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Important Stuff

1. DO NOT REMOVE ALL THE LAMPS FROM THE CIRCUIT, LEAVING ONLY THE CELL
2. DO NOT CONNECT AN AMMETER DIRECTLY TO CELLS WITHOUT LAMPS.
3. IF THE LAMP APPEARS TOO BRIGHT, SWITCH OFF IMMEDIATELY.
4. In a series circuit, put an ammeter in the middle of the cells of a battery to find the current there.

Type 1: Structure of Atom

An atom is like a tiny building block that makes up everything around us. All matter is made up of atoms.
Just like bricks are used to make houses, similarly atoms are used to make everything around us.
We can visualize an atom as a small sphere. At the centre of the atom, there lies another sphere, a very tiny one, called the Nucleus.
An atom contains the following parts:
*Electrons *Protons *Neutrons *Nucleus
(a) The Nucleus is present in the centre of the atom. The Nucleus contains protons and neutrons.
(b) Protons are positive charged particles.
(c) Neutrons have no charge.

Thus, a nucleus contains protons and neutrons. And since protons are positive particles, we can say that the Nucleus is also positively charged.
Electrons are negatively charged particles. They are found outside the nucleus and they revolve around nucleus in circular orbit.
In any atom, the number of protons is always equal to the number of electrons.
Number of protons = Number of electrons.
Since positive charge is always equal to the negative charge, they cancel each other and hence a atom has no charge (or zero charge), neutral.
An atom can be compared to our Solar system.
a.) Nucleus in an atom is like the Sun in the Solar System. It is present in the middle of the atom.
b.) Electrons are like planets revolving around the nucleus.
c.) Electrons are very small in comparison to the nucleus.

Type 2: Electricity

Electricity is a form of energy.

Electricity is produced by the movement of electrons.

We get electricity from Power Plants and Cells / Batteries.

Electric Cell: - It is a device that produces electricity. An electric cell produces electricity from the chemicals stored inside it. An electric cell has two terminals: - a positive and a negative terminal.

Battery: - A battery is a collection of electric cells joined together.

Static Electricity:- Normal electricity flows through wires.

Static electricity is a type of electricity that stays in one place.

Static electricity is produced when we rub two things. This rubbing causes electrons to go from one object to the another.

For example when we rub a balloon on our hair, then electrons (-ve charge) moves from hair to the balloon. Due to this, balloon becomes negatively charged and hair becomes positively charged.

Examples of Static Electricity:

1. Lightning in the clouds.
2. Clothes sticking together when rubbed against each other.
3. Balloon sticking to a wall after rubbing with hair or skin.

Conductors:- Conductors are those materials which allow electricity to pass through them. It means electricity can pass easily through conductors. All metals are good conductors of electricity. This is the reason wires are made up of metals like copper and aluminium.

Insulator:- Insulators are those materials which do not allow electricity to pass through them.

Rubber, Plastics, Wood are some examples of insulators.

The outer covering of wires is made up of plastics/rubber because they are insulators.

Use of Electrostatics in daily life:

1. Electrostatic Painting of Car: The concept of electrostatics can be used to efficiently paint a car. This method is called Electrostatic painting.

In this method, a negative charge is given to the car.

The paint is sprayed using a special gun which gives positive charge to the droplets of paint.

We know that opposite charges attract each other. So negatively charged car will attracts positively charged paint droplets.

This attraction helps the paint to uniformly cover the entire car, even around the corners.

2. Electrostatics can help to clean smoke from a chimney. The concept of electrostatics can be used to clean smoke from a chimney.

Smoke coming out of a chimney has ash and dust particles which can cause air pollution.

To clean this smoke, it first passes through a metal net (or grid/screen) in the chimney.

The metal net gives a negative charge to the smoke particles. Then these negative smoke particles move towards a positively charged plate and stick to it (opposite charges attract).

So, now only clean air comes out of the chimney, ash particles are removed.

The ash and dust particle sticking to the plate can be removed from the plate.

Thus, we see that the concept of electrostatics can help to reduce air pollution.

Problems: Give a brief reason for the following:

(a) The electric wires are made up of metals.

(b) Electric wires are covered with plastics.

(c) The pins of TV plugs are made of metal.

(d) The outside of a plug is made of plastic.

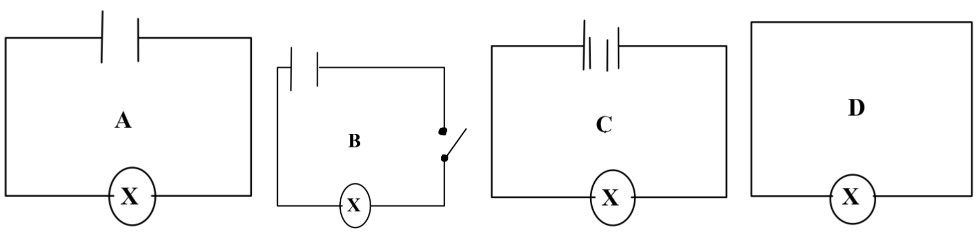
Solutions: (a) Metals are good conductors of electricity. They allow electricity to pass through them. Hence, electric wires are made up of metals.

(b) Plastic is an insulator. It does not allow electricity to pass through it. Hence, wires are covered with plastic so that we do not get electric shock by touching them.

(c) Pins are made up of metal because metal are good conductor of electricity, and Electricity is used to power the TV.

(d) Outside of plug is made up of plastic because Plastic is an insulator. It does not allow electricity to pass through it. Hence, our hands are safe from shocks when we touch the plug.

Problems: Explain in which of the circuits the lamp will glow?



For circuits in which the lamp will not glow, what could you do to make them glow?

Solution: The bulb will glow in circuit A.

Bulb will not glow in circuit B because the switch is open (OFF). I can close the switch to make the bulb glow.

The bulb will not glow in circuit C because the two cells in the battery are not connected properly in series. I can reverse one of the cells such that the positive terminal of one cell will connect with the negative terminal of the other cell.

The bulb will not glow in circuit D because there is no power source (cell or battery). To make the bulb glow, I can connect a cell/battery in the circuit.

Problem: Decide whether each of these statements about current in a series circuit is True or False?

1. The current is larger near the battery and smaller away from it.
2. If there are two bulbs in the circuit, the first bulb will use more current than the second bulb.
3. The current is same at every point in a series circuit.
4. An ammeter will show the same reading whether it is placed on one side of the battery or on the other side.
5. Glow of bulb means bulb uses a part of current.
6. Current becomes smaller after passing through each bulb.
7. If one bulb in a series circuit goes off, the whole circuit stops working.
8. The more bulbs we add in a series circuit, the dimmer they become.

Solution:- (1.) False. In a series circuit, the current is same at all points in the circuit.

(2.) False. Both the bulbs in a series circuit will get the same current. Also, bulb do not use current, but it uses the energy of the current.

(3.) True. A series circuit has only one path for the flow of current, so current is same everywhere.

(4.) True, because current is same at all points of a series circuit.

(5.) False. Bulbs uses energy of the not the current. The amount of current will remain the same.

(6.) False. The current remains the same, it doesn't get smaller. Only the electrical energy carried by the current becomes smaller.

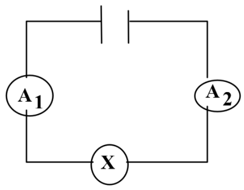
7. True. A series circuit has a simple path for current to move. If one bulb goes off, the path gets broken and hence no current will flow. So the whole circuit stops working.

8. True. Adding more bulbs in the circuit means the amount of current decreases. And hence they glow dimmer.

Also, the total energy of the circuit is shared between the bulbs. If the number of bulbs increase, then energy their share of energy decreases and they glow dimmer.

Problem: In the given circuit, the ammeter A_1 shows a reading of 1A.

Calculate the reading of ammeter A_2. What can we say about the current passing through the battery?



Solution: Ammeter A_2 will also show a reading of 1A (similar to A_1) because same current flows through all the points in a series circuit.

In a series circuit, the same current flows through every part of the circuit. If the current passing through the battery is also 1A.

Theory: 1. A cell is the energy source of a circuit.

A cell contains chemical and these chemicals have chemical energy stored in them.

When a cell is connected to a circuit, this energy is converted into the electrical energy.

This electrical energy is carried by the electrons.

All cells have two connections. These connections are called terminals. One of the terminal is marked positive (+) and the other is marked negative (-).

2. Like charges repel and Unlike charges attract each other.

Hence electrons (-) are attracted towards the positive terminal of the cell and are repelled from the negative terminal of the cell.

Problem: Can you design an activity to show that same current travels at all the parts of a series circuit?

Solution: To prove that same current flows through every part of circuit, we will do the following:

a. Make a series circuit with a battery and \underline{ampere} two lamps.

b. We use an ammeter very close to the positive terminal, another close to negative terminal and another one in the middle of the circuit.

c. We will observe that all the ammeters will show same reading irrespective of where they are placed.

d. Both the lamps will glow equally bright.

e. Point (c) and (d) prove that same current is flowing through every part of the circuit.

Conductors allow electrons to flow inside them.

Wires in homes are made up of copper because copper is a very good conductor of electricity.

But overhead wires that carry electricity across long distances are made up of Aluminium or Steel because Aluminium is lighter and cheaper than copper.

Problem: Silver is a better conductor of electricity than copper. But Silver is not used for making wires for homes. Why?

Solution: Silver is very expensive compared to copper. Hence it is generally not used for wiring purposes at homes.

Problem: Using the idea of moving particles, explain the difference between conductors and insulators?

Solution: We know that everything is made up of atoms and atoms contains electrons. In conductors, the atoms contains electrons which can move from one atom to another. When electrons move, the current can flow. Hence conductors allow electricity to pass through them.

In insulators, the electrons are tightly packed, they cannot move from one atom to another. Hence an insulator do not allow current to pass through it.

So basically we can say that everything is made up of atoms and atoms contains electron.

If a material is made up of atoms in which electrons are free to move, then it's a conductor.

But if the material is made up of atoms in which electrons are not free to move, then it is an insulator.

Activity to test whether a material is Conductor or Insulator.

Consider we have two materials A and B and we wish to find out which one is a conductor and which is an insulator.

We need a cell (battery), Crocodile clips.

Connect the circuit as shown below

First of all to check the connections are complete, we connect the crocodile clips A and B together and we will see the lamp will glow. It shows that circuit is working correctly and all connections are "okay".

Now we disconnect the Crocodile clips A and B.

Now we put any object X between A and B and see if the lamp glows. If the lamp glows, it means current can pass through X and hence it is a conductor.

However, if lamp does not glow, it means current cannot pass through X and hence X is an insulator.

Summary: Put any material between the clips A and B and if the:

lamp glows → Material is conductor

lamp does not glow → Material is an insulator.

The current in a circuit increases if we increase the number of cells/batteries, or we decrease the number of components (lamps / buzzers / motors).

Problems: Answer the following!

a. The current flows in a wire due to the movement of which particle?

b. What is the nature of charge on these particles?

c. Explain the direction of flow of these particles in a circuit?

Solution: a. Electrons are particles whose flow make the current.

b. Electrons have negative charges.

c. Electrons are negatively charged particles.

They flow from the negative terminal of the battery, through the circuit, to the positive terminal of the battery.

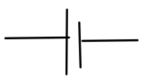
Recall:- Like charges repel & unlike charges attract each other.

Problem:- Draw a circuit symbol for the following!:-

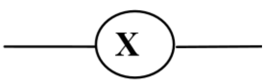
(a) Cell (b) Open Switch (c) Lamp (d) Ammeter (e) Buzzer.

Draw a series circuit using all these components.

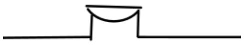
Solution:

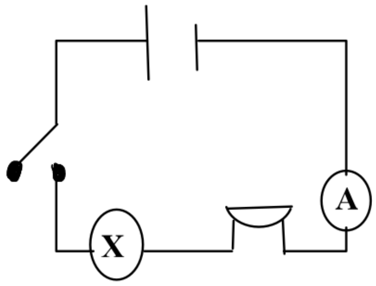
(a) Cell - 

(b) Open Switch - 

(c) Lamp - 

(d) Ammeter - 

(e) Buzzer - 

(f) 

Problem: Serena did an experiment to test whether an object is a conductor or an insulator.

a) Describe why the lamp will light up when Serena places a conducting material between the crocodile clips?

b) Next Serena connects another material between the crocodile clips, the lamp stays off. Give reason why the lamp does not glow?

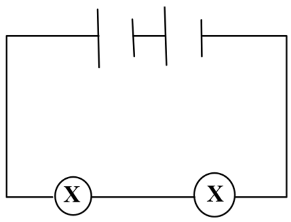
Solution: a) The lamp will light up because a conducting material allows electric current to pass through it. It completes the circuit.

b) The lamp does not glow because one of the reason:-

(i) The object is an insulator.

(ii) The connections may be loose so the circuit may not be complete.

Problem: Considers the diagram below:



Draw another circuit such that:

a) The current is larger than the original circuit.

b) Current is smaller than the original circuit.

Solution: We know that

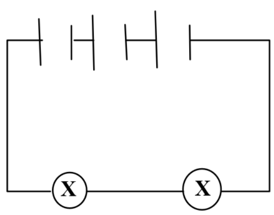
To increase the current

- Increase the number of cells/batteries
- Reduce the number of lamps.

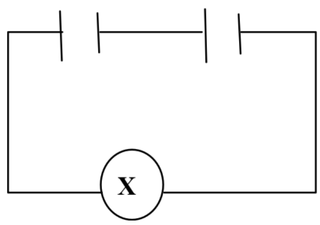
To decrease the current

- Reduce the number of cells/batteries
- Increase the number of lamps, buzzers

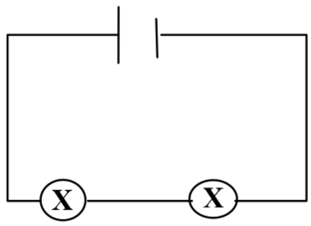
a) To increase the current, we could either increase the cells/batteries or reduce the number of lamps. So the circuit is



OR



b) To reduce the current, we reduce the number of cells/batteries or we increase the number of lamps (or add buzzers and other components).



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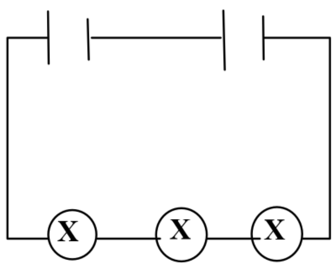


Problem: A balloon gets negatively charged if we rub it against our skin or hair. Explain what would happen if two such negatively charged balloons are held close to each other. Will they attract or repel each other?

Solution: The two negatively charged balloons will repel each other because like (same) charges repel each other.

And Unlike (different) charges attract each other.

Problem: A plastic ruler gets negatively charged when rubbed against a cloth.

a) What will be the charge gained by the cloth?

b) Will the plastic ruler and the cloth will attract or repel each other?

Solution: When a plastic ruler is rubbed against a cloth, then electrons get transferred from the cloth to the plastic ruler.

a) The cloth loses electrons and becomes positively charged.

b) They will attract because unlike (different) charges attract each other.

Problem: When a balloon is rubbed against our hairs, it sticks to the head. But the hair strands now stand out and repel one another. What do these observations tell about the electric charge on the balloon and the hair?

Solution: When we rub a balloon on our hair strands, the electrons move from the hair strands to the balloon. This makes the hair strands positive and the balloon negatively charged.

Due to opposite charges, the balloon sticks to the hair strands.

The hair are all positively charged and hence they repel each other. This repulsion makes them stand out and fluffy.

Problem: What would be the force of interaction (attractive or repulsive) between the following pairs of particles?

a) Electron - Electron

b) Proton - Proton

c) Electron - Proton

Solution: a. Repulsive force

b. Repulsive force

c. Attractive force

Reason:- Electrons have negative charge, Protons have positive charge

Like charges repel each other.

Unlike charges attract each other.

Type 3: Electric Circuit

An electric circuit is a closed path in which electric current can flow.

Main parts of an electric circuit:

1. Cell / Battery: Cell / Battery provides energy which makes electrons to move around the circuit.

   Cell / Battery in a circuit is like "Heart" in a body which pushes blood throughout the body.

   Remember: electric current always flows from positive terminal towards the negative terminal.

2. Bulb / Motor / Any device: All electric circuits uses one of these devices which uses the electrical energy to do work.

   For example, Bulb converts electrical energy to light energy.

   Motor converts electrical energy to mechanical energy (movement).

3. Switch:- It is used to turn the circuit ON or OFF.

   When switch is ON, electric current (electrons) flows through the circuit.

   When switch is OFF, electric current do not flow in the circuit.

4. Wires:- Wires are made up of conductors. They are like roads/highway for electric current.

Working of an electric Circuit:-

When an electric circuit is completed then:-

1. Cell provides energy to move the electrons. This energy comes from chemical energy reactions occurring inside the cell.
2. Electrons move out from the negative terminal of cell, move along the circuit and again enter the cell through its positive terminal.
3. Any Lamp/Bulb in the circuit converts a part of electrical energy to light energy (& thermal energy).

CIRCUIT DIAGRAM:-

We use symbols to make circuit diagram.

Electric Current

Electric Current is produced by the flow of electrons. The symbol for electric current is I.

Ampere is a unit used to measure electric current. The symbol is ‘A’.

Basically, Ampere tells us how much current is flowing in a circuit.

Ammeter:- Ammeter is an instrument used to measure the amount of current in a circuit.

Ammeters are connected in SERIES in a circuit. It means the positive terminal of ammeter is connected towards the positive terminal of the cell/battery.

Ammeter gives exact value of current.

Use of Lamp to estimate the size of Current

When a lamp is connected in a closed circuit, it glows. It means current is flowing through the circuit.

We can use the Brightness of the lamp to estimate the amount of current.

More Brightness = More Current

Less Brightness = Less Current

Activity:- 1. We make a simple circuit with one battery, one bulb and a switch.

If switch is ON, the bulb glows.

2. Connect 2 batteries instead of one. The bulb will glow more brighter. It means more current flowing in circuit.

3. If we add two more bulbs in the circuit. All the 3 bulbs will glow dimmer.

It means current is reduced in the circuit.

1. Describe the structure of an atom?

Solution: Atom is the smallest particle of matter. It has a small nucleus at the centre. Nucleus contains protons & neutrons. Electrons revolve around the nucleus in circular orbits.

2. Differentiate between conductors & insulators? Give examples.

   Solution: Conductors are those materials which allow electric current to pass through them.

   Example: metals, like copper, aluminium and silver.

   Insulators are materials which do not allow electric current to pass through them.

   Example: Rubber, Plastics, wood.

3. What is an electric circuit? Briefly explain its various components?

   Solution:

4. Define Ampere? Write its symbol?

   Solution:

5. How to connect an Ammeter to measure current in a circuit?

   Solution:

Assignment

1. A battery is
   a. Combination of cells
   b. Combination of switches
   c. Combination of plugs
   d. None of the above

   Solution: a

2. The unit of current is
   a. Ampere
   b. Joules
   c. Light
   d. Volt

Solution: a

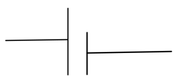
3. The instrument used to detect the flow of current in a circuit is
    a. Ammeter
    b. Voltmeter
    c. Galvanometer
    d. All the above

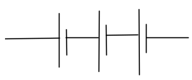
Solution: a

4. Which symbol represents an electrical component used to store energy?
    a.
    b.
    c.
    d.

Solution: a

1. Draw the symbol of the following-

a. Cell 

b. Battery 

c. Heater

d. Lamp

e. Switch

2. What is an electric circuit?

Solution: An electric is a closed path through which electric current can flow.

An electric circuit contains a cell / Battery, wire, lamp / motor, Switch.

3. How many types of electric circuits are there? Define them.

Solution: There are two types of electric circuits. These are (a) Series Circuit

(b) Parallel circuit

a. Series Circuit:- In series electric circuit, all the components are connected one after the another in a simple loop. Current can flow in only one loop.
b. Parallel Circuit:- In parallel electric circuits, there are more than one loop through which current can flow.

4. Differentiate between cell and a battery.

Solution: Cell:- A cell is a small source of electrical energy. It symbol is .

Battery:- A battery is a collection of more than one cells connected in series to each other. Its symbol is .

When we rub a balloon against our hair, clothes or skin then it can stick to the walls.

This happens because when we rub any two objects, then electrons get transferred from one object to another.

And we say that balloon gets charged.

Why do objects become charged?

All objects are made up of atoms. Atoms contains three type of particles: Electrons, Protons and Neutrons.

Electrons are negatively charged.

Protons are positively charged.

Neutrons are neutral, they have no charge.

An atom always has equal number of electrons (–) and Protons (+). So an atom is always neutral, it has no net charge.

When we rub a balloon with skin, clothes, or hair, then electrons move from the hair or skin to the balloon.

- Electrons have a negative charge, so the balloon becomes negatively charged.
- Hair have lost electrons, so they become positively charged.

Always Remember:

Like charges repel each other. It means a positive charge will repel another positive charge. And a negative charge will repel another negative charge.

Unlike (opposite) charges attract each other. It means a positive charge will always attract a negative charge. And a negative charge will always attract a positive charge.

A. Point

When we rub a conductor to our hair, clothes, or skin, then electrons move from our hair to the conductor.

But conductors allow electricity to pass through them, hence electrons can move inside the conductor. And if you touch the conductor, electrons will pass through the conductor to our hand and then through our body to the earth.

But if we rub an insulator with our hair, then electrons will move from hair to the insulator. But electrons cannot pass through insulators, hence these electrons stay on the surface of the insulator.

Problem: Explain why an atom is neutral?

Solution: An atom always contain equal numbers of positive charged protons (+) and negative charged electrons (-). These equal and opposite charges cancel each other and make the atom neutral (no charge or zero charge).

Problem: Explain why insulators (like plastics or balloon) becomes charged when you rub them but conductors (like metals) do not get charged?

Solution: Insulators do not allow charge particles (like electrons) to move inside them. The charged particles stays on the surface (static) of the insulator & makes it charged.

Conductors allows charged particles to move inside them. If we touch any charged conductor, these electrons move from conductor to our body and then through our body to the earth. Hence conductors do not get charged.

Problem: If a student rubs a balloon and a plastic rod against his hairs and them brings them close together, will they attract or repel each other? Explain your answer.

Solution: When a balloon and a plastic rod is rubbed against hair, then electrons move from hair to the balloon and plastic rod.

This makes both the balloon and the plastic rod as negatively charged. We know that like (Same) charges repel each other. Hence the balloon and the plastic rod will repel each other.

Problem: Alex feels a small electric shock when he touches a metal door after walking across a carpet. Can you explain this observation? Would he still get a shock if the handle was made of plastic? Justify your answer?

Solution: When Alex walks on the carpet, his feet rubs against the carpet and so electrons get transferred from feet to the carpet.

This makes his body positively charged. When he touches a metal door handle, which is a conductor, the extra charge on his body moves into the metal handle. This flow of electrons is felt as an electric shock.

But if the handle is made up of plastic (an insulator), then charge from Alex body will not flow easily and so he would not get a shock.

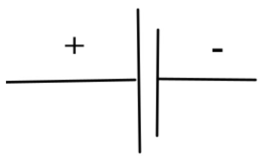
Problem: Why do people sometimes feel a small electric shock when they touch a car metal handle door? Explain the reason?

Solution: This happens due to Electrostatics (or static electricity).

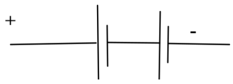
When a car moves, its tyres rubs against the road. This rubbing causes movement of electrons between the tyres and the road.

These electrons charge the car body & when we touch the car door, the charge flows from the car to our body. This sudden flow of charge causes the electric shock.

A cell has a positive and a negative terminal. The longer vertical line is the positive terminal. The shorter vertical line is the negative terminal.



A battery is a collection of two or more cells. To make a battery, cells must be connected side by side in series (end-to-end). It means the positive terminal of one cell is connected to the negative terminal of the next cell.



Battery

Problem: Why are electric wires covered with plastic?

Solution: Electric wires are covered with plastic because plastic is an insulator. It prevents electric shocks.

Problem: Why do we need only a simple switch in a series circuit?

Solution: A series circuit has only a single loop in which current can flow. Hence, a simple switch is sufficient to ON or OFF the current in this loop.

Problem: A student connects a lamp and a cell in a series circuit and places an ammeter before the lamp. The ammeter reads 0.3 A. He then moves the ammeter after the lamp. What will the reading be? Explain?

Solution: In a series circuit, all the components are connected in a single loop. The current at all points same everywhere in a series circuit. So, the ammeter will read same 0.3 when placed after the lamp.

Problem: Is the current in a series circuit different near the positive and negative terminals of a cell? Explain?

Solution: No, the current in a series circuit is exactly same near the positive and negative terminal of a cell. A series circuit has a single loop and current remains the same. The number of electrons moving out of the negative terminal is exactly the same to the number of electrons reaching the positive terminal of the cell.

How cells and Lamps/motors affect the current?

If the number of cells is increased:

- The current will increase.
- The brightness of lamp will increase.
- The reading of ammeter will increase.

If the number of lamps are increased:

- The current will decrease.
- The brightness will reduce.
- The reading of ammeter will reduce.

Problem: Explain the meaning of the following terms?

a. Neutral

b. Charged

c. Earthed

Solution: a) Neutral means no charge. If an object has extra electrons, it becomes negatively charged. If an object has fewer electrons, then it becomes positively charged. However, if the object has equal number of electrons and protons, then it has no charge or it becomes neutral.

b) Charged means an object either has more or fewer electrons than protons.

c) Earthed (or grounded) means connected to the earth.

Earth is a very big planet. It is so big that it can take a large amount of charge without getting charged.

Earthed means connecting an object to earth so that extra charges can go into the ground instead of staying.

Earthing is necessary, otherwise the excess charge may give shock.

Problem: Below are some sentences describing different parts of an electric circuit. Read carefully and identify each circuit component.

a) This provides energy to an electric circuit.

b) All the components are connected in a simple loop, in this type of circuit.

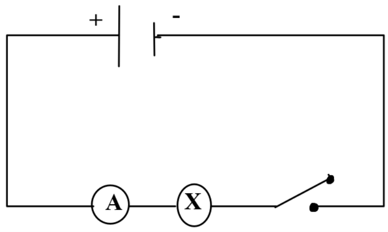
c) This component allows you to control the circuit by turning it on or off.

Solution:- a) Cell / Battery

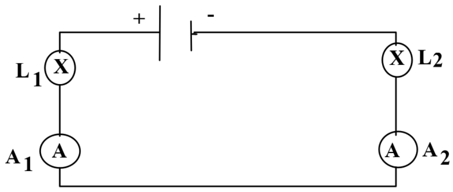
b) Series Circuit

c) Switch

Problem: Draw a series circuit having a battery, a lamp, a switch, an ammeter.

Solution: 

Problem: A circuit contains two ammeters, two lamps and a switch as shown below.



a. Which ammeter (A_1 or A_2) will show maximum reading? Why?

b. Which lamp (L_1 or L_2) will show maximum brightness?

Solution: The circuit is a Series Circuit because all the components are connected in a single loop.

a. Both the ammeters will show same reading because current is same at all the points in a series circuit.

b. Both the lamps will show with equal brightness because the same current will flow through each lamp in a series circuit.

Problem: Mashima rubs a balloon against her hair and then the balloon sticks with pieces of paper.

a.) Is the balloon positively or negatively charged?

b.) Explain why the balloon attracts paper?

Solution: a.) The balloon is negatively charged because of the transfer of electrons from the hair to the balloon.

b.) When the balloon is brought closer to the paper, then negative charges (electrons) in the paper are pushed away (like charges repel) and the positive charges comes closer to the rod (opposite charges attract).

The paper gets attracted because the positive charge of the paper is attracted towards the negative charge of the balloon.

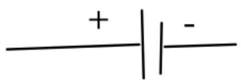
Advantages of using circuit diagram:-

Circuit diagrams are easier to draw.

Precautions:

- No gaps in the line
- Wires are not drawn through the components

In the circuit symbol of a cell or a battery, the larger line represents positive terminal and the smaller line represents negative terminal.



An ammeter should never be connected directly across the terminals of a cell / battery. A high current means electrons are moving very fast.
A small current means electrons are moving slowly.
Ammeter measures Current.
The SI unit of Current is Ampere. Sometimes it is written as "amps" or symbol A.

How to Connect an Ammeter:-

An ammeter has two terminals.

Positive terminal is the RED terminal.

Negative terminal is the BLACK terminal.

Positive (Red) terminal is connected towards the positive terminal of the battery.

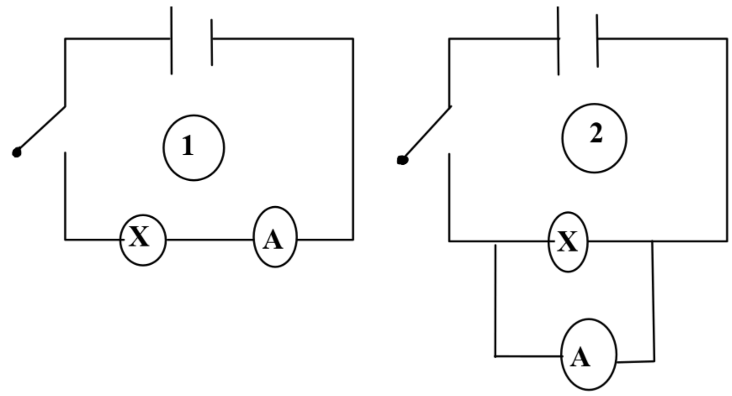
Negative (Black) terminal is connected to the negative terminal of the battery.

An ammeter is always connected in SERIES.

It means all the components are connected end to end, one after the another.

There is only a single loop & no branching in the circuit.

Problem: Consider the diagram below. Which circuit has correctly used an Ammeter?



Solution: An Ammeter is always connected in series with other components of the circuit. It means they must be connected one after the another. There should be no branch in the circuit.

The Circuit 1 is correct because Ammeter A is connected in series. Only a single loop of current. No branching.

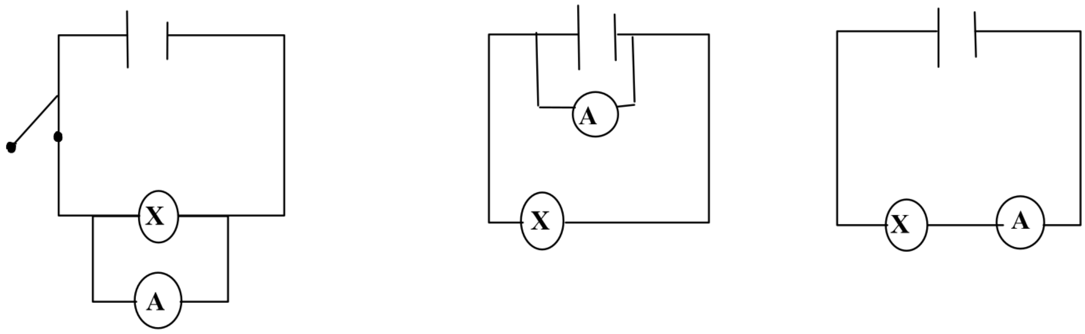
Circuit 2 is incorrect because ammeter is not connected in series. There is a branch forming across the lamp.

Infact here the Ammeter is connected in PARALLEL across the lamp.

Problem: What is the SI unit of current?

Solution: Ampere is the SI unit of current. It is also written as amps with symbol A.

Problem: Below are three diagrams showing how to measure current in a circuit. Which diagram is correct? Justify?



1 **2** **3**

Solution: An ammeter should always be connected in series in a circuit.

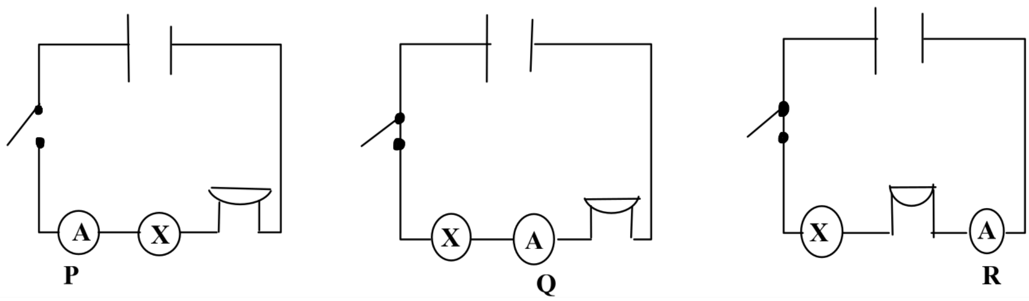
No branching in the circuit.

We see that circuit 3 has correctly used the Ammeter to measure the current.

Activity to Find Out the Current at Different Parts of a Series Circuit

Consider a circuit diagram containing one cell/battery, one lamp, one buzzer, and an ammeter.

Make the circuit as shown below. We will place the ammeter in three different positions (P, Q & R)of the circuit.

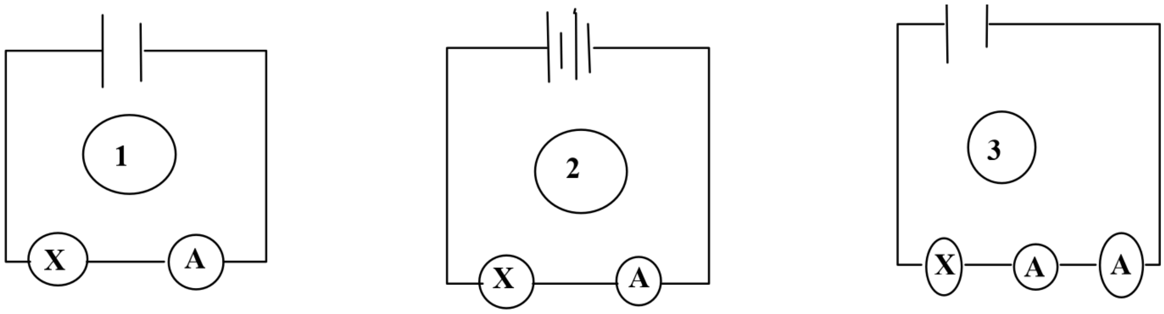


Can you predict where the readings of the ammeter in three positions P, Q, & R would be same or different.
We will find that ammeters in position P, Q and R will show the same reading.
It means current remains the same at all points in a Series circuit.
Reason - A series circuit is like a simple road on which cars (electrons) are moving.
If 10 cars (electrons) leaves from negative terminal of battery, then these 10 car (e) will move and reach the positive terminal of the battery.

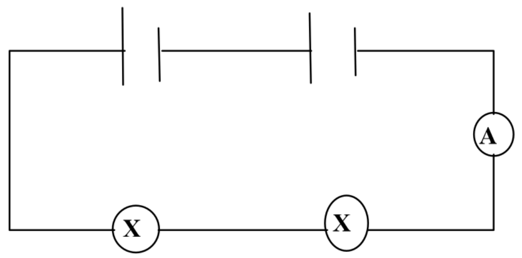
So the current remains the same.

- Adding or Removing Components in a Circuit.

Cell/Battery are source of energy in an electric circuit. They give energy to electron to move in a circuit.
So it means that if we add more cells/batteries, the current will also increase.
Cells/Battery increases means Current will increase.
We know that lamps convert electrical energy into light energy.
Similarly Buzzer transfers electrical energy into sound energy.
So if a circuit has only one lamp, all the electrical energy is available to a single lamp.
But if we use two lamps, then the electrical energy of the current is shared between two lamps. So they get less energy and hence will glow dimmer.
Also since lamp takes away electrical energy so electrons start moving slowly. This means small current decreases.
So if the number of lamps increases, the current in the circuit decreases.
Summary:
If number of lamps increases, then their brightness and current decreases.
Problem: Consider the circuit diagrams below. All the components are identical in these circuits.



Which of these circuits will have the maximum and the minimum value of current? Explain your answer?
Solution: We know that current in a circuit increases if the number of cell/battery increases.
Also current in a circuit will decrease if the number of lamps (components) are increased.
Circuit 2 will have maximum current because it has 2 cells and a single lamp.
Circuit 3 will have minimum current because it has a single cell and two lamps.
We can arrange these circuit in order of increasing current reading as:-
Circuit 3 < Circuit 1 < Circuit 2
Problem: Look at the circuit diagrams and suggest two ways to increase and decrease the current in this current.



Solution: The circuit has a battery, two lamps and an ammeter.

Two ways to increase the current

a) Increase the number of cell / battery.

b) Reduce the numbers of lamps.

Two ways to decrease the current

a) Reduce the number of cell/batteries

b) Increase the number of lamps or add other components like buzzer, motor, etc.

Type 4: Electric Circuit Models

Type 5: Miscellaneous Problems

Problem: Suggest how a plastic ruler can be given an electrostatic charge?

Solution: A plastic ruler can be given an electrostatic charge by rubbing it against our skin, hair or on any piece of cloth.

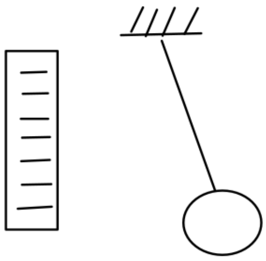
This rubbing transfers electron from one object to another.

Generally the plastic ruler gets a negative charge when it is rubbed against our skin/hair.

Problem: A negative charged plastic ruler is brought close to a charged sphere suspended through a string.

Considering the position of the ruler and the sphere. State and explain-

- what could be the charge on the sphere. If the negatively charged plastic ruler is removed and replaced by a positively charged plastic ruler, what would be the position of the sphere?

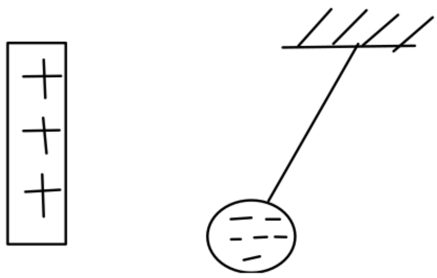


Solution: From the figure, it is clear that the sphere is repelled by the plastic ruler.

We know that Like (same) charges repel each other.

Hence we can say that the sphere also has a negatively charged on it.

If the positively charged plastic ruler is replaced by a positively charged plastic ruler, then the sphere will be attracted towards it because Unlike (different) charges attract each other.



Problem: Name the instrument used to measure electric current? How should it be connected in a circuit? Give its symbol?

Solution: Ammeter is used to measure current. The unit of measuring current is Ampere (A).

An ammeter is always connected in series in a circuit.

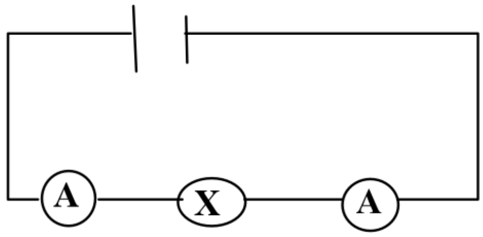
Its symbol is 

.

Problem: Venus made a circuit containing a cell and a lamp. She wanted to measure the amount of current entering the lamp and the amount of current leaving the lamp. Can you help Venus to draw an electric circuit for the set up.

Use your knowledge of current electricity to predict whether the readings of the two ammeters is same or different?

Solution: Venus can make this circuit



Both the ammeters will show same value of current because current in a series circuit is same at all parts of the circuit.

Problem: Give example of two materials that are (a) Conductors (b) Insulators.

Solution: Examples of Conductors are Silver, Copper, Aluminium (all metals).

Examples of Insulators are Wood, Plastic, Rubber, Glass.

Problem: Ampere is the unit of current. Calculate how many milliamps are there in 1 amp.

Solution: SI unit of current = Ampere (Amp)

1 amp has 1000 milliamps.

Reason: 1 Amp = 1000 milli amps

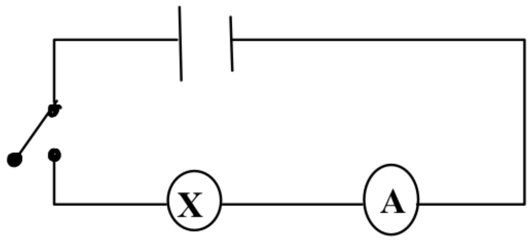
$= 1000*10^{3}$ amps (milli $= 10^{3}$)

$= 10^{3}*10^{3}$amps

= 1 amps

Problem: Draw a circuit diagram showing a battery, a lamp, a switch in series circuit. Also add an ammeter to measure the current flowing in the circuit.

Solution: Series circuit means a single loop for flow of current.



Problem: Explain in terms of movement of electrons the process of a balloon (or a plastic ruler) becoming negatively charged when rubbed against our skin.

Solution: When two materials are rubbed against each other, then electrons get transferred from one material to another.

Electrons are negative charged particles. If a particle has excess electrons it becomes negatively charged and if it has fewer electrons it becomes positively charged.

In case of balloon rubbing against skin, electrons move from the skin to the balloon.

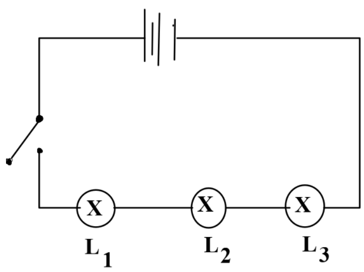
This makes the skin positively charged and the balloon negatively charged.

Type 6: Comparing Circuit

Problem: (a) Draw a circuit diagram where three lamps can be switched ON and OFF together in a car?"

Solution: We need a circuit with three lamps connected in series with a switch. The power source is the Car battery.

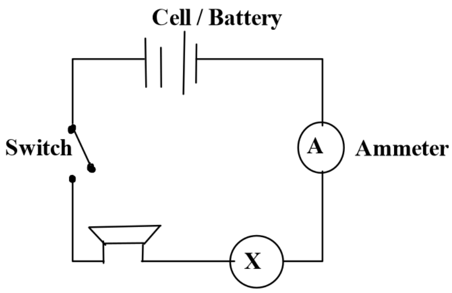
Car battery



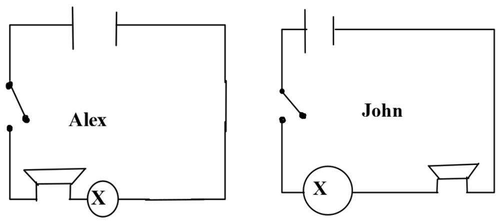
(b) Draw a circuit where a door bell with a lamp can be switched ON and OFF together, along with a way to measure current flowing through the door bell?

Solution: The door bell and the lamp should go ON and OFF simultaneously together. Hence they must be connected in series with a switch and power source (Cell/Battery).

To measure the current through the door bell. We will use an Ammeter in the circuit. Ammeters can be placed anywhere because same current flows in every part of a series circuit.



Problem: Alex and John were asked to draw a circuit diagram where a car headlight and horn turn on and off at the same time with one switch. Their diagrams are:



1. Are these circuit diagrams correct?
2. The above two diagrams are different yet correct explain?

Solution: 1. Yes, the circuit diagrams drawn by Alex and John are correct. Both the diagrams have a buzzer and a lamp connected in series with a battery using a switch.

The diagrams are different in the sense that the position of the lamp and buzzer is inter-changed, but it will not make any difference because they are connected in a series circuit. The same current flows through all parts of a series circuit, regardless of the order of the components.

Hence, both the diagrams are different and yet correct at the same time.