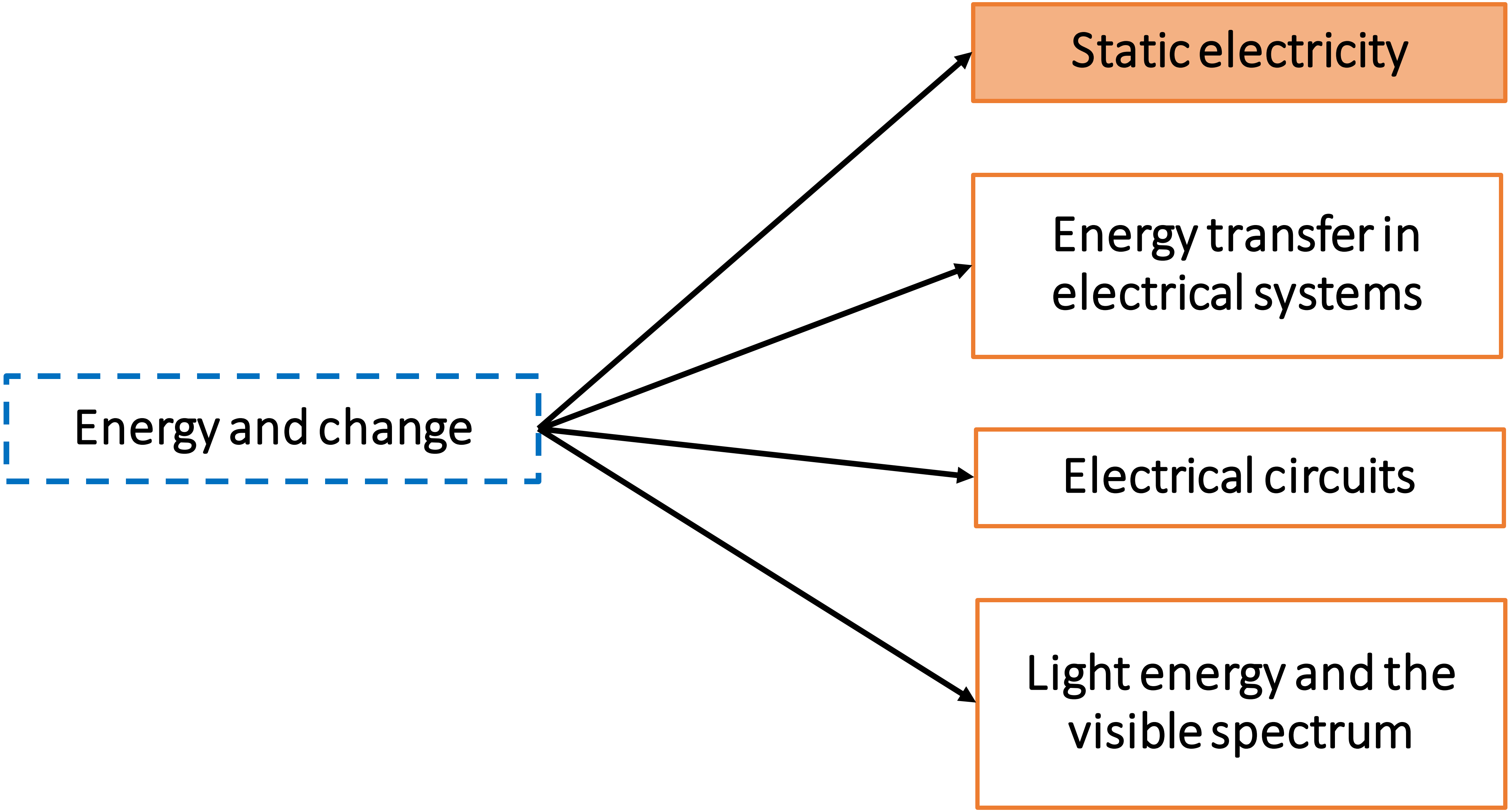
Term 3: Energy and change

Mrs Ramuhashi





Energy and change
Static electricity
Energy transfer in electrical systems
Electrical circuits
Light energy and the visible spectrum

Static electricity is an imbalance of **electric** charges within or on the surface of a material. The **charge** remains until it is able to move away by means of an **electric** current or **electrical discharge**.

A static electric charge can be created whenever two surfaces contact and separate, and at least one of the surfaces has a high resistance to electric current (and is therefore an electrical insulator). The effects of static electricity are familiar to most people because people can feel, hear, and even see the spark as the excess charge is neutralized when brought close to a large electrical conductor (for example, a path to ground), or a region with an excess charge of the opposite polarity (positive or negative). The familiar phenomenon of a static shock – more specifically, an electrostatic discharge – is caused by the neutralization of charge.

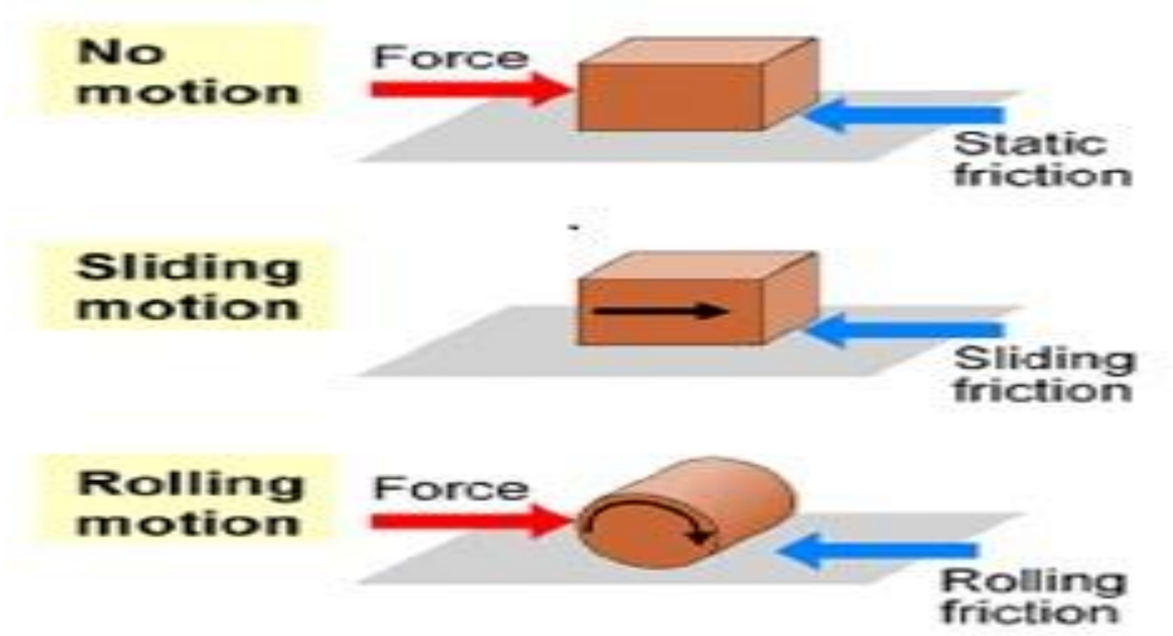
Material that can be used for friction and static electricity

- Human hands (usually too moist, though) *Very positive*
- Rabbit fur
- Glass
- Human hair
- Nylon
- Wool
- Fur
- Lead
- Silk
- Aluminum
- Paper
- Cotton
- Steel *Neutral*
- Wood

Amber
Hard rubber
Nickel, Copper
Brass, Silver
Gold, Platinum
Polyester
Styrene (Styrofoam)
Saran Wrap
Polyurethane
Polyethylene (like Scotch Tape)
Polypropylene
Vinyl (PVC)
Silicon
Teflon *Very negative*

Friction is the force that opposes the motion of an object.

Types of Friction



Two Friction forces

kinetic friction force. It is exerted on one surface by another when the two surfaces rub against each other because one or both surfaces are moving. If you stack additional books on top of the first book to increase the normal force, the kinetic friction force will increase

Static friction force, which is the force exerted on the surface by another when there is no motion between the two surfaces.

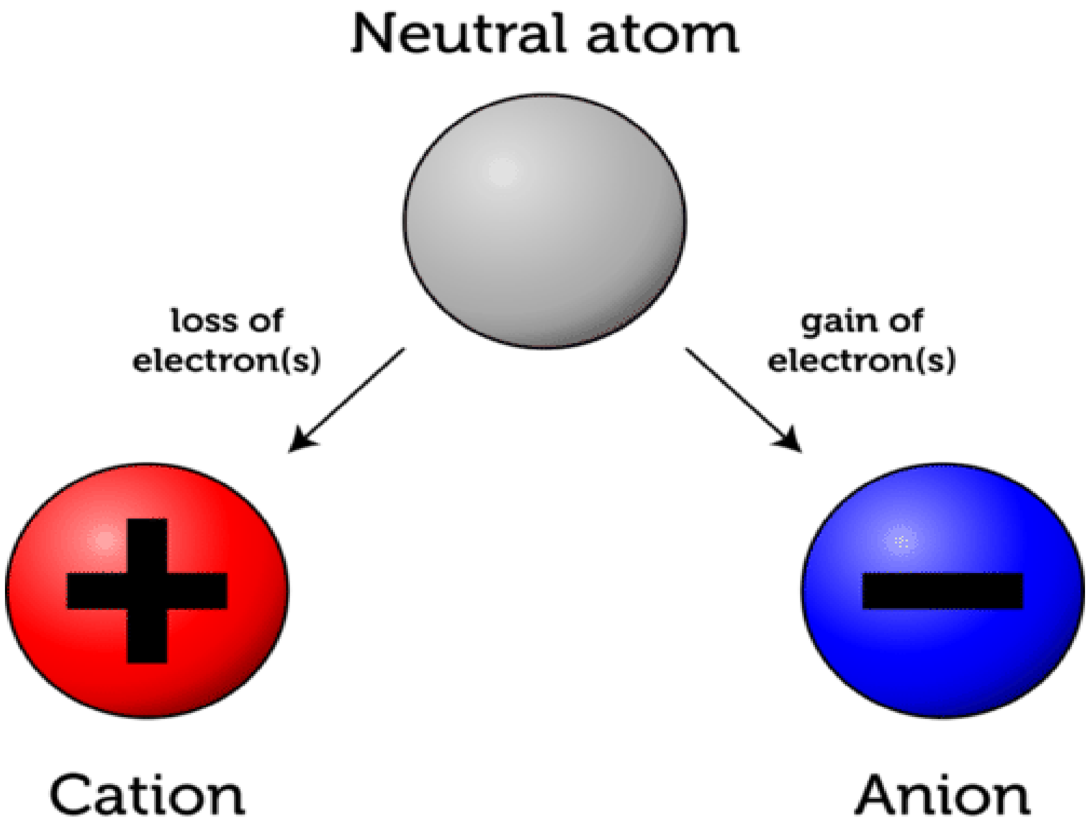
Transfer of Electric Charge

Why is this girl's hair standing straight up? She is touching a device called a van de Graaff generator. The dome on top of the device has a negative electric charge. When the girl places her hand on the dome, she becomes negatively charged as well—right down to the tip of each hair!

Q: What causes the hair to stand on end?
A: All of the hairs have all become negatively charged, and like charges repel each other. Therefore, the hairs are pushing away from each other, causing them to stand on end.

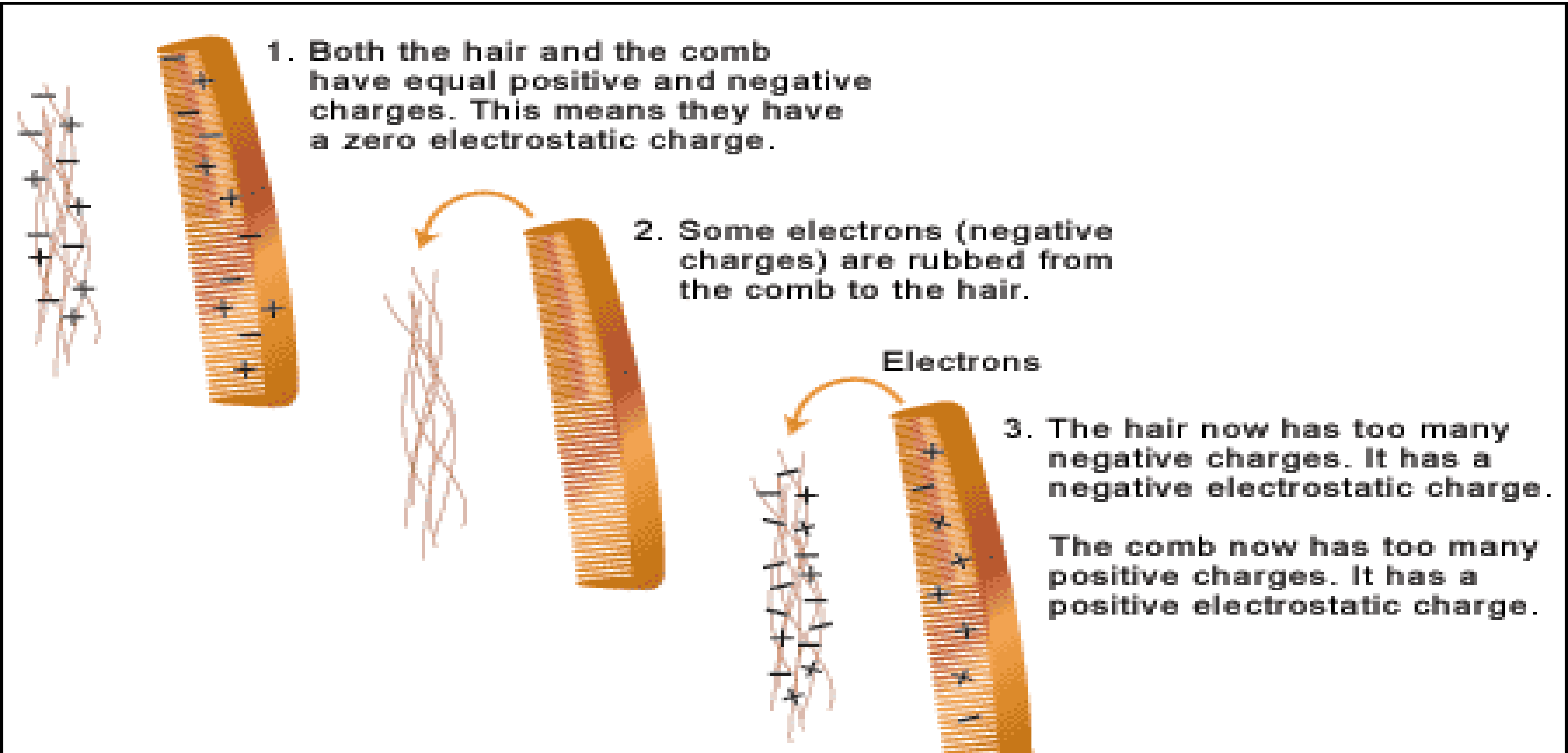
Transferring Electrons

The girl pictured above became negatively charged because electrons flowed from the van de Graaff generator to her. Whenever electrons are transferred between objects, neutral matter becomes charged. This occurs even with individual atoms. Atoms are neutral in electric charge because they have the same number of negative electrons as positive protons.



However, if atoms lose or gain electrons, they become charged particles called ions. You can see how this happens in the **Figure** below. When an atom loses electrons, it becomes a positively charged ion, or cation. When an atom gains electrons, it becomes a negative charged ion, or anion

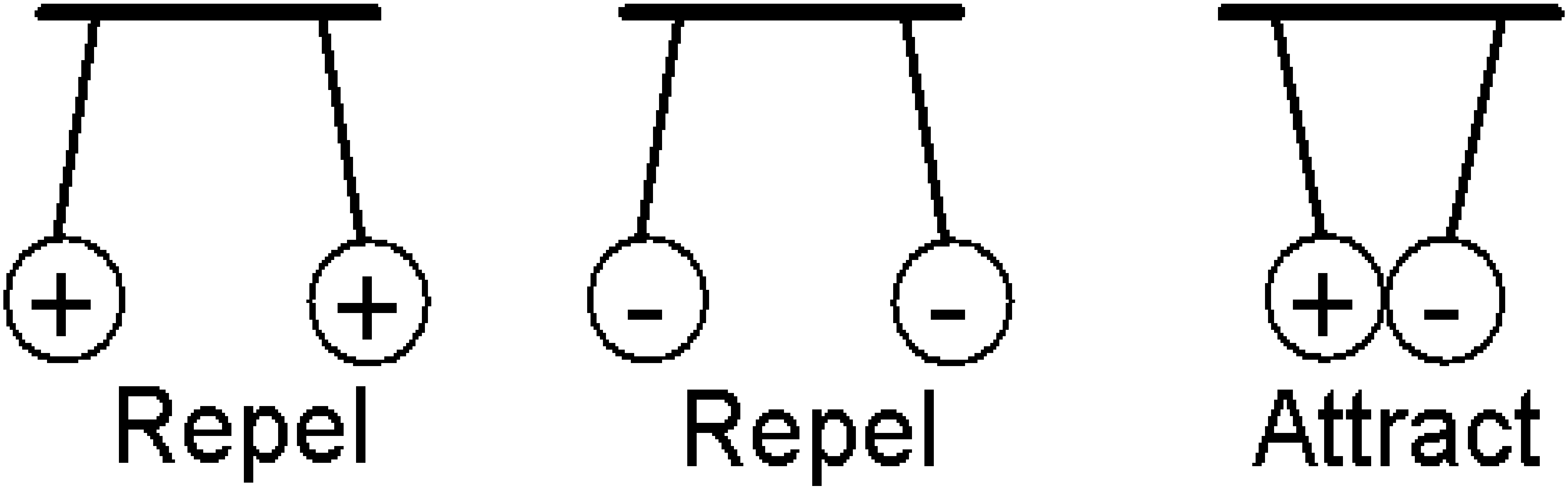
HAIR AND COMB CHARGE



The 'negative charge' that he described is actually the result of an object acquiring additional electrons. The 'positive charge' occurs as the result of the loss of electrons. The plastic rod being rubbed with fur is very much like the plastic comb you asked about. Like the rod with fur, when the comb is pulled through hair, it acquires a negative charge. That is, it picks up more electrons than it had before.

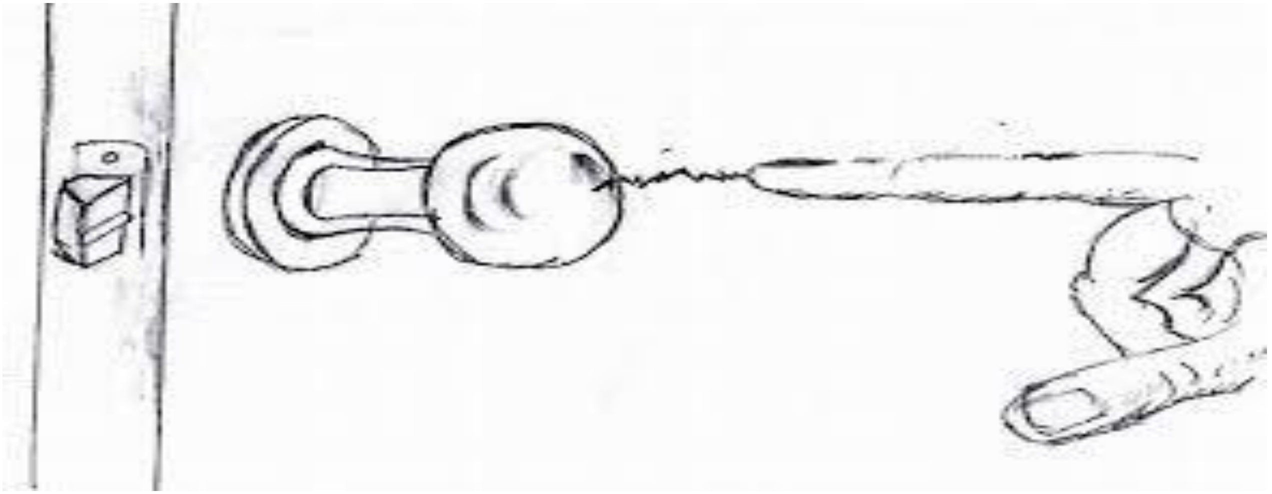
Another example of this the common trick of rubbing a plastic balloon in someone's hair. After being rubbed together, the plastic in the balloon picks up a negative charge, while the person's hair ends up with a positive charge. And as we all know, in this classic case of 'opposites attract', the hair will actually stick to the balloon. This attraction between oppositely charged objects is what we know as 'static'.

Static Electricity is produced by a concentration of Negative or Positive Electric Charges. Similar Charges Repel each other, but Opposite Charges Attract each other.



ELECTRIC SPARK AND SHOCK

Electric sparks an abrupt electrical discharge that occurs when a sufficiently high electric field creates an ionized, electrically conductive channel through a normally-insulating medium, often air or other gases or gas mixtures. Michael Faraday described this phenomenon as "the beautiful flash of light attending the discharge of common electricity".



SHOCK- static shock is the result of the redistribution of electric charges between different materials. While relatively harmless, static shocks can be annoying and even painful.

Activity 1 TERM 3

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Write answers in your classwork book

QUESTIONS FOR REVISION

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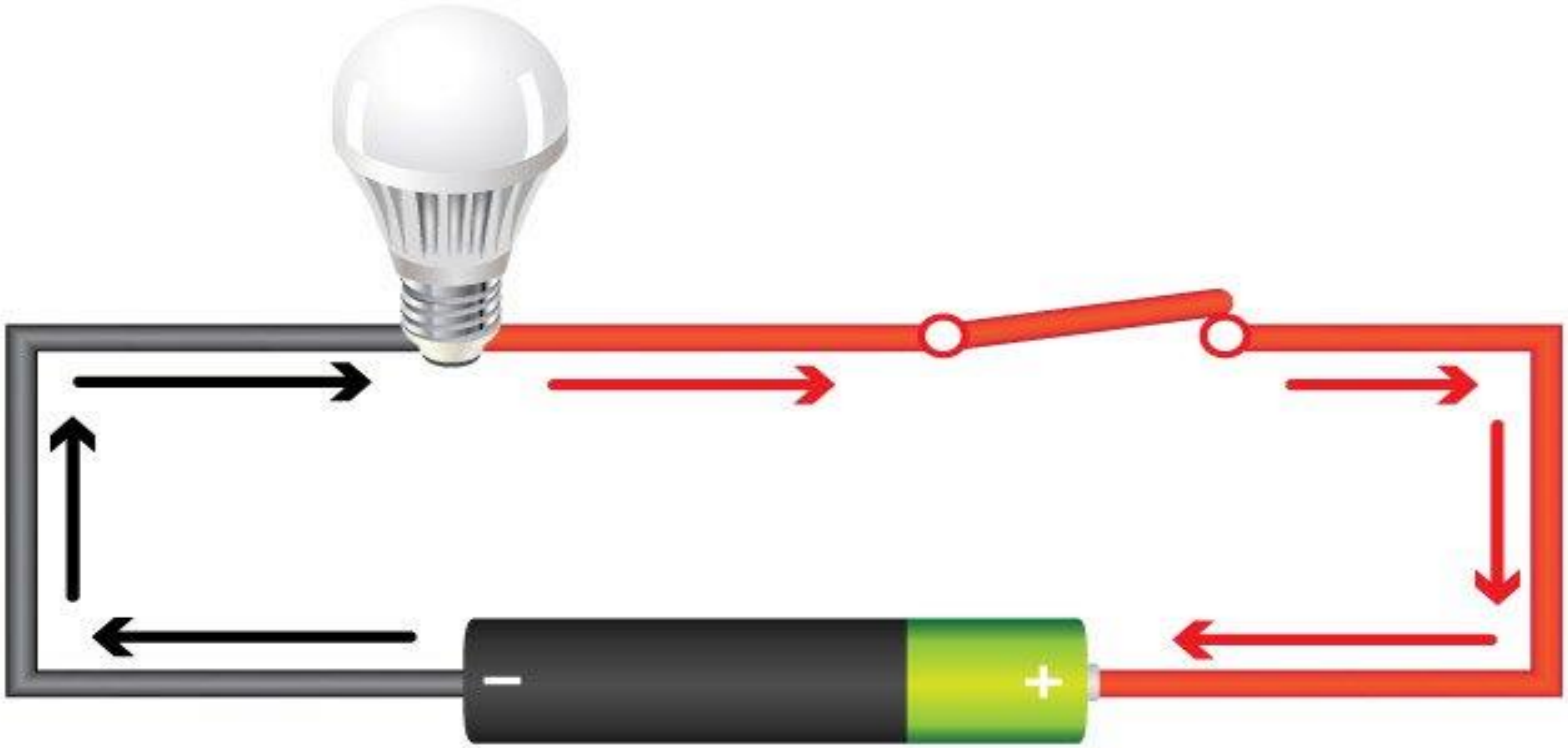
QUESTION 1
QUESTION 2
QUESTION 3

Circuits and current electricity

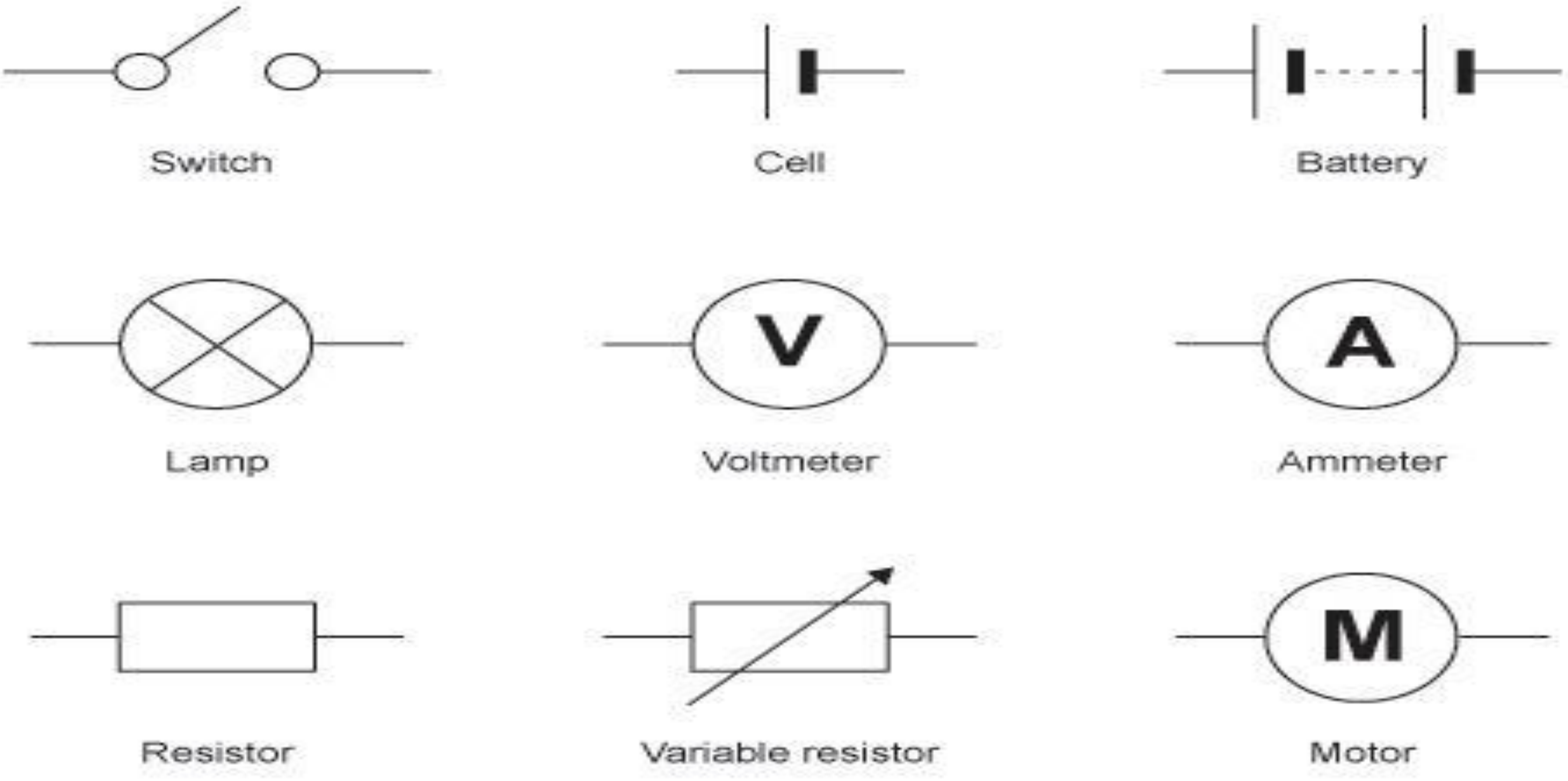
An electric current is the movement of charge in a closed, conducting circuit

A complete circuit is a complete conducting pathway for electricity. It goes from one terminal of a cell along conducting material, through a device and back to the other terminal of the cell.



- An electric circuit needs a **source of energy** (a cell or battery).
- Cells have positive and negative terminals.
- A circuit is a **complete pathway** for electricity.
- The circuit must be **closed** in order for a device to work, such as a bulb which lights up.
- We can say that an electric circuit is a **closed system** which transfers electrical energy.
- A circuit is made up of various **components**,

Electrical symbol



ELECTRIC CELL AS ENERGY SYSTEM

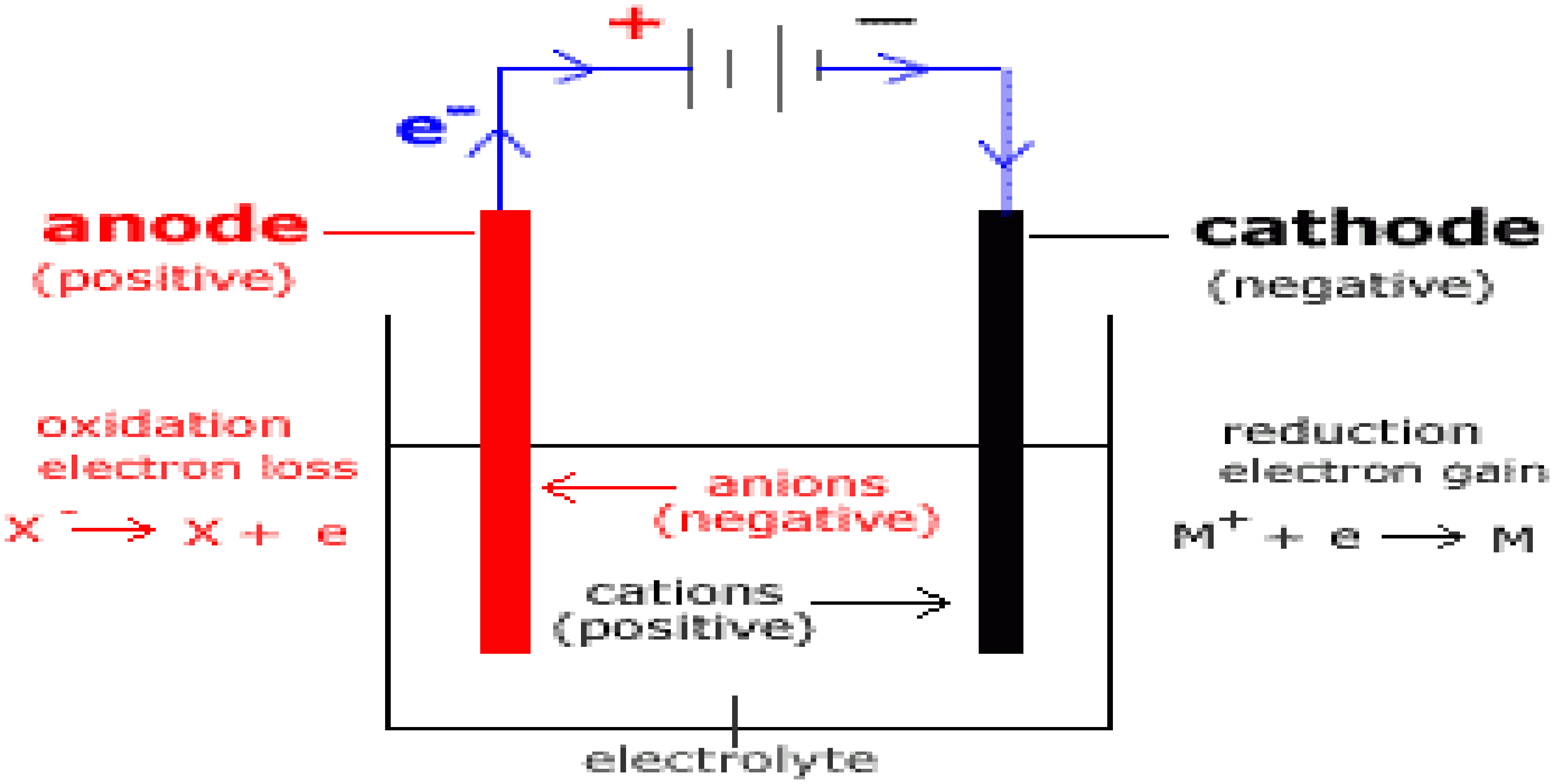
Electric cell is a device that converts chemical energy to electrical energy. Cell comprises **of two electrodes** and **an electrolyte**. **Electrodes** are made of materials that participate in chemical reaction with the **electrolyte**. There are two kind of chemical reactions happening within the cell at ,**oxidation** and **reduction**.

Oxidation implies the electrode material loses electron and positive ions dissolves into the electrolyte.

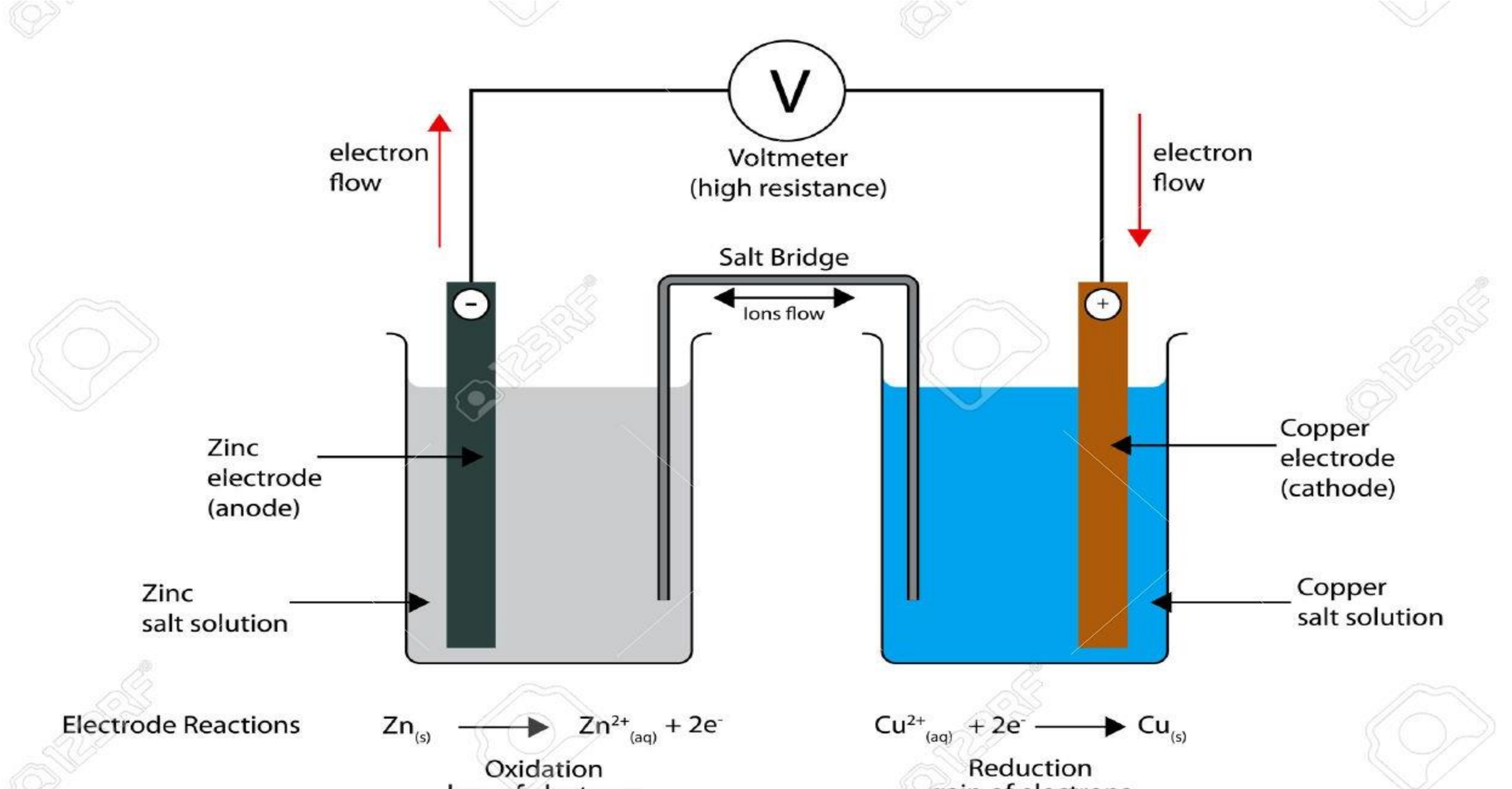
This happens at one electrode(called **anode**) and this electron can flow out if the anode to external conducting wire provided there is a strong pulling force(called **reduction potential**) at the other electrode where this electron is accepted by the ion and deposits as metal in the electrode (called **cathode**). This two half cell reaction when combined (i.e. oxidation and reduction) is called redox chemical reaction. This is responsible for the flow of electrons in the external circuit which can be used to drive different electrical load.

Electrolysis is the process in which ions are decomposed or break into **simple** substances when electric current is passed into it. The word Lysis means destroy or destruction. ... Cathode attracts the positively charged ions and anode attracts the negatively charged ions.

ELECTROLYSIS



SIMPLE CELL/ELECTROLYSIS



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QUESTIONS FOR REVISION

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QUESTION 1
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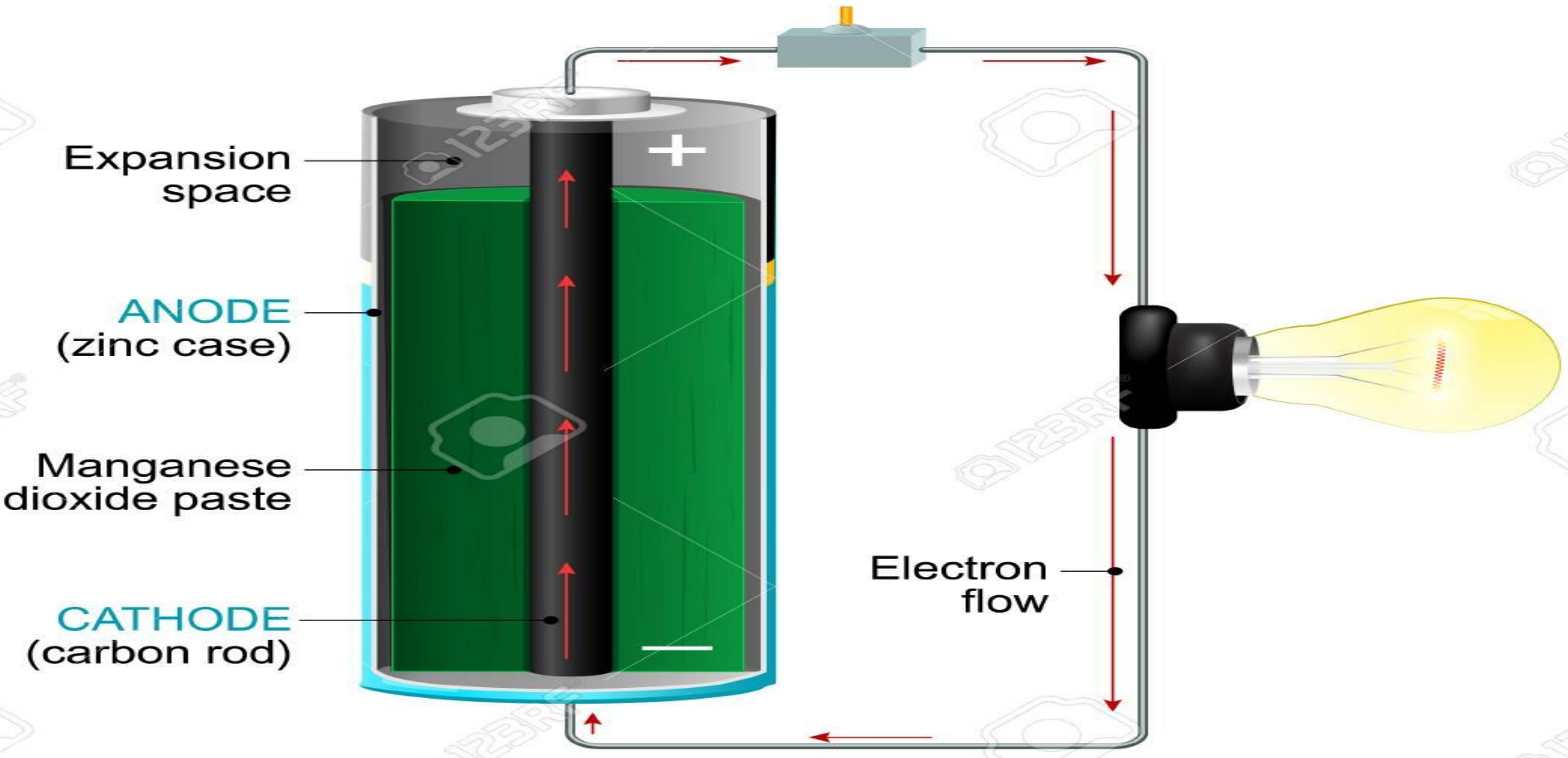
Dry cell battery



USES OF ELECTRIC CELL

Electrical cell is the one which generates electricity independently. It converts stored **chemical energy** into **electrical energy**. Cells are used in hand held instruments. Your mobile phone is powered by an electric cell. Also your laptop computer.

Source of electricity in an electric cell

Cells using **electricity**

An **electrical cell** (or an "electrolytic **cell**") is used for these reactions. It is a container which has to have a chemical reaction involving electrodes. The chemical substances are exposed to **electrical power**, and the electrolysis reaction happens inside the **electrical cell**.

Two **types** of electrochemical **cells**:

A Galvanic **Cell** or Electrolytic **Cell** and Voltaic **Cell** induces a spontaneous redox reaction to create a flow of **electrical** charges, or **electricity**. Non-rechargeable batteries are examples of Galvanic **cells**.

Voltaic cell

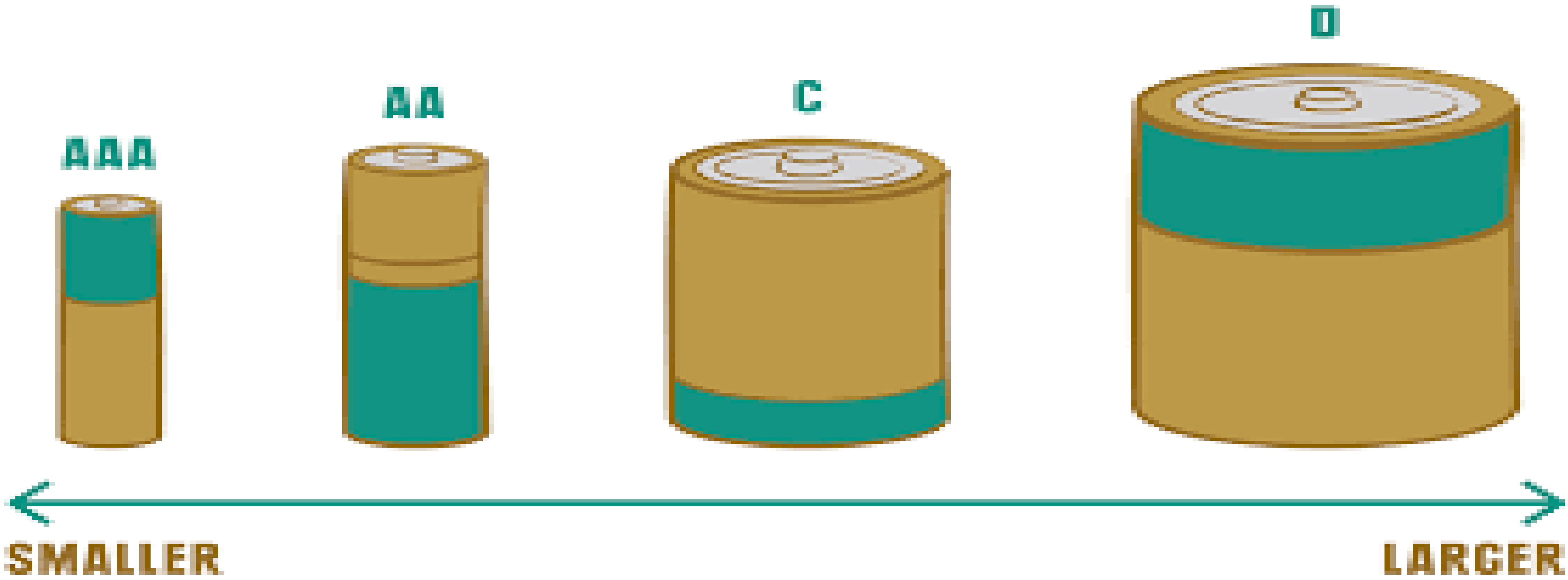
- Spontaneous
- Chemical → Electrical
- Uses activity differences between two metals to create electricity
  - Voltage generated = VOLTaic

Electrolytic cell

- Non-spontaneous
- Electrical → Chemical
- Electrolysis
  - Lyse = break
  - Uses electricity to break ionic compounds

Three secondary batteries commonly used for laptops:
Nickel Cadmium, Nickel Metal Hydride, and Lithium Ion

Primary batteries are "single use" and cannot be recharged. Dry **cells** and (most) alkaline batteries are **examples of primary** batteries. **Flashlight or smoke detector** have simple dry **cell** or batteries. In these **cells** Zn acts as anode and graphite electrode acts as cathode. The electrolyte **is** ZnCl2 and ammonium chloride.




AAAA
AAA
AA
C
D
J
N
9B

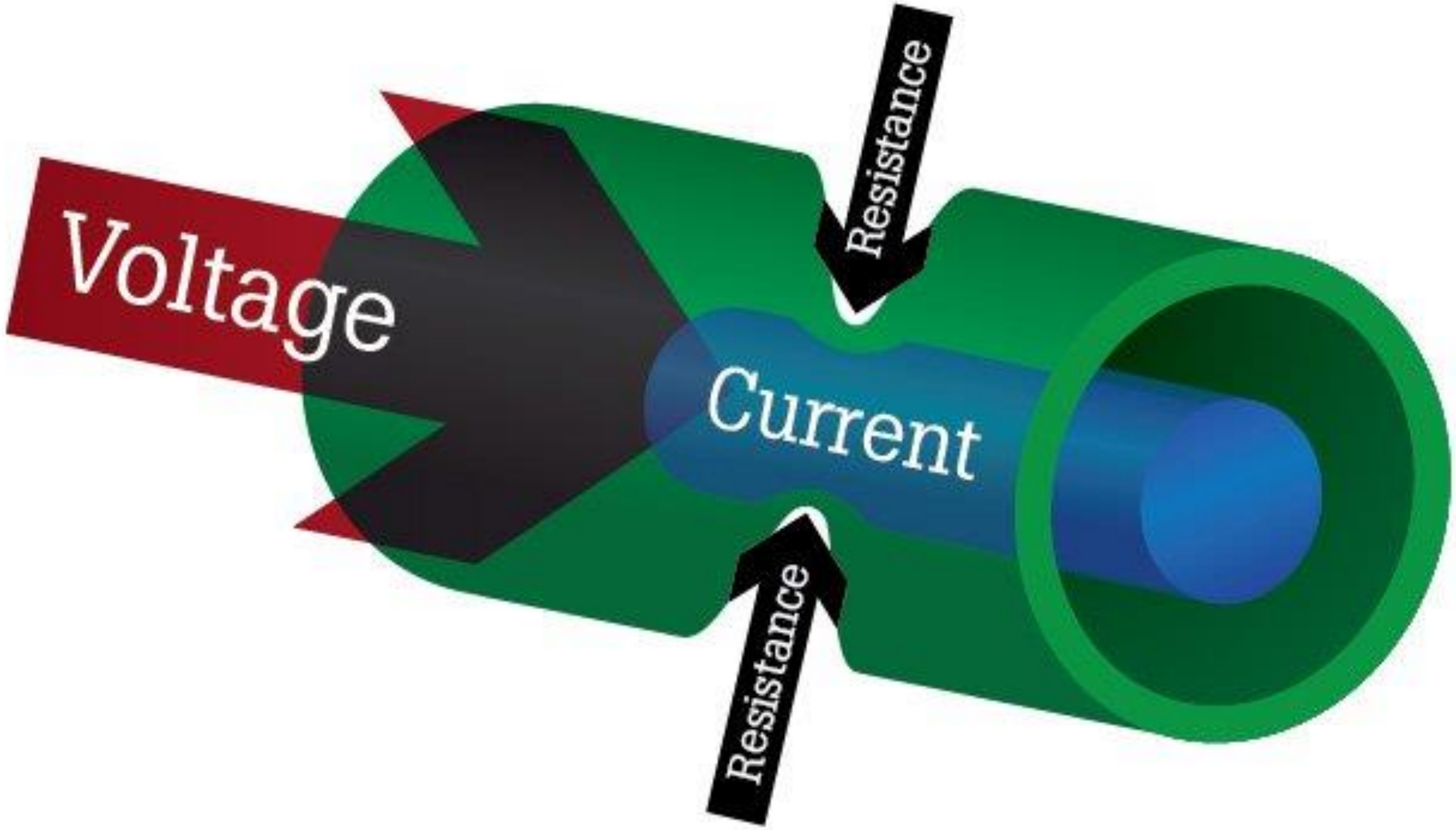

Types of Battery
Different Types of Battery and their Advantages and Disadvantages


Li-ion
ENERGY
ACCUMULATOR 3000
ACCUMULATOR 2500
Li-ion
A23
Alcline
A23
BATTERY
ACCUMULATOR
Alcaline
9v
Battery
4.5v
ACCUMULATOR
Battery
Battery
1.5v
C
Li-ion
AAA
Alcline
AAA
12V
Battery
Li-ion
ALCALINE
ENERGY
12v
4.5v
1.5v
3v
ENERGY
AA
ALCALINE
AA
ENERGY
9V

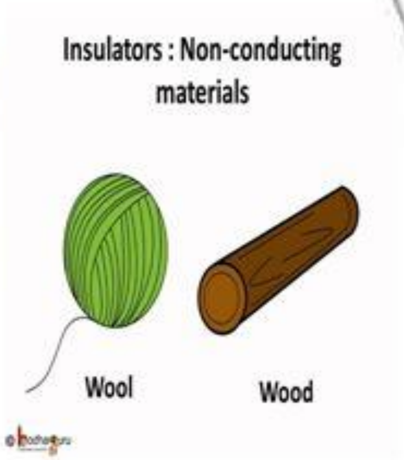
Resistance and Ohm’s law

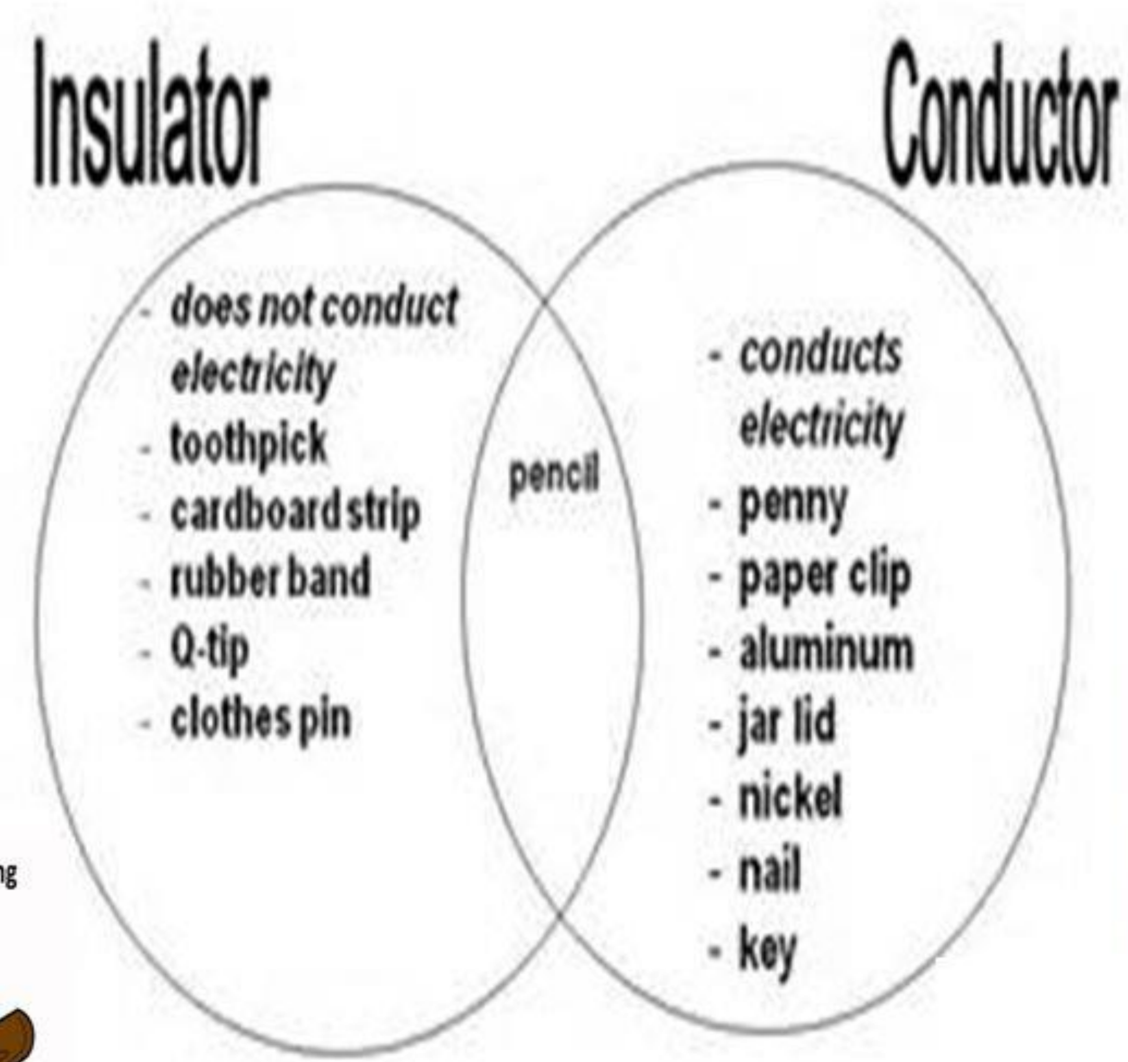
Resistance is a measure of the opposition to current flow in an electrical circuit. **Resistance** is measured in ohms, symbolized by the Greek letter omega (Ω). Ohms are named after Georg Simon Ohm (1784-1854), a German physicist who studied the relationship between voltage, current and **resistance**.

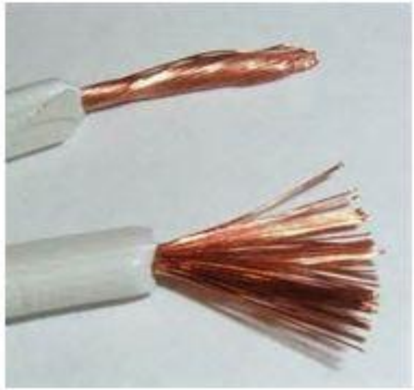
An electric current flows when electrons move through a conductor, such as a metal wire. The moving electrons can collide with the ions in the metal. This makes it more difficult for the current to flow, and **causes resistance**.


Voltage
Resistance
Current
Resistance

Insulators
Conducto







Resistance is the measure of opposition to electric current. • A short **circuit** is an electric **circuit** offering little or no **resistance** to the flow of current. Short **circuits** are dangerous with high voltage power sources because the high currents encountered can cause large amounts of heat energy to be released.

In **electrical** terms, this is represented by two **circuits** with equal voltages and different resistances. The **circuit** with the higher **resistance** will allow less charge to flow, meaning the **circuit** with higher **resistance** has less current flowing through it.

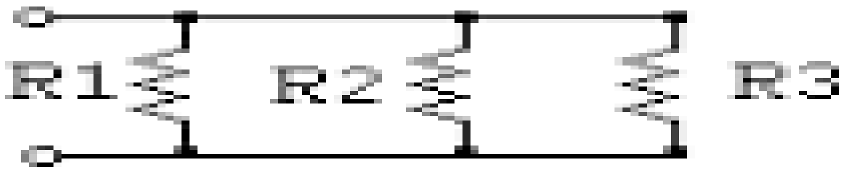
The total **resistance** of an electrical circuit with resistors wired in a **series** is the sum of the individual resistances: ... Each **resistor** in a **parallel** circuit has the same full voltage of the source applied to it. The current flowing through each **resistor** in a **parallel** circuit is **different**, depending on the **resistance**.

To **calculate** the total overall **resistance** of a number of **resistors** connected in this way you add up the individual resistances. This is done using the following **formula**: R total = R1 + R2 +R3 and so on. Example: To **calculate** the total **resistance** for these three **resistors in series**.

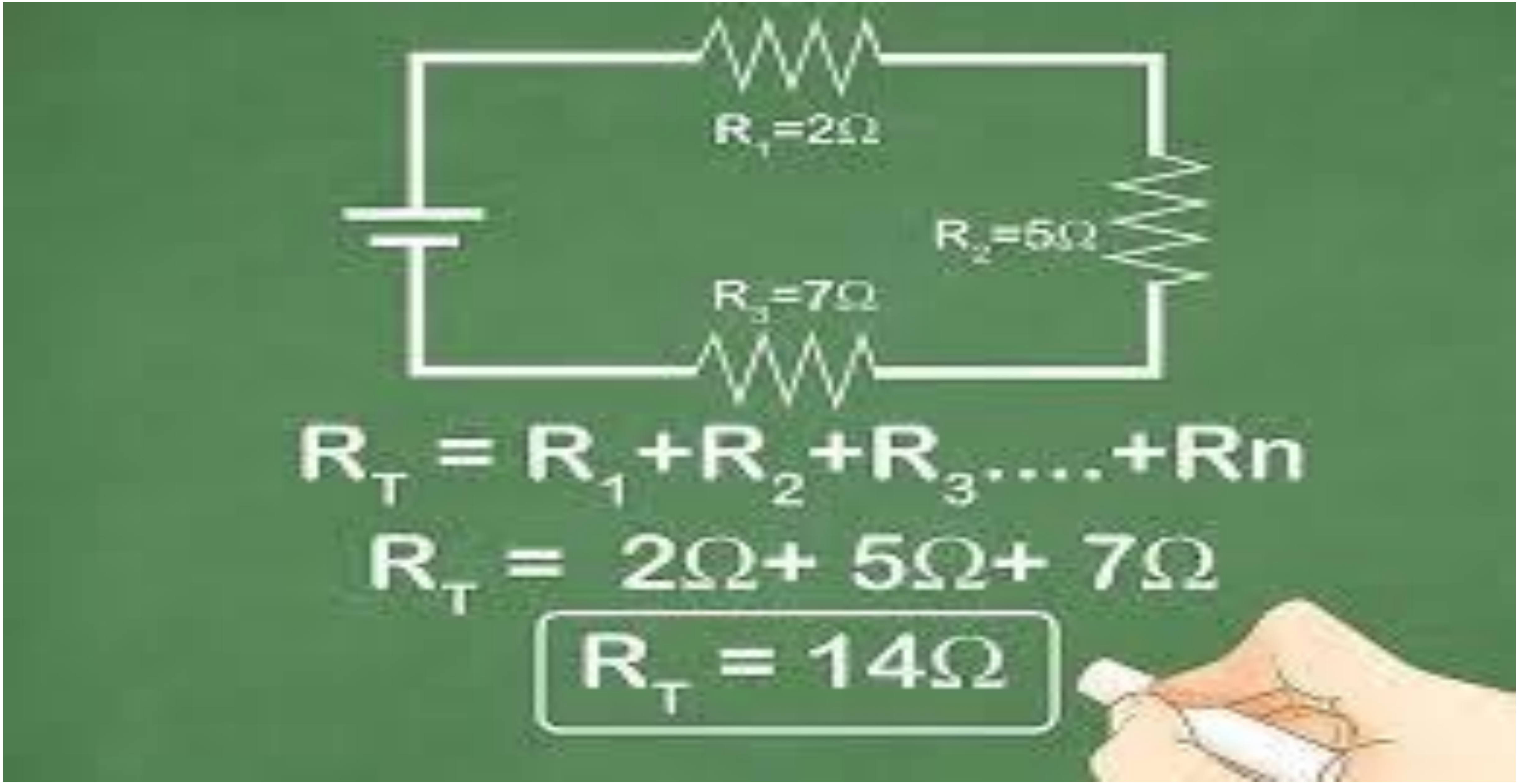
Resistors in series

$$R_s = R1 + R2 + R3$$

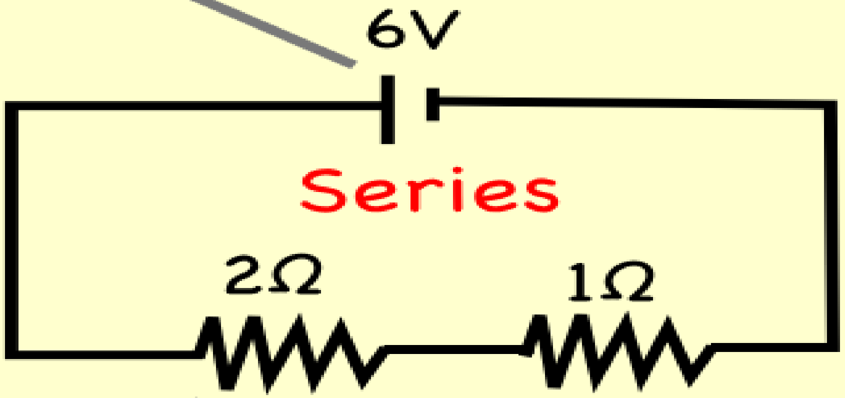
Resistors in parallel.



$$R_p = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$


R1=2Ω
R2=5Ω
R3=7Ω
RT = R1+R2+R3....+Rn
RT = 2Ω+ 5Ω+ 7Ω
RT = 14Ω

Battery (6 Volts)



Resistor (2 Ohms)

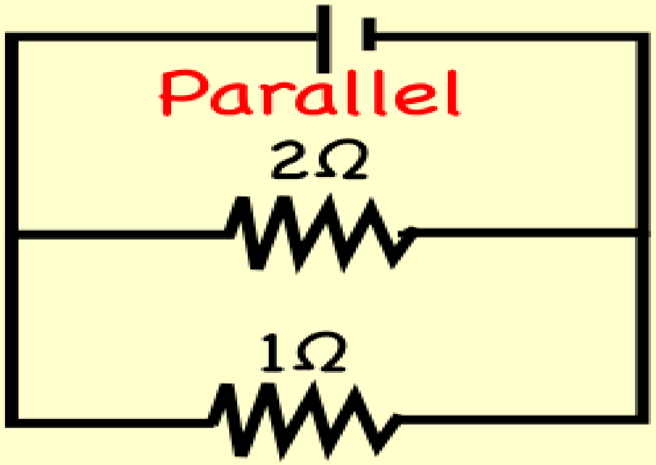
total resistance

$$R = R_1 + R_2$$
$$= 2\Omega + 1\Omega$$
$$= 3\Omega$$

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

$$I = \frac{V}{R} = \frac{6V}{3\Omega}$$
$$= 2\ A$$

total resistance



$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

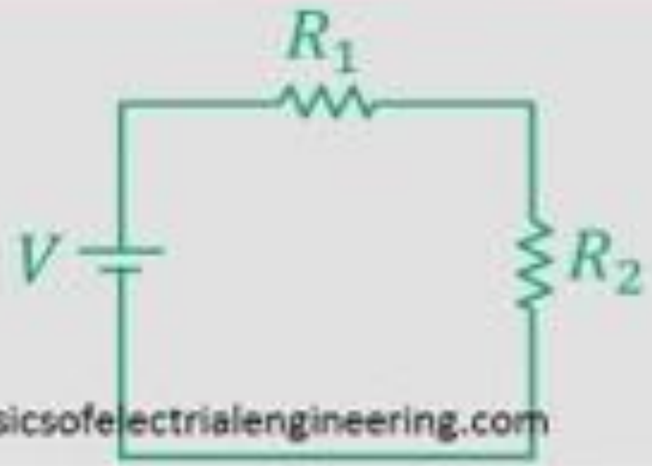
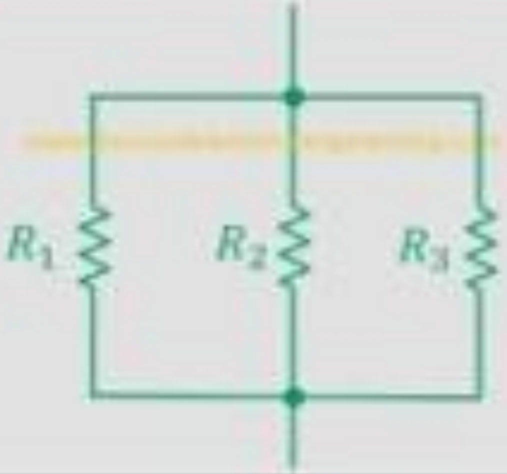
$$\frac{1}{R} = \frac{1}{1\Omega} + \frac{1}{2\Omega}$$

$$\frac{1}{R} = \frac{3}{2\Omega}$$

$$R = 2/3\ \Omega$$

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

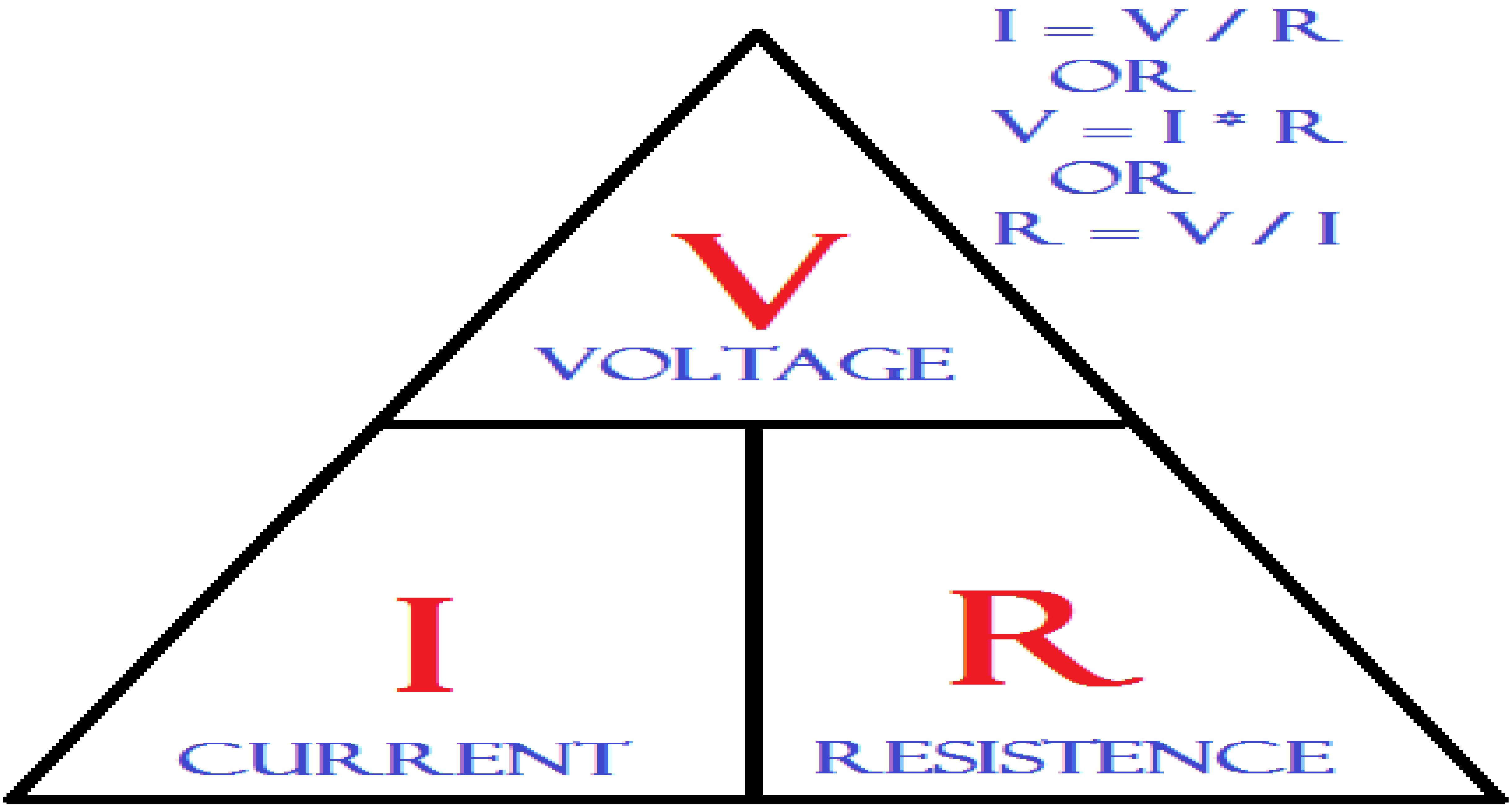
$$I = \frac{V}{R} = \frac{6V}{2/3\Omega}$$
$$= 9\ A$$

	Series	Parallel
How it looks		
Current	Always remains same in series	Divides in parallel
Voltage	Divides in parallel	Remains same in series
Equivalent resistance	$R_{eq} = R_1 + R_2 + R_3$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots \frac{1}{R_n}$

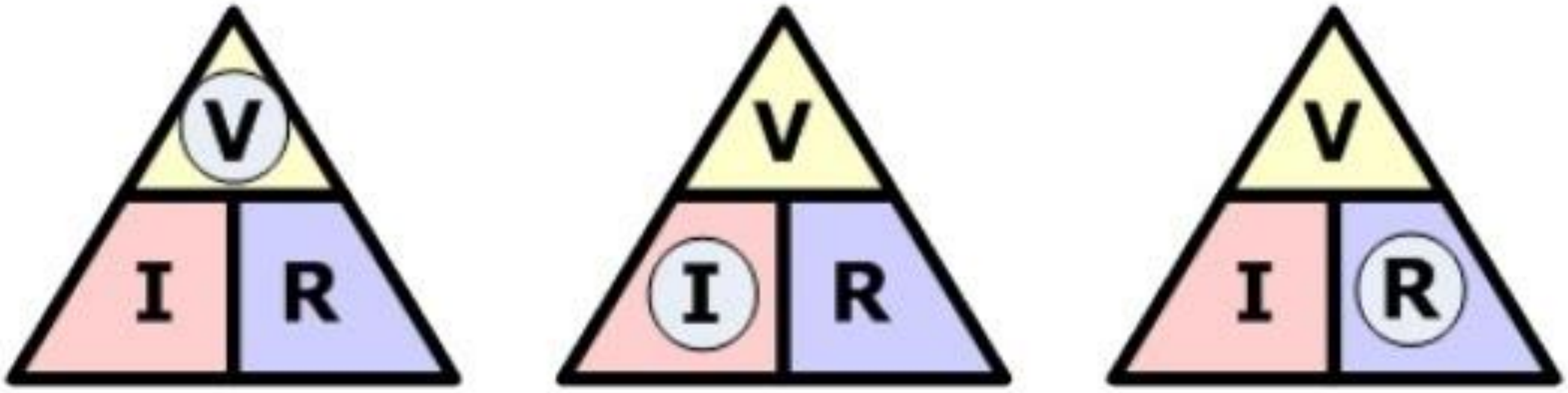
OHM'S LAW

This relationship states that: The potential difference (voltage) across an ideal conductor is proportional to the current through it. The constant of proportionality is called the "resistance", R. **Ohm's Law** is given by: V = I R where V is the potential difference between two points which include a resistance R.

If you **know the** total current and the voltage across the whole circuit, you can find the total **resistance** using Ohm's Law: R = V / I For example, a parallel circuit has a voltage of 9 volts and total current of 3 amps. The total **resistance** R = 9 volts / 3 amps = 3 Ω.


I = V / R
OR
V = I * R
OR
R = V / I
V
VOLTAGE
I
CURRENT
R
RESISTENCE

Ohm's Law Triangle



$$V = I \times R$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

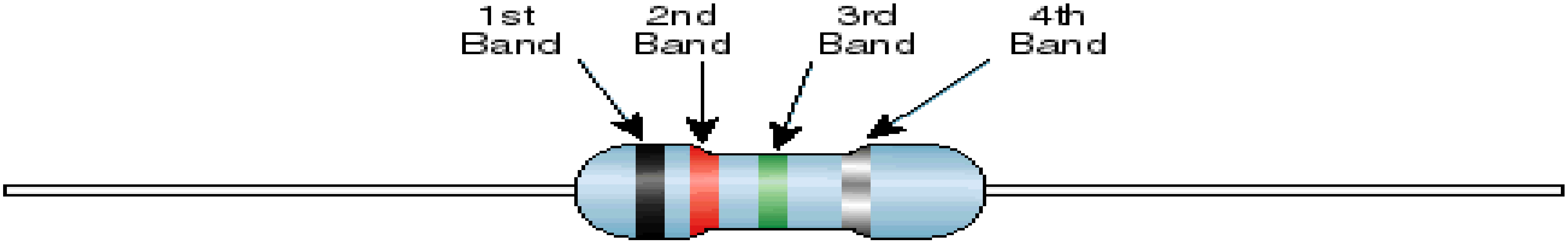
Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere ("Amp")	A
Voltage	E *or* V	Volt	V
Resistance	R	Ohm	Ω

RESISTOR

A **resistor** is a passive two-terminal electrical component that implements electrical **resistance** as a circuit element. In electronic circuits, resistors are **used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.**

The main **function** of resistors in a circuit is to control the flow of current to other components. Take an LED (light) for example. If too much current flows through an LED it is destroyed. So a **resistor** is used to limit the current.

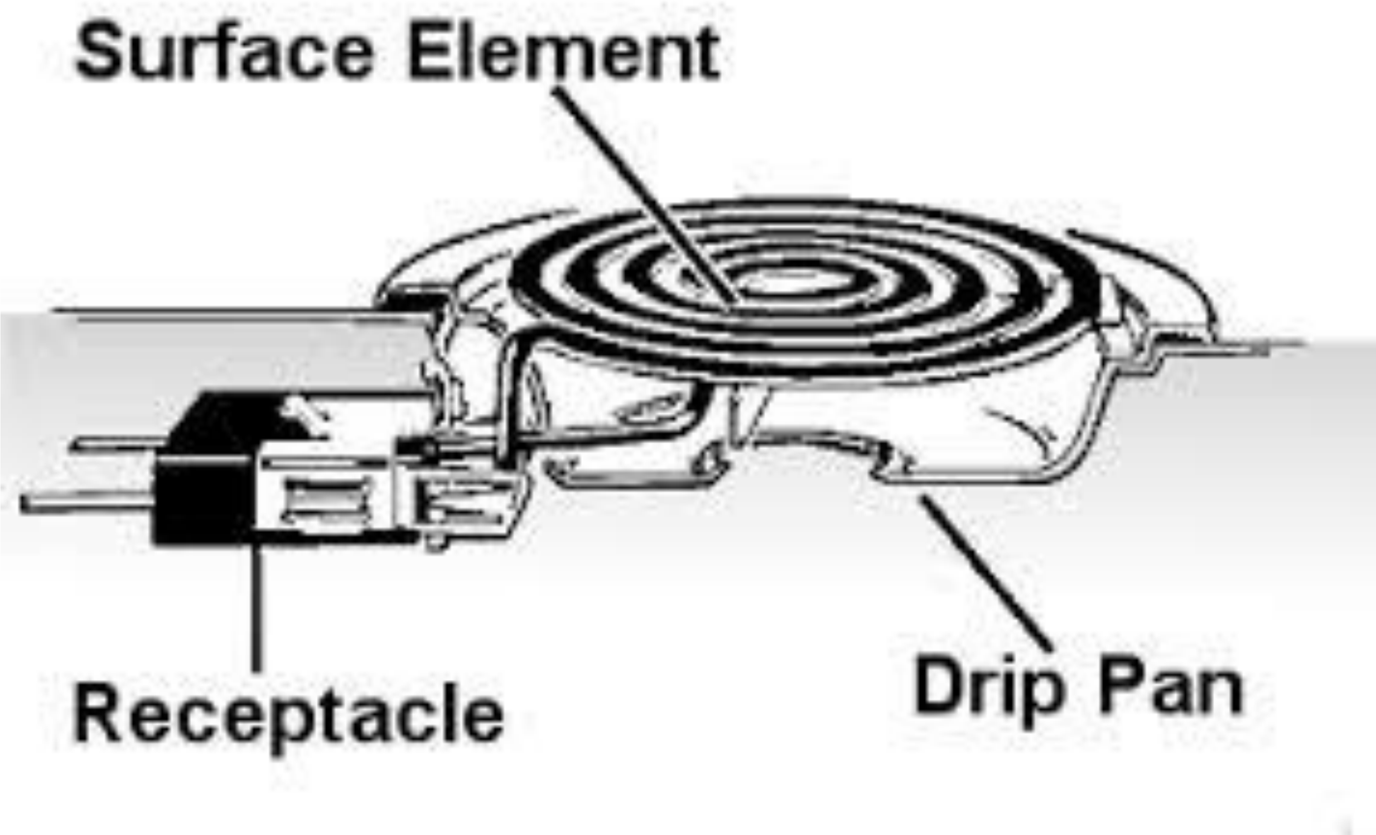
Standard EIA Color Code Table 4 Band: ±2%, ±5%, and ±10%

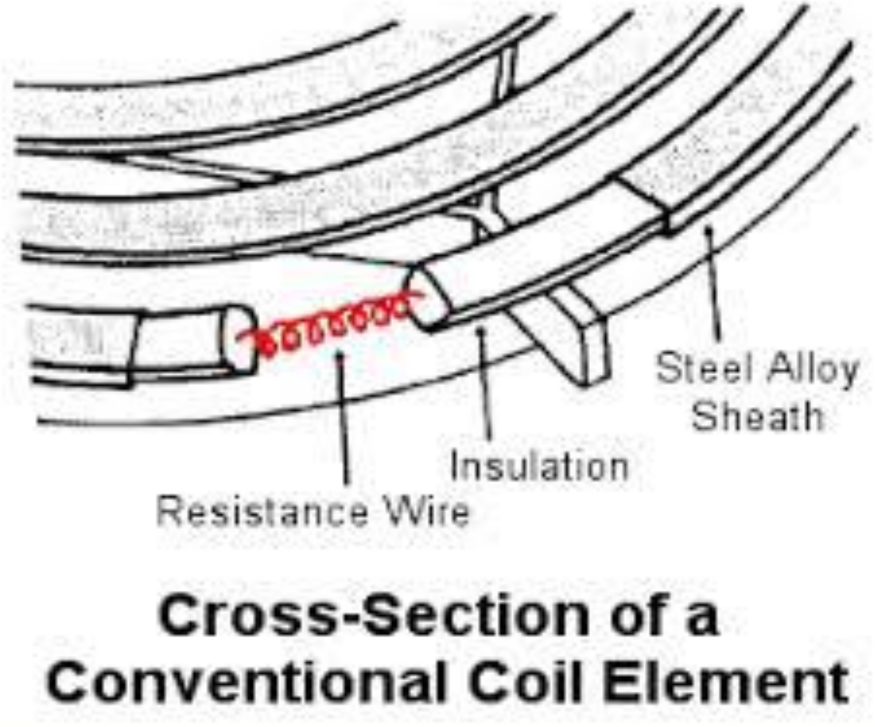


Color	1st Band (1st figure)	2nd Band (2nd figure)	3rd Band (multiplier)	4th Band (tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	±2%
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			10^{-1}	±5%
Silver			10^{-2}	±10%

Letters as an aid to memory	Colour	Figure (A, B)	Multiplier (C)
B	Black	0	10^0
B	Brown	1	10^1
R	Red	2	10^2
O	Orange	3	10^3
Y	Yellow	4	10^4
G	Green	5	10^5
B	Blue	6	10^6
V	Violet	7	10^7
G	Grey	8	10^8
W	White	9	10^9

Electrical elements are conceptual abstractions representing idealized **electrical components**, such as resistors, capacitors, and inductors, used in the analysis of **electrical** networks.






KIT
CHEN

fuse is an electrical safety device that operates to provide overcurrent protection of an electrical circuit. Its essential component is a metal wire or strip that melts when too much current flows through it, thereby interrupting the current.

The **function** of a **fuse** is usually to prevent fire - that's the basic protection a **fuse** offers - between power supply and appliance there may be a few feet or metres of cable - if a short circuit occurs in the appliance, the cable could easily become overheated (due to excess current) and burn or rupture its insulation.

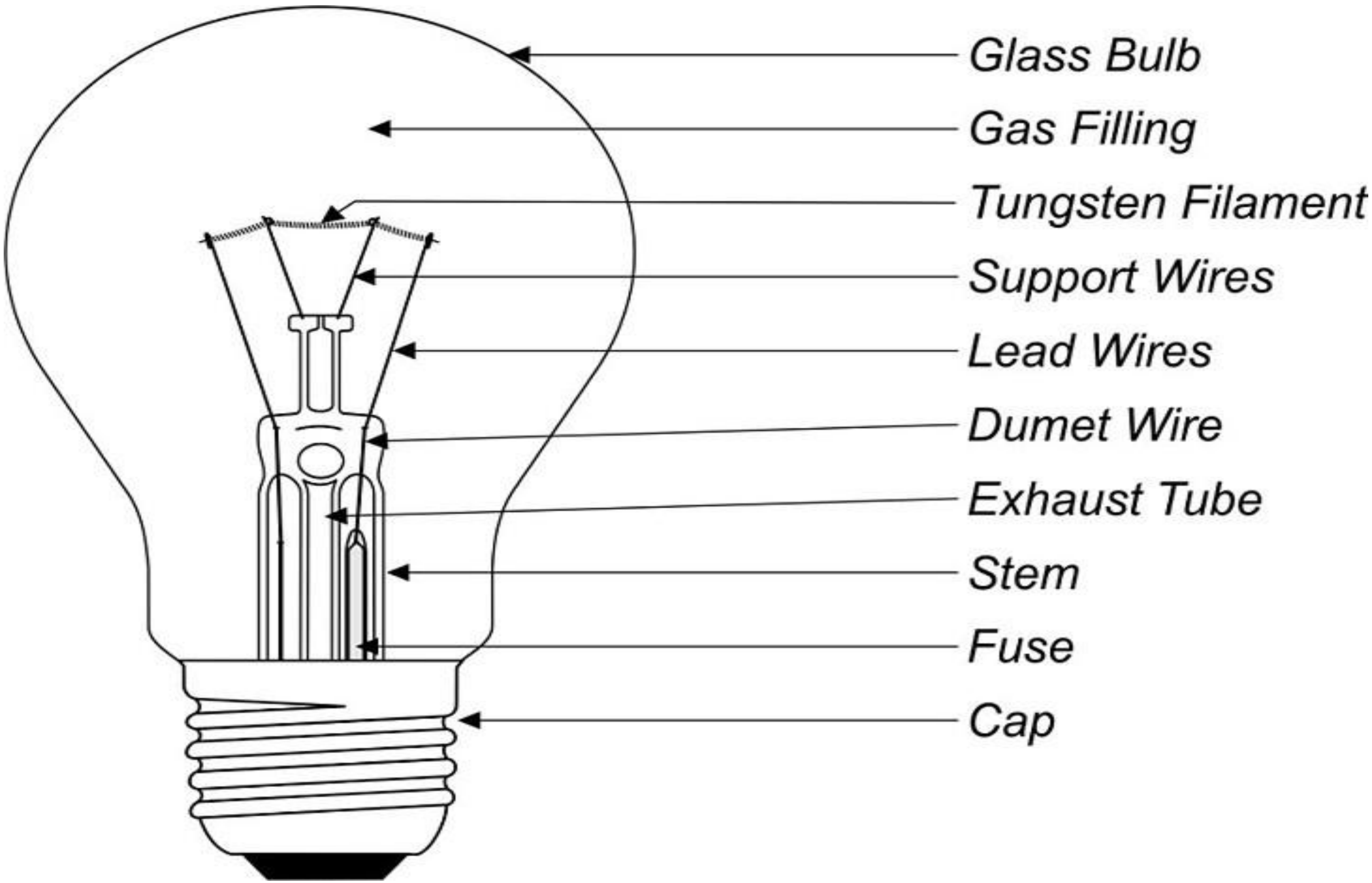

T25A

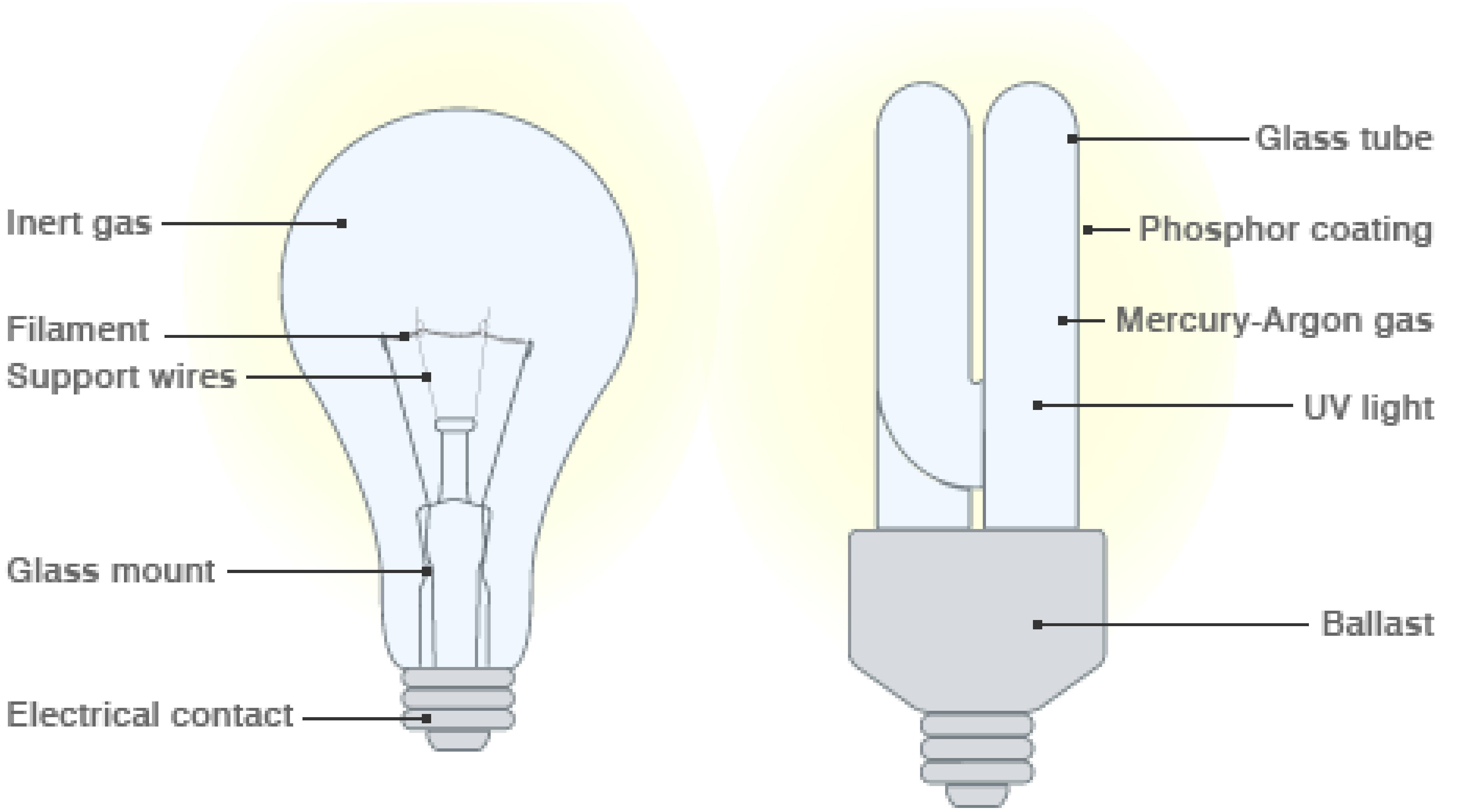

Type of Fuse
3/4

An incandescent light bulb produces light by heating a filament wire to a high temperature until it glows.

A CFL contains a mixture of argon and mercury gases that produces invisible ultraviolet light (UV) when the gas is excited by electricity.

An LED contains electrons that recombine with electron holes, releasing energy in the form of photons and illuminating the bulb.

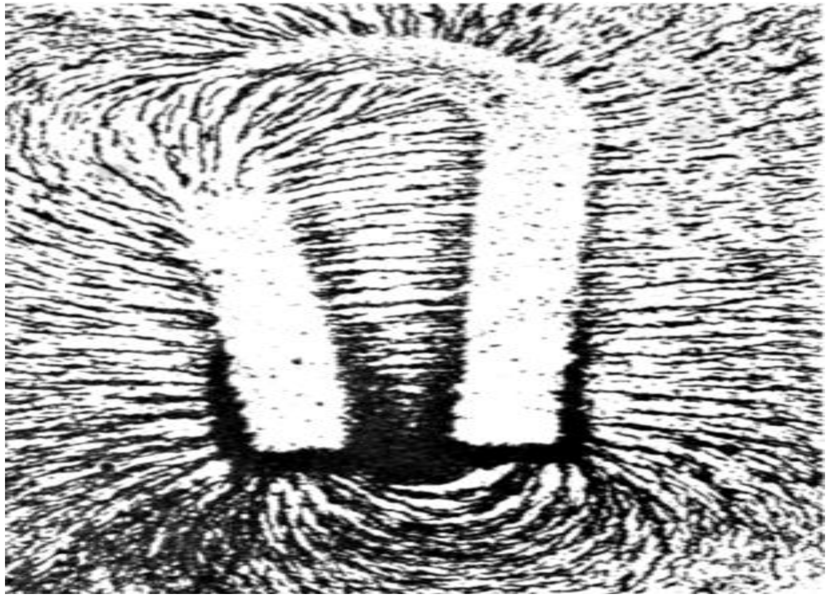

Glass Bulb
Gas Filling
Tungsten Filament
Support Wires
Lead Wires
Dumet Wire
Exhaust Tube
Stem
Fuse
Cap


Inert gas
Filament
Support wires
Glass mount
Electrical contact
Glass tube
Phosphor coating
Mercury-Argon gas
UV light
Ballast

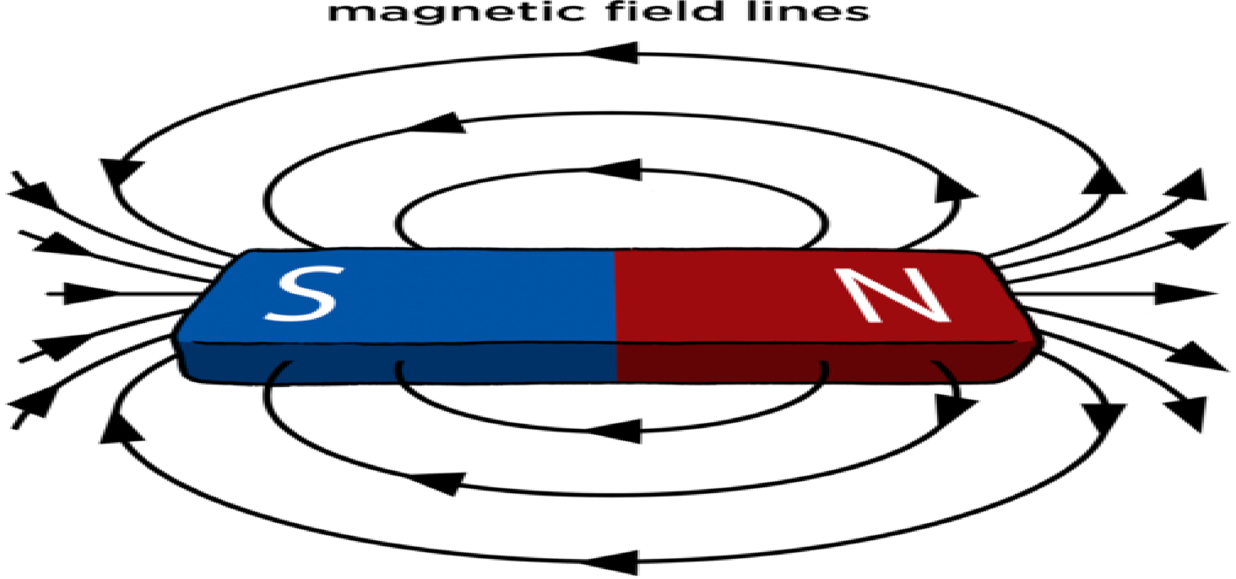
Magnetic force

- A magnet is a material which has a strong magnetic field around it.
- Magnetic forces of attraction exist between a magnet and a magnetic substance, such as iron, steel, cobalt and nickel.
- A magnet has two poles, a north and south pole. Opposite poles attract each other and like poles repel each other.
- The Earth has a magnetic field around it. We can use compasses to tell direction as the needle is a magnet which points to magnetic North.

The pattern you saw with your magnets can be represented by **field lines**. Field lines are used to show something we can't actually see. The closer the field lines are drawn together, the stronger the field being described. The more field lines that are drawn, the stronger the field. The field lines go from the north pole to the south pole. The following diagram shows the field lines around a bar magnet.

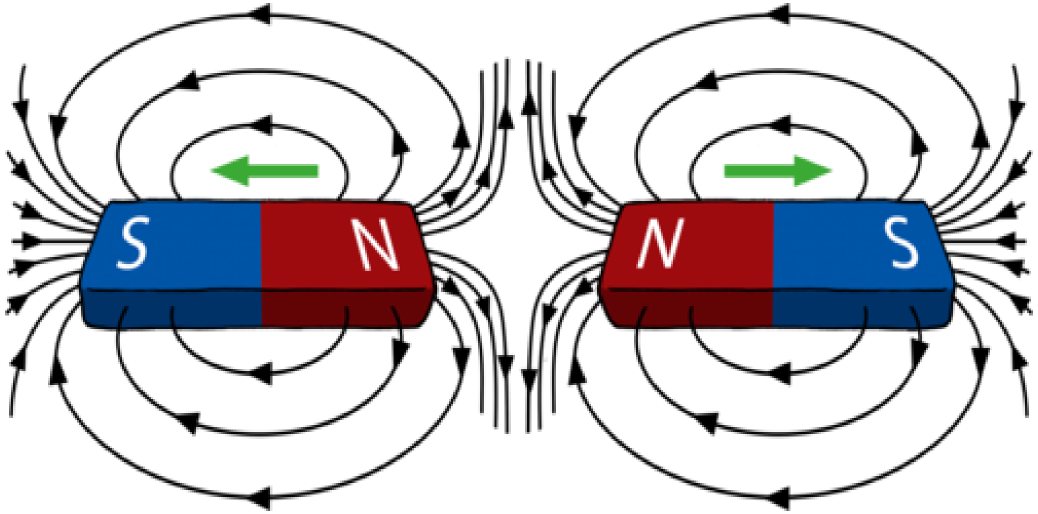


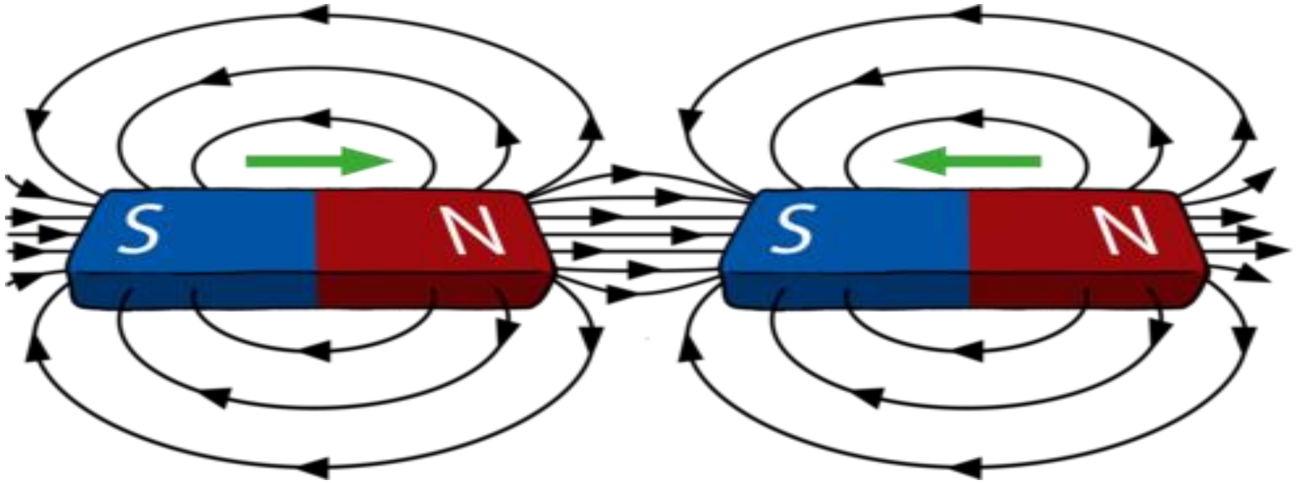
The magnetic field around a horseshoe magnet



The diagrams show the field lines between bar magnets which are attracting and those which are repelling.

<u>Like poles repel.</u> <u>Opposite poles attract</u>



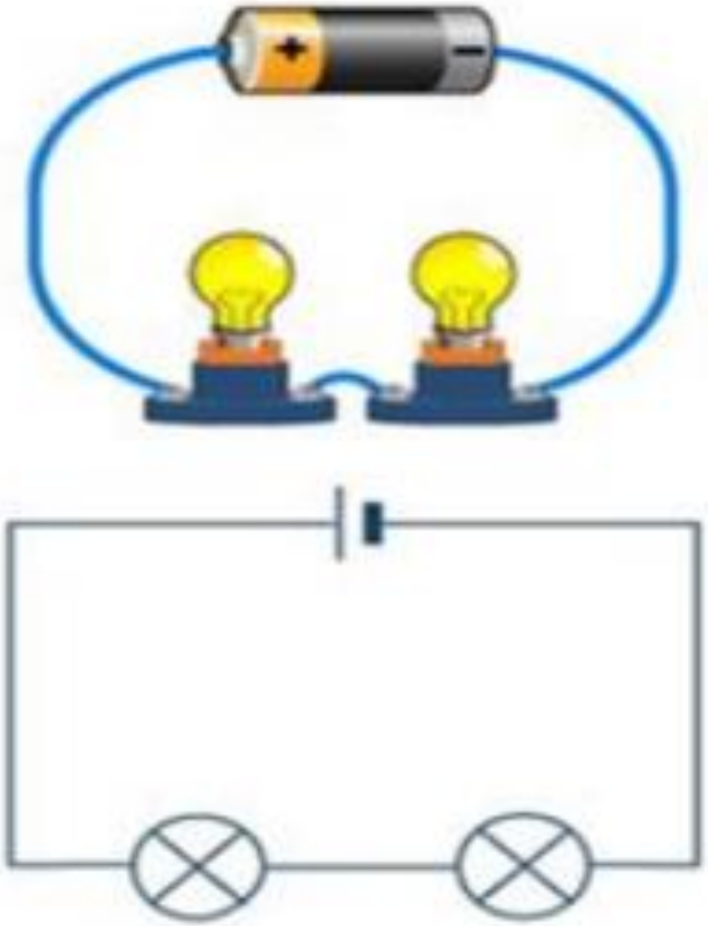


SERIES AND PARALLEL CIRCUIT

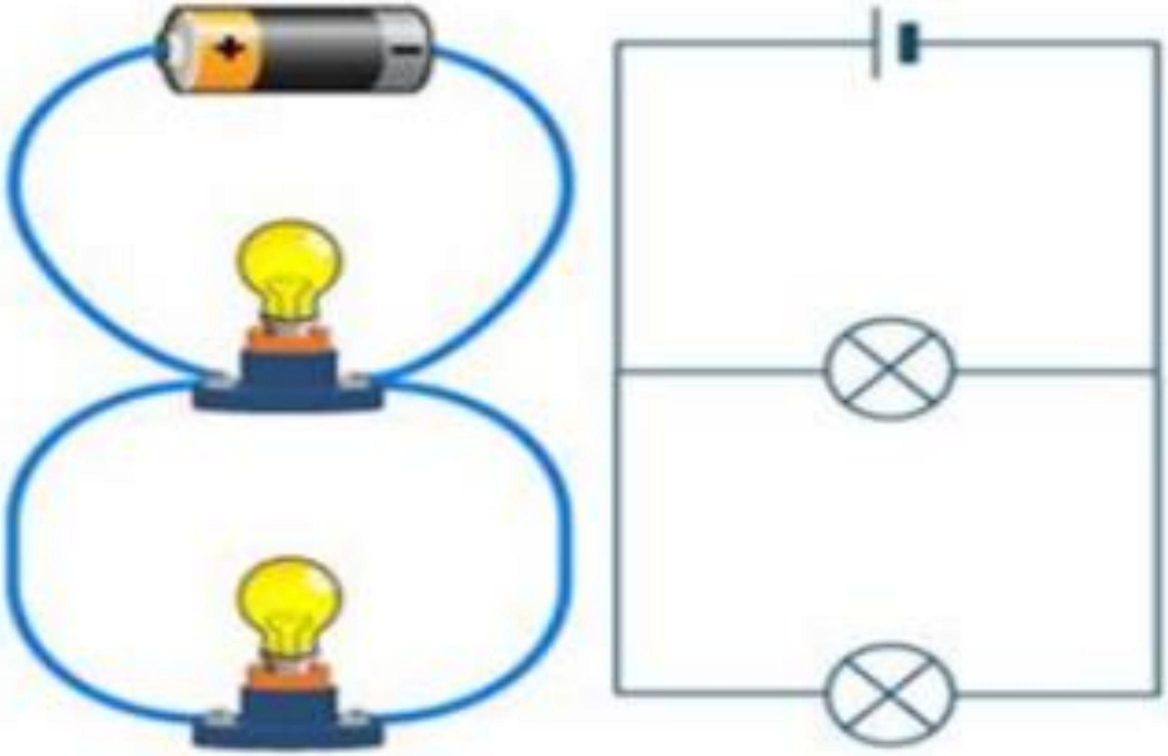
Parallel circuits have multiple branching pathways for electrical current whereas a simple **series circuit** forms a single path. The components of a **parallel circuit** are connected differently than they are **in a series circuit**; the arrangement affects the amount of current that flows through the **circuit**.

Components of an electrical circuit or electronic circuit can be **connected** in many different ways. The two simplest of these are called **series** and parallel and occur frequently. Components **connected** in **series** are **connected** along a single path, so the same current flows through all of the components.

SERIES AND PARALLEL CIRCUIT



Series Circuit

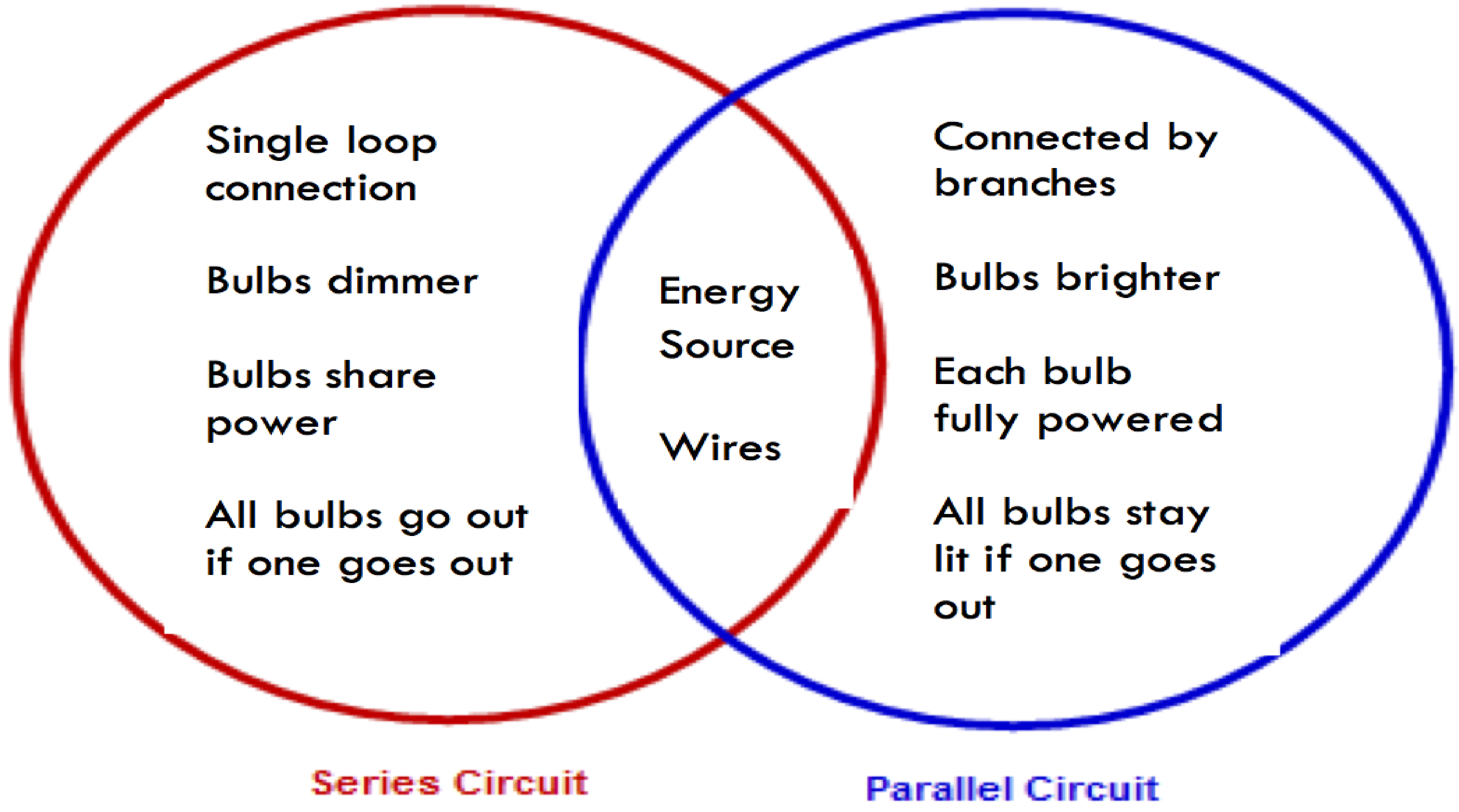


Parallel Circuit

DIFFERENCES BETWEEN SERIES AND PARALLEL CIRCUIT

- **One** pathway *(circuit)*
- Current *(flow of electric charge)* **same** anywhere in the circuit
- Voltage (measure of strength of electrical power) **shared** in ratio to resistance

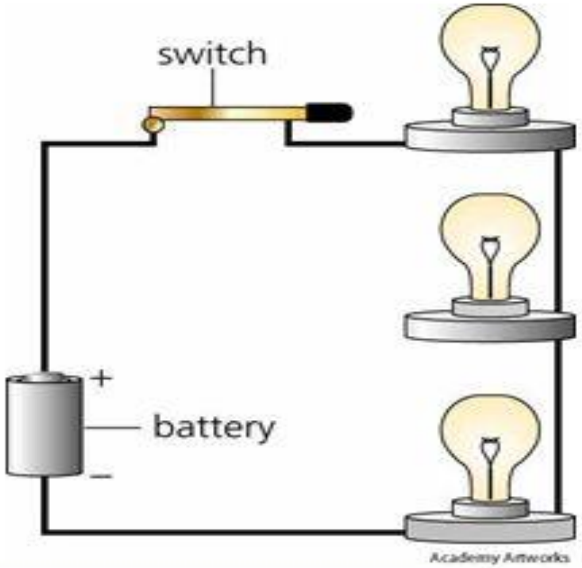
- **Two or more** pathways
- Current **splits**, passes through pathways, and adds up again
- Voltage across **each** pathway equals supply voltage

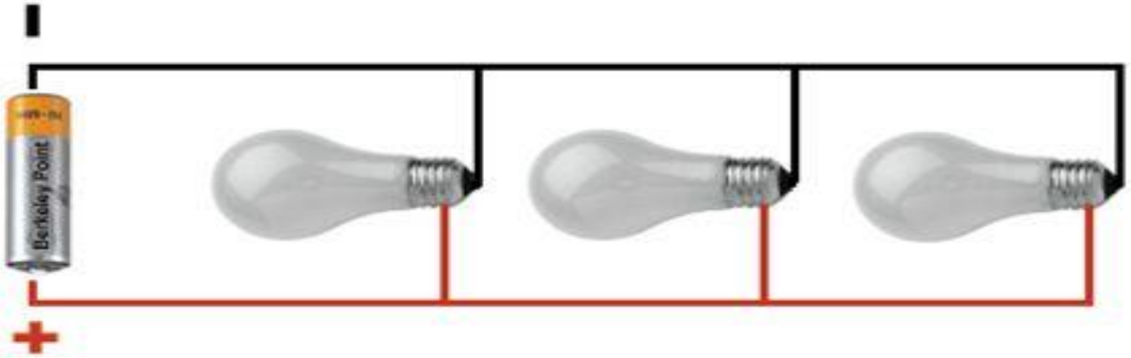

Single loop connection
Bulbs dimmer
Bulbs share power
All bulbs go out if one goes out
Energy Source
Wires
Connected by branches
Bulbs brighter
Each bulb fully powered
All bulbs stay lit if one goes out
Series Circuit
Parallel Circuit

Current and circuits

What is a circuit and where do you see them?

Types of Circuits





Series Circuit

- There is one single loop (one pathway for current to flow)
- Example: old Christmas lights
- When one burns out, they all go out!

Parallel Circuit

- There are loops within a loop (multiple pathways for current to flow)
- Example: Car & home, power bar
- When one burns out, the others still work!

Advantages and Disadvantages of Parallel and Series circuits

	Advantage	Disadvantage
Wiring done in parallel	Other bulbs remain working if one bulb is blown or removes All bulbs glow brightly	More current is needed when extra bulbs added The battery runs out quicker
Wiring done in series	You can turn off all of the appliances / lights with one switch The wiring is simpler	If one bulb is disconnected the circuit is not complete and all the bulbs will go out Resistance of the circuit is greater if more than one bulb – the other bulbs don't glow as brightly Hard to find the blown bulb

A **diode** is a specialized electronic component with two electrodes called the anode and the cathode. Most **diodes** are made with semiconductor materials such as silicon, germanium, or selenium. ... The fundamental property of a **diode** is its tendency to conduct electric current in only one direction.

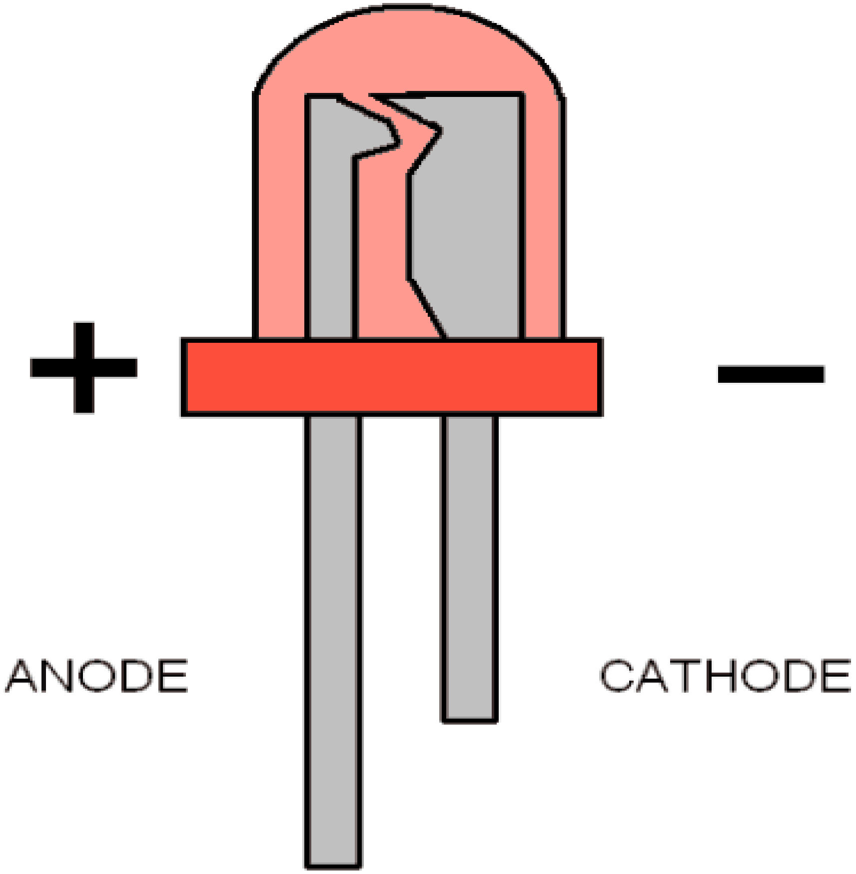
A **light-emitting** diode (**LED**) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of protons.

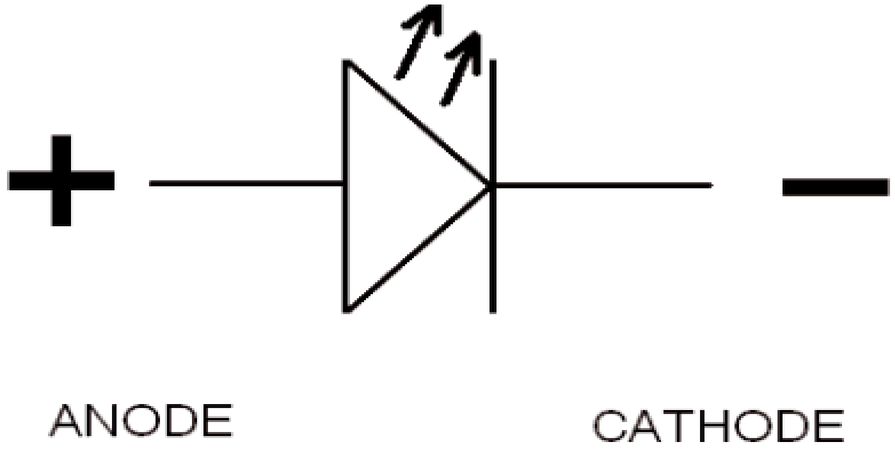
A **light-emitting diode** is a two-lead semiconductor **light** source. It is a p–n junction **diode** that emits **light** when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of protons

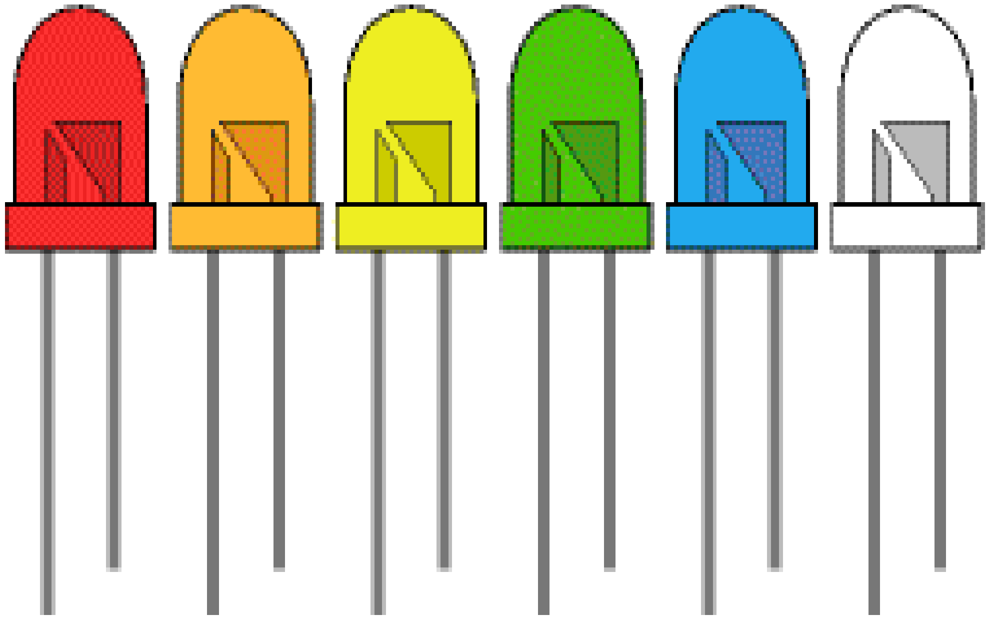
Among other things, they form numbers on digital clocks, transmit information from remote controls, light up watches and tell you when your appliances are turned on. Collected together, they can form images on a jumbo television screen or illuminate a traffic light.Kettle,fridges,microwave,cellphone,laptop.

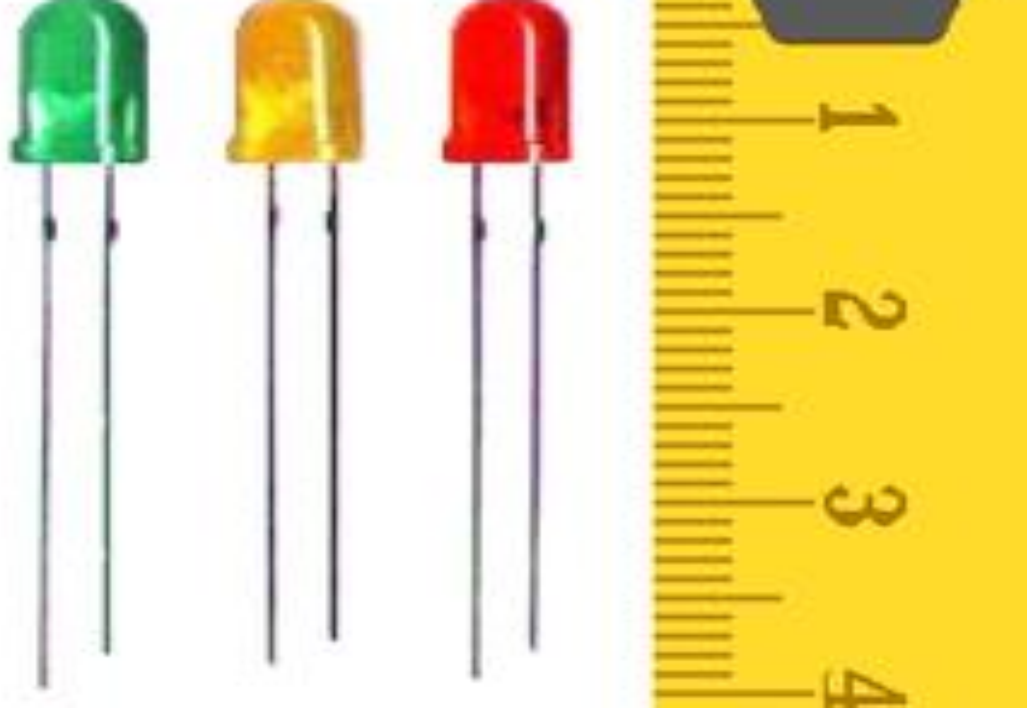

Hi

DIODE AND SYMBOL








1
2
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Key **Differences between** the **LED and Diode**. The **diode** is a semiconductor device which conducts only in one direction. While the **LED** is the type of **diode** which emits light. ... Whereas the **LED** is made of the gallium arsenide and gallium phosphide whose electrons emit light while transferring the energy.

LED bulbs run dramatically cooler than their incandescent cousins, but that doesn't mean they don't produce heat. **LED** bulbs **do get hot**, but the heat is pulled away by a heat sink in the base of the bulb.

Activity 1 TERM 3

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ANGLE OF INCIDENCE

Incident ray: The ray of light falling on the surface.

Reflected ray: The incident ray bouncing back in the same medium after striking the reflecting surface.

Point of incidence(P): The point of the mirror surface, where incident ray strikes and reflected ray bounces off.

Normal ray: It is the line drawn perpendicular to the reflecting surface at the point of incidence.

Angle of incidence (i) : Angle between incident ray and normal.

Angle of reflection (r) : Angle between normal and reflected ray.

Activity 1 TERM 3

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