Examples

Level – 1

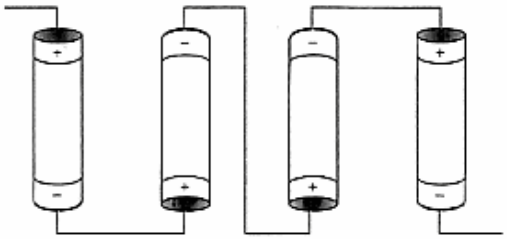
(1) **What is a filament?**

Answer: In the bulb there is a thin wire called the filament which glows when an electric current passes through it. When the filament is broken the bulb gets fused and does not glow.

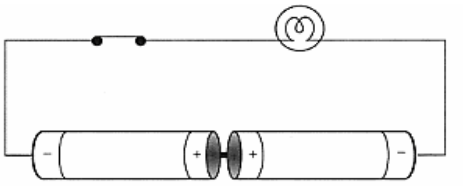
(2) **Adjacent figure shows four cells fixed on a board. Draw lines to indicate how you will connect their terminals with wires to make a battery of four cells.**



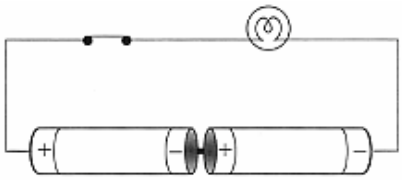
Answer:



(3) **The bulb in the circuit (as shown in the adjacent figure) does not glow. Can you identify the problem? Make necessary changes in the circuit to make the bulb glow.**



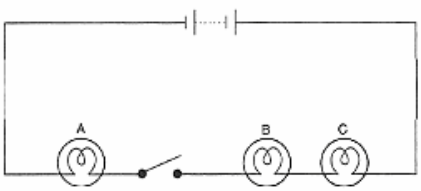
Answer: The problem in this circuit is the connection of two cells. Here, both the positive terminals of the cells are connected to each other. This must be reversed for any one cell to make the bulb glow i.e., positive terminal of one cell should be connected with the negative terminal of the other.



(4) **In the circuit shown in the adjacent figure:**

(i) Would any of the bulbs glow when the switch is in the "OFF" position?

(ii) What will be the order in which the Bulbs A, B and C will glow when the switch is in 'ON' position?

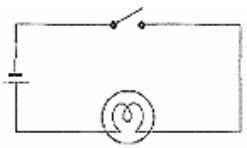


Answer: (i) No, none of the bulbs will glow unless the switch is in 'ON' position.

(ii) All three bulbs will glow at the same time as far as the capacity of the battery is concerned.

(5) **What is an open circuit with respect to ON-OFF switch?**

Answer: When the switch is in the OFF position, the circuit is incomplete and said to be open circuit. No current flows through any part of the circuit and thus, bulb will not glow in this situation.



Level – 2

(1) **Why does a cell stop producing electricity after some time?**

Answer: An electric cell produces electricity from chemicals stored inside it. When the chemicals inside the cell are used up, then the cell stops producing electricity.

(2) **Why does a fused bulb not light up?**

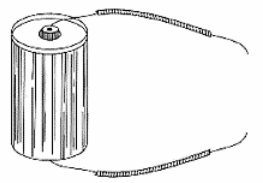
Answer: A fused bulb means a break in its filament which results break in the path of the current between the terminals of the electric cell. Thus, a fused bulb does not light up as no current passes through its filament.

(3) **Why is the handle of electrician's screwdriver made of plastic?**

Answer: A screw driver is made of steel. It is a good conductor of electricity. So, electricity can easily flow through it. Plastic is a bad conductor and does not allows electricity to pass through it. That's why the electrician has a plastic handle to protect him from any shock.

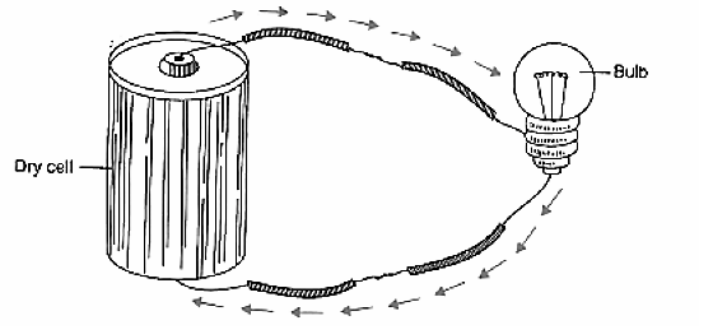
(4) **How do we connect wires to the electric cell?**

Answer: Two separate wires are connected to the two terminals of the cell as shown below:



(5) **How is an electric bulb connected to the cell?**

Answer:



Exercise

FILL IN THE BLANKS

(1) Battery is the combination of _____.
(2) In a battery, positive terminal of one cell is connected to the _____ terminal of the next cell.
(3) In an electric circuit, the bulb glows only when the switch is in the _____ position.
(4) In an electric bulb, there is a thin wire called _____ which glows when an electric current passes through it.
(5) A device that is used to break an electric circuit is called _____.
(6) An electric cell has _____ terminals.
(7) Vertical longer line in the symbol for a cell represents its _____ terminal.
(8) Materials through which current cannot flow are called _____.
(9) Materials through which current can flow are called _____.
(10) Electricity we use in our homes is supplied from a _____.

TRUE AND FALSE

(1) It is convenient to represent electric components by symbols.
(2) A connecting wire is symbolized by a zig-zag line in the circuit diagram.
(3) When an electric current flows through a wire, the wire gets heated.
(4) The key or switch can be placed anywhere in the circuit.
(5) Rubber and wood are good conductors of electricity.
(6) Air is a good conductor of electricity.
(7) We should never join the wires connected to two terminals of a cell.
(8) Electric current can pass through metals.
(9) Instead of metal wires, a jute string can be used to make a circuit.
(10) Electric current can pass through a sheet of thermocol.

OBJECTIVE TYPE QUESTIONS

(1) In making a battery
(A) positive terminal of one cell is connected to the negative terminal of the next cell.
(B) positive terminal of one cell is connected to the positive terminal of the next cell.
(C) negative terminal of one cell is connected to the negative terminal of the next cell.
(D) None of the above.

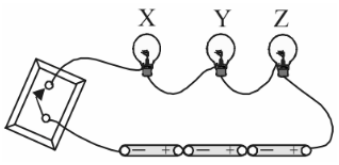
(2) Where the key or switch can be placed in the circuit?
(A) left side of the battery
(B) right side of the battery
(C) can be placed anywhere in the circuit
(D) near the positive and ruminal of the bulb

(3) A switch is used to turn an appliance ON or OFF. Which is the safest position for the switch?
(A) on the live wire (B) on the neutral wire
(C) on the heating element (D) on the earth wire

(4) Bulb does not glow when the probes are hung in the air. The reason is _____.
(A) air absorbs the electricity (B) air is a bad conductor of electricity
(C) electricity is discharged into air (D) air disperses the electricity

(5) Which of the following is not a component of torch?
(A) Bulb (B) Switch
(C) Battery (D) Tester

(6) Three bulbs X, Y and Z are connected in a circuit as shown in the adjacent figure. When the switch is on, then
(A) All the bulbs will glow at the same time
(B) Bulbs will glow in the order of X, Y and Z
(C) Bulb Z will glow first
(D) Bulb X will glow first whereas bulbs Y and Z will glow simultaneously after some time.



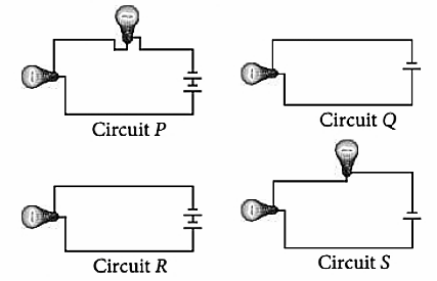
(7) Cell is a device which converts
(A) chemical energy into electrical energy (B) electrical energy into chemical energy
(C) electrical energy into magnetic energy (D) None of these

(8) Bulb glows only in
(A) closed circuit (B) open circuit
(C) in both A and B (D) closed circuit if bulb is fused

(9) To prevent electric shocks, the metallic electrical wires are covered with
(A) copper (B) silver
(C) aluminium (D) plastic

(10) An example of a conductor is
(A) tap water (B) salt solution
(C) metal wire (D) All of these

(11) There are four different circuits with bulbs(identical) and batteries as shown here. **[SOF NSO 2018 Leve-1]**
In which circuit will the bulb(s) be the brightest?
(A) Circuit P
(B) Circuit Q
(C) Circuit R
(D) Circuit S



(12) Which of the following statements is/are correct? **[SOF NSO 2018 Level-2]**
(i) Human body is a good conductor of electricity.
(ii) The air gap surrounding an electric circuit acts as a conductor.
(iii) Silver conducts electricity better than any other metal.
(iv) When electricity lights up a bulb, no heat is produced.
(A) (i) and (ii) only (B) (iii) and (iv) only
(C) (i) and (iii) only (D) (ii) and (iii) only

(13) Which of the following statements is/are true? **[SOF NSO 2018 Level-2]**
I. An electric cell has two terminals, a positive terminal and a negative terminal while an electric bulb has one terminal.
II. An electric cell produces electricity from the chemicals stored inside it.
III. A break in the filament of a bulb indicates that the bulb is fused.
IV. Thomas Alva Edison invented the electric bulb and the electric cell.
(A) I and II only (B) II only
(C) II and III only (D) I, IV and I only

Answer Key

CHECK YOUR CONCEPT

(1) **(i)** (C) current electricity

FILL IN THE BLANKS

(1) two or more cells
(2) negative
(3) ON
(4) filament
(5) Switch
(6) two
(7) positive
(8) Insulators
(9) Conductors
(10) Power house

TRUE OR FALSE

(1) True
(2) False
(3) True
(4) True
(5) False
(6) False
(7) True
(8) True
(9) False
(10) False

OBJECTIVE TYPE QUESTIONS

(1) (A)
(2) (C)
(3) (A)
(4) (B)
(5) (D)
(6) (A)
(7) (A)
(8) (A)
(9) (D)
(10) (D)
(11) (C)
(12) (C)
(13) (C)