

Electric current and Its chemical effects

- **Introduction**

Introduction

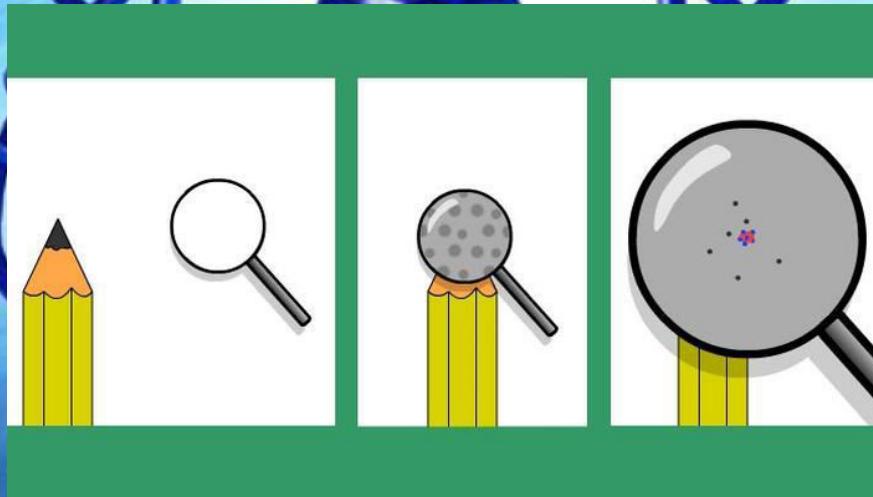
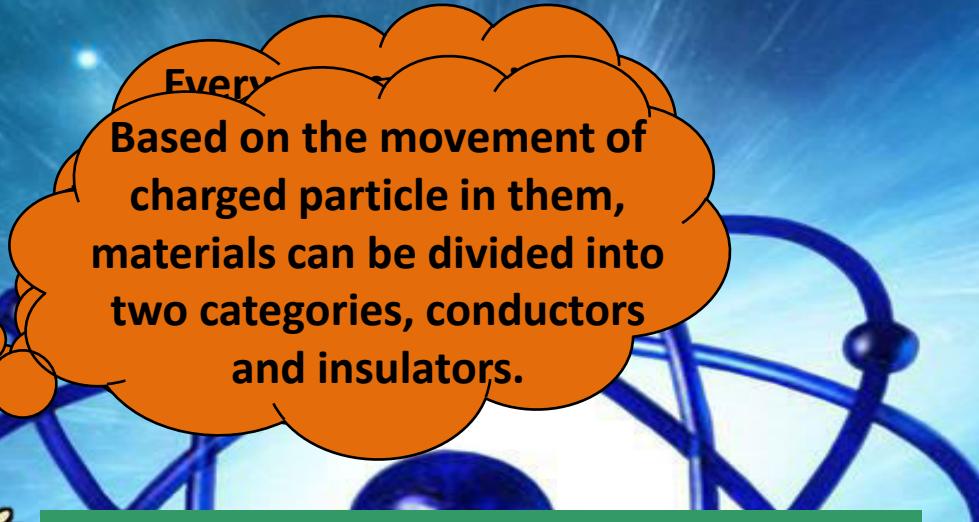


Because water is a good conductor of electricity.

What are good conductors of electricity?

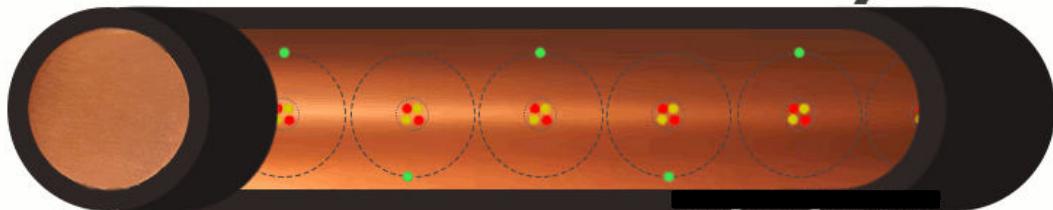
You elders might have cautioned against touching electrical appliance with wet hands.





Materials in which charged particles can not move easily are called insulators.

The flow of electricity



Insulators do not allow an electric current to flow through them easily.

Examples : Glass, air, plastic, rubber, and wood



Questions

1. Is it safe for the electrician to carry out electrical repairs outdoors during heavy downpour? Explain.
2. What are conductors? Give two examples.
3. What are insulators? Give two examples.



Electric current and Its chemical effects

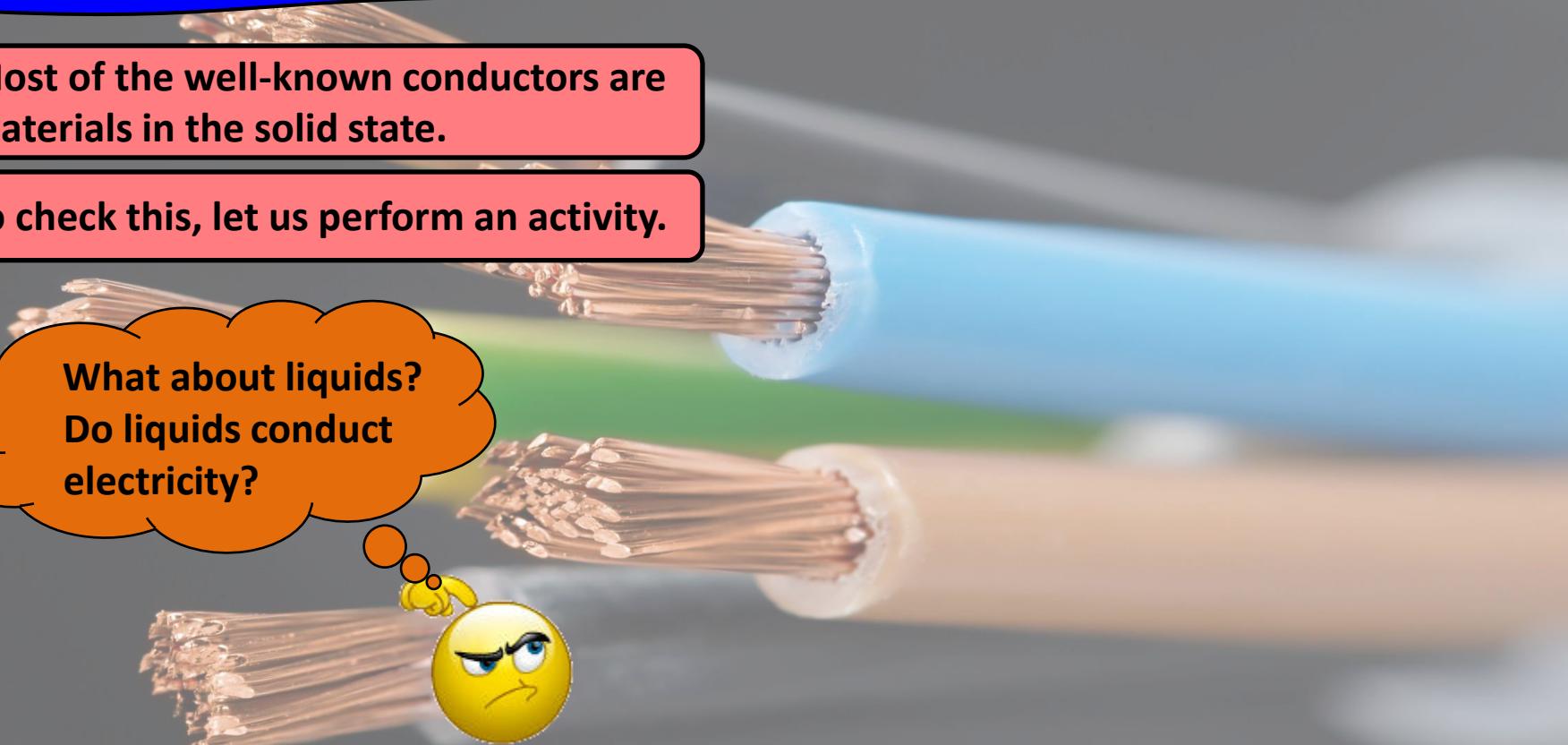
- **Conduction through liquids**

Conduction through liquids

Most of the well-known conductors are materials in the solid state.

To check this, let us perform an activity.

What about liquids?
Do liquids conduct
electricity?



Conduction through liquids

Aim: To test electrical conductivity of various liquids.

Battery

What do you observe?

Vinegar

Lemon juice

Vinegar

Liquid	LED	Inference
Lemon juice		Good conductor
Vinegar		Good conductor

Conduction through liquids

Activity:

Repeat this with lemon juice, vinegar, tap water, and glycerine.

What do you observe?

Glycerine

Liquid	LED	Inference
Lemon juice		Good conductor
Vinegar		Good conductor
Distilled water		Poor conductor
Tap water		Good conductor
Glycerine		Poor conductor

Conduction through liquids

Due to the heating effect of current, the filament of the LED gets heated to a high temperature and it starts glowing.

If the current through a circuit is too weak, the filament does not get heated and the LED does not glow.

Why does the LED glow when electric current passes through it?



Questions

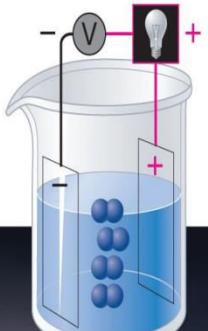
1. Explain why lemon juice and vinegar are good conductors of electricity.
2. How can you test whether the liquids conduct or do not conduct electricity?
3. Pure water is a poor conductor of electricity. Explain.



Electric current and Its chemical effects

- **Electrical conductivity of water**
- **Cause of Conductivity of liquids**

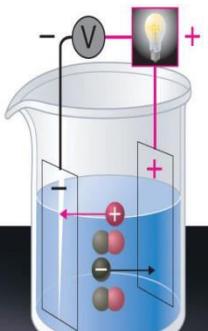
ELECTRICAL CONDUCTIVITY



No
current
flows



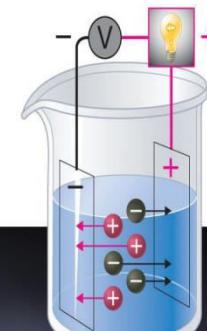
(a) Nonelectrolyte



Some
current
flows



(b) Weak electrolyte



Extensive
current
flows



(c) Strong electrolyte

Electrical conductivity of water

Pure water is a poor conductor of electricity.

The presence of even a small amount of dissolved salts makes water a good conductor of electricity.

One is more likely to get an electric shock upon touching an electrical appliance with wet hands than with dry hands.

This is because wet skin has many times more conductivity than dry skin.



Getting an electric shock could result in very serious consequences, even death.



CAUSE OF CONDUCTIVITY OF LIQUIDS

We now know that distilled water does not

Now dip the free ends of the two wires in the solution of salt in distilled water

~~Now dissolve a small amount of common salt in distilled water.~~

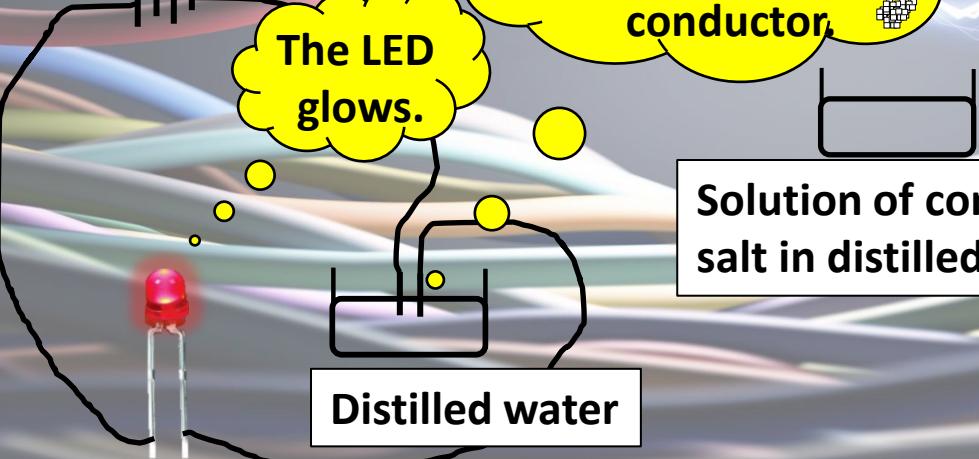
(sodium chloride) in the distilled water.

We conclude that a
solution of common salt
in water is a good
conductor.

The LED
glows.

Solution of common
salt in distilled water

Distilled water



CAUSE OF CONDUCTIVITY OF LIQUIDS

Common salt (NaCl) consists of charged sodium ions and chloride ions.

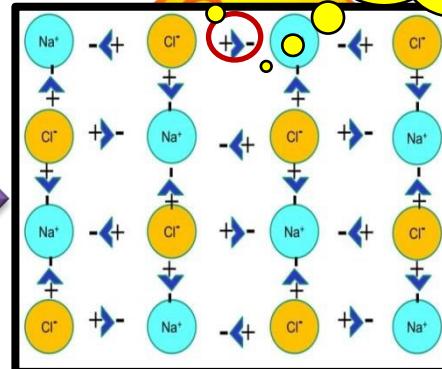
The water molecules surround the sodium and chloride ions.

The molecules of salt dissociate into ions when dissolved in water. This process is known as ionization.

It is the movement of these ions within the solution, that makes distilled water conduct electricity.



H_2O



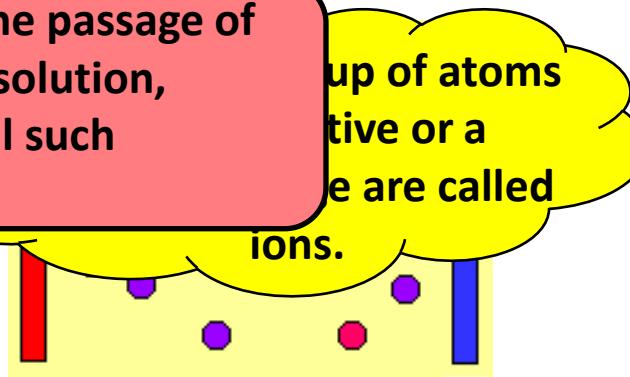
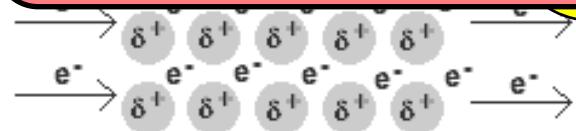
CAUSE OF CONDUCTIVITY OF LIQUIDS

In metals, which are good conductors, the charge carriers are a type of particles called electrons.

In liquid the charge carriers are ions.

The free mobile ions allow the passage of electric current through the solution, making it conductive. We call such solutions as an electrolyte.

up of atoms
tive or a
e are called



Questions

1. Why do impurities present in water increase its conductivity?
2. Compare metallic conduction with electrolytic conduction.
3. Sodium chloride solution is a good conductor of electricity. Explain.



Electric current and Its chemical effects

- Electrolytes
- Non-electrolytes
- Conversion of chemical energy
into electrical energy
- Voltaic cell

Electrolytes

Electrolyte

A compound that conducts electricity in molten

(l) What is an
electrolyte? (solution) state and which

position (b) into ions, w electric curr...

into ions, w electric curr...

throughout the solution.

The
con-
mol-
call

Tap water, oxalic acid,
carbonic acid, citric acid
are examples of weak
electrolyte.

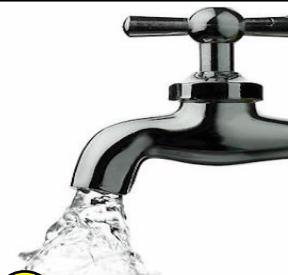
In s
num
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are

Electrolyte

Weak electrolyte

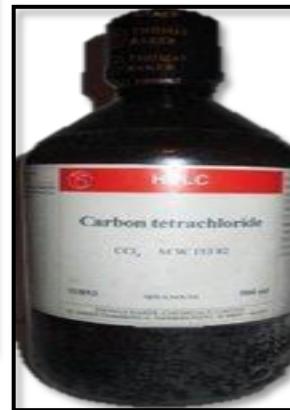


Non-electrolytes

A non-electrolyte does not provide ions in its solution and therefore current does not flow through such solutions.



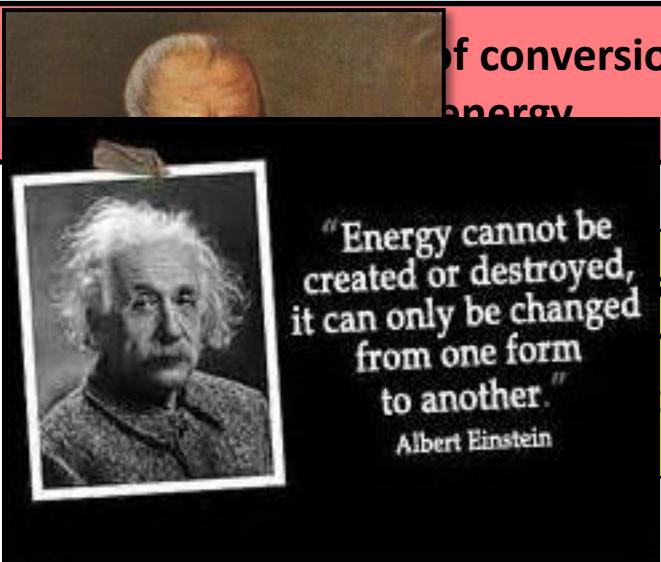
Distilled
water



Distilled water, alcohol, carbon disulphide and carbon tetrachloride are examples of non electrolyte.

Conversion of chemical energy into electrical energy

It was an Italian scientist, Alessandro Volta who gave us the first practical 'source of such a conversion' in the year, 1790.



of conversion of chemical

energy

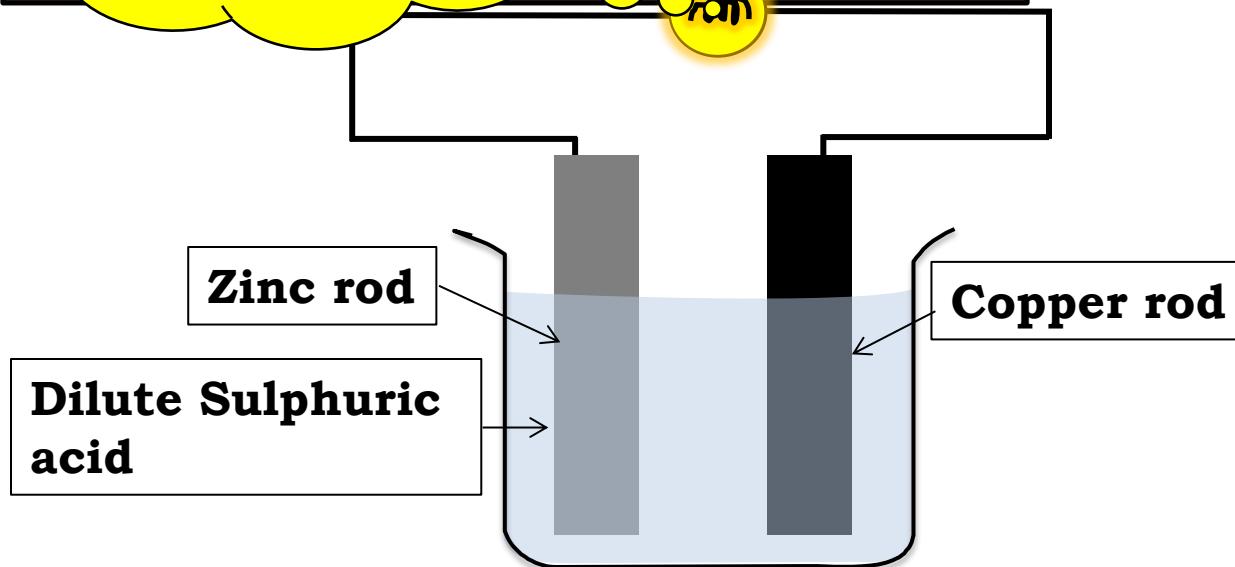
"Energy cannot be
created or destroyed,
it can only be changed
from one form
to another."

Albert Einstein

arrangement
known as the
galvanic cell.

Voltaic cell

When the two different metals, zinc and copper, are immersed in dilute sulphuric acid, electrons flow from the zinc rod to the copper rod. This causes a current to flow through the circuit, which is completed by the salt bridge. The electrons flow from the zinc rod, through the salt bridge, to the copper rod. The circuit is then completed by the bulb, which lights up.



Questions

1. What are electrodes and electrolyte?
2. Differentiate between strong electrolytes and weak electrolytes.
3. Draw a well labelled diagram of voltaic cell.

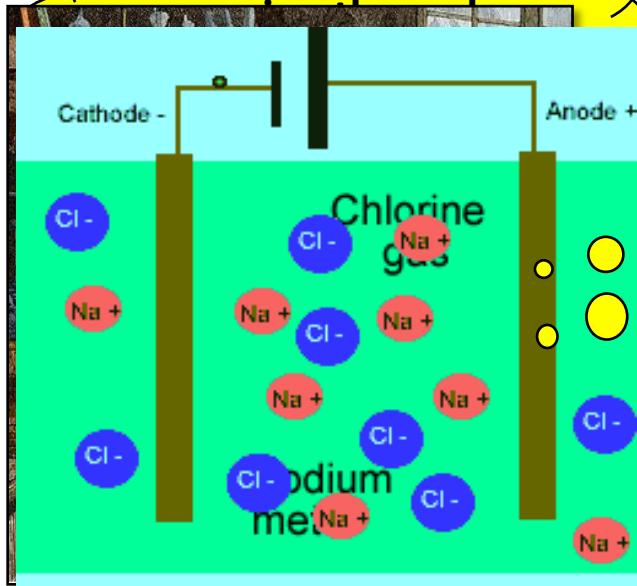


Electric current and Its chemical effects

- Chemical effects of electric current
- Electrolysis of water
- Factors affecting the chemical reaction in the solution
- Chemical reactions taking place at electrodes

Chemical effects of electric current

Michael Faraday, a well known British experimental physicist, began his experiments on the passage of electricity through liquids in 1834.

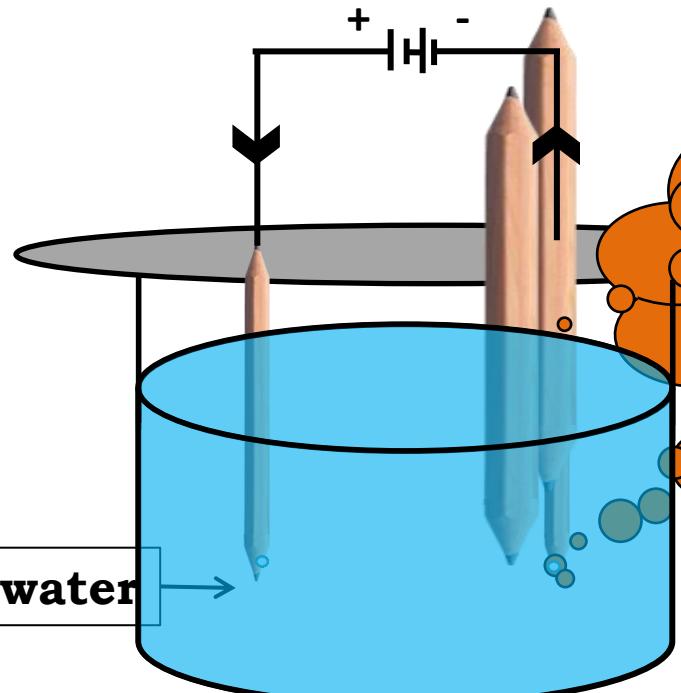


Faraday called this phenomenon, of passage of electricity through liquids, as electrolysis.

Electrolysis of water

Activity

Now wait for 3 to 4 minutes and observe the electrodes carefully.



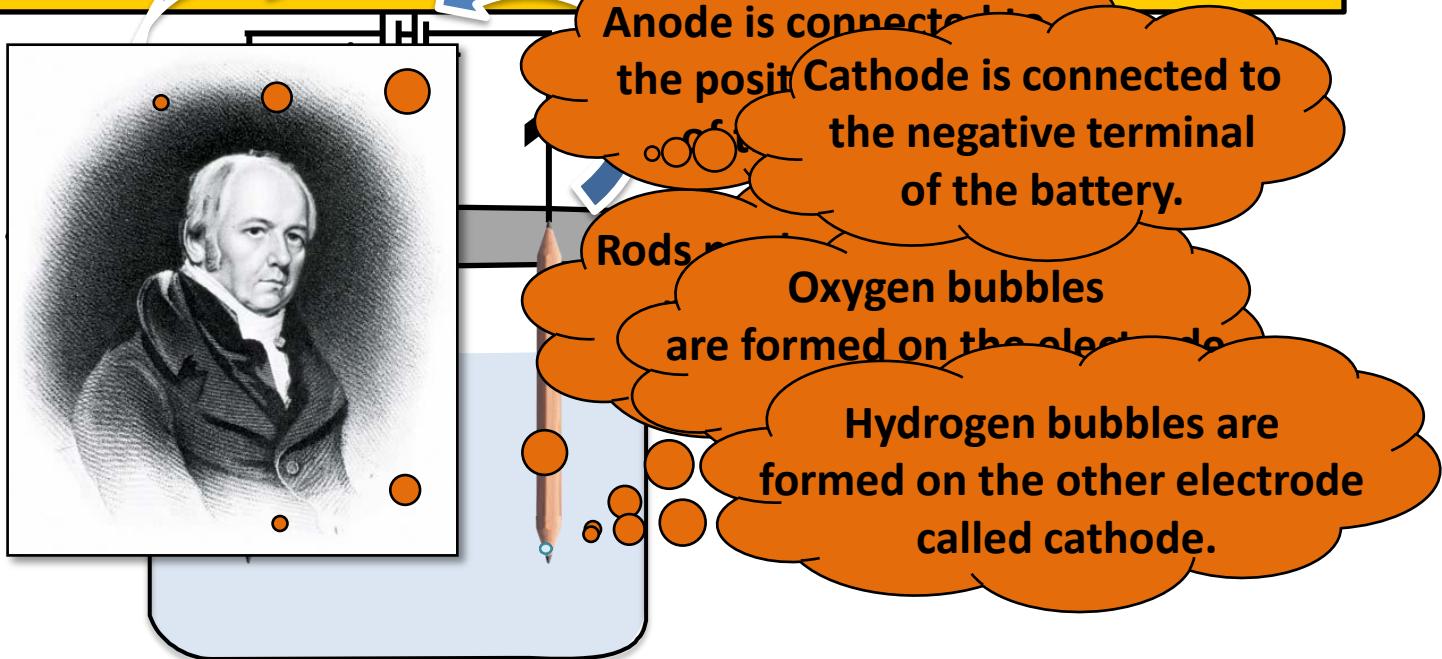
Tap water →

Can we call the change taking place in a solution a chemical change?

but...
bottom.

Electrolysis of water

It was a British Chemist, William Michelson who had shown that if electrodes were immersed in water, and a steady current was passed through it, bubbles of oxygen and hydrogen were produced.



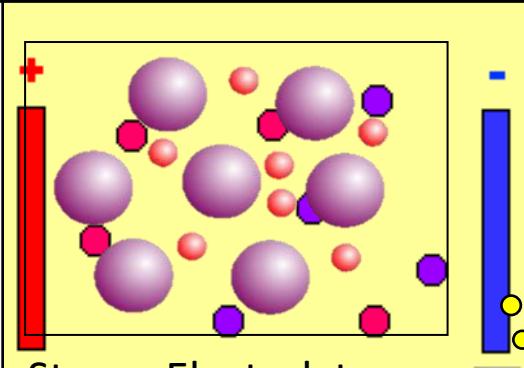
Factors affecting the chemical reaction in the solution

Nature of the electrode.

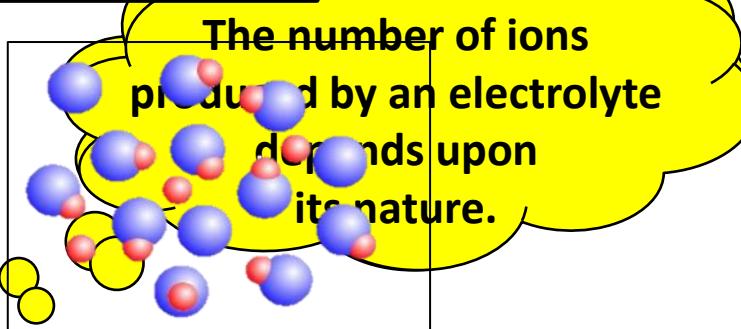
Nature and concentration of the solution.

Weak electrolytes, dissociate to only small extents and give lesser number of ions.

Therefore, the solutions of weak electrolytes have low conductance.



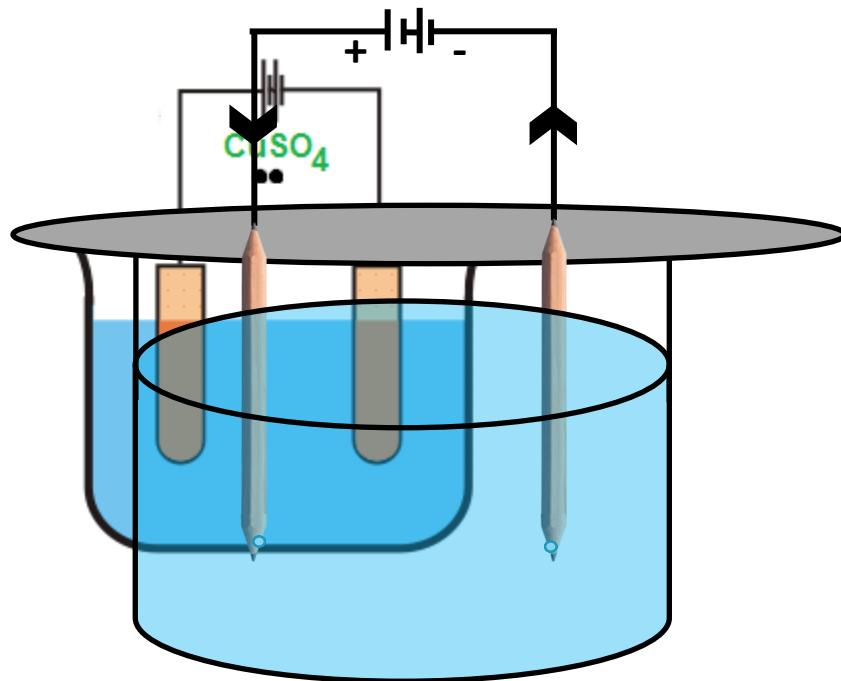
Strong Electrolyte



Weak Electrolyte

Chemical reactions taking place at electrodes

Change of colour of solution may occur due to dissolving of different ions.



Questions

1. What is meant by the chemical effect of electric current? Explain with the help of an example.
2. Name the gases released when electric current is passed through water.
3. List the factors affecting the chemical reaction in solution.



Electric current and Its chemical effects

- Applications
- Electrorefining of metals
- Electroplating

Applications

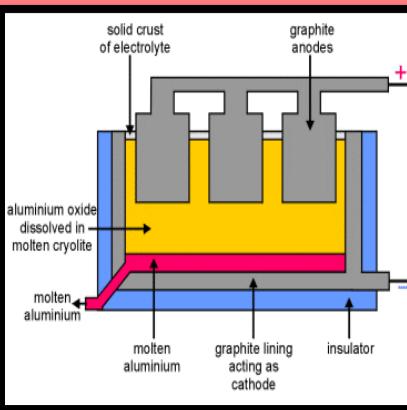
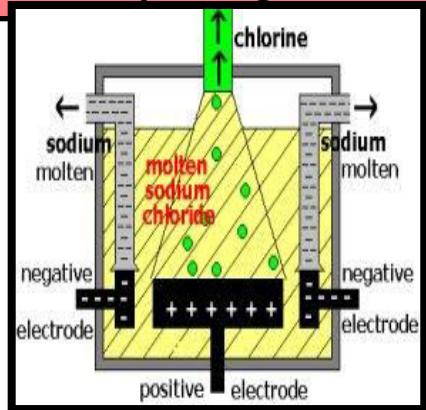
Electrolysis has some important scientific and industrial applications.

Metals like aluminium, sodium, potassium, calcium are extracted by this method.

Extraction of metals from ores

Metals are extracted from their ores by the process of electrolysis.

Electroplating



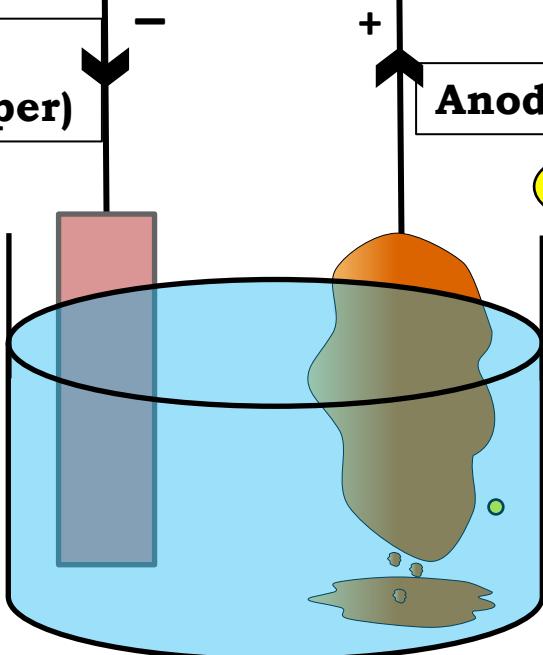
Electrorefining of metals

Activity

Dip the impure copper rod and the pure copper strip in the copper sulphate solution as the cathode.

On passing electric current, the impure copper dissolves into the solution

Cathode
(pure copper)



The impurities are collected below the anode collectively called anode mud.

Electroplating

Cathode: The object to be coated.

Anode: The metal to be used for coating.

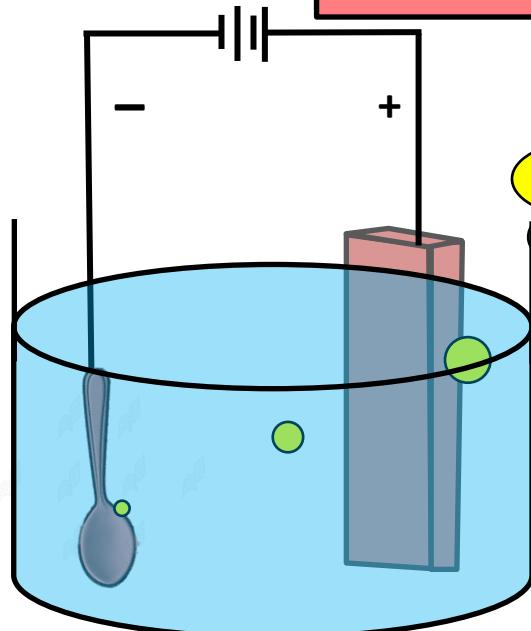
Electrolyte: Dissolved salts of the metal to be coated.



Electroplating

Activity

Electroplate for 20 – 25. minutes
electroplated in the copper sulphate solution.
the battery using a connecting wire.

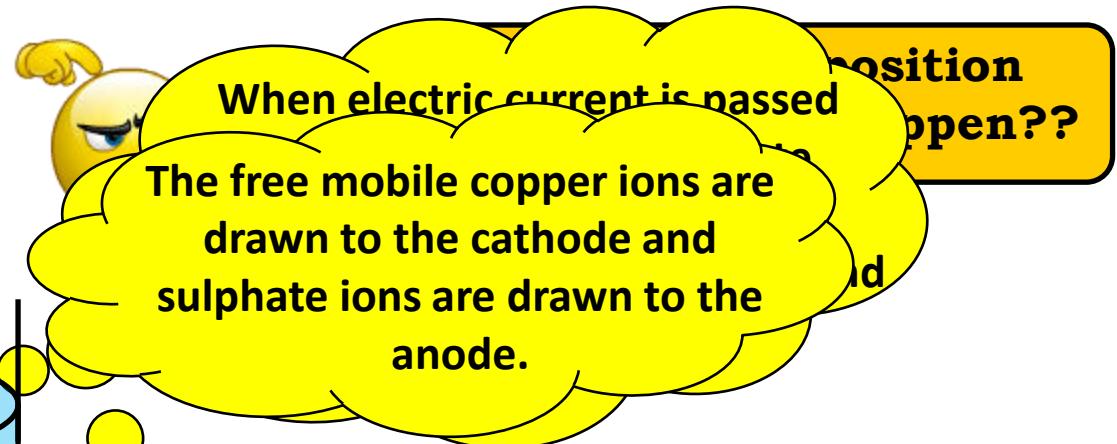
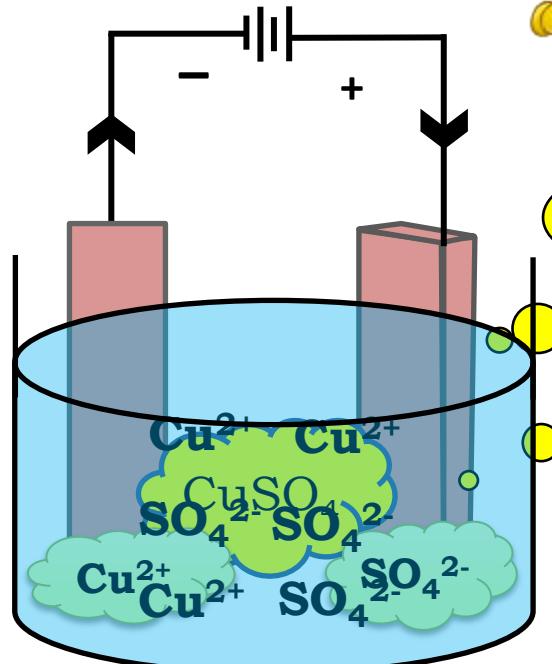


A uniform brown coating of copper metal is formed on the object.

Electroplating

Activity :

To understand this, let us trace the flow of charges (ions).



Questions

1. What are the applications of chemical effects of electric current?
2. Explain the term electrorefining.
3. What do you mean by electroplating? How does it take place?



Electric current and Its chemical effects

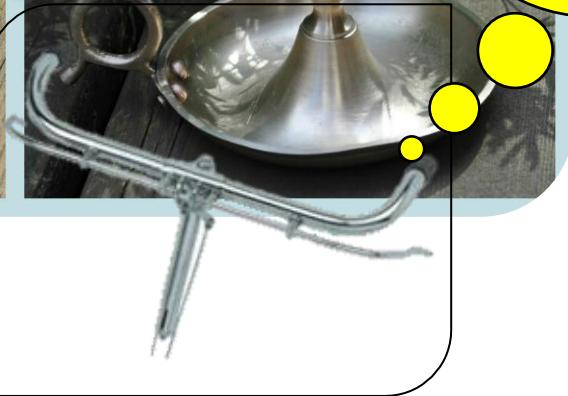
- Practical applications of Electroplating
- Michael Faraday
- Electro-magnetic induction

Practical applications of Electroplating

To provide a protective coating



Some coatings also help to increase the strength of the base metal.

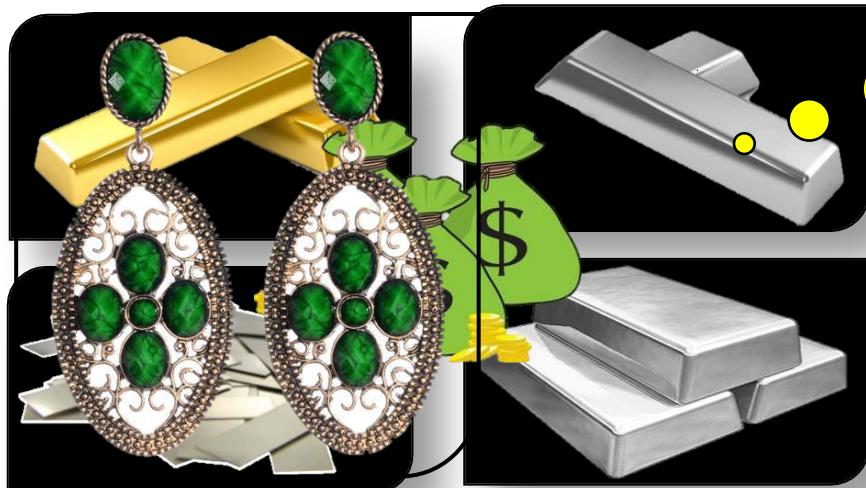


The chromium deposit not only provides a shiny appearance but also helps to avoid corrosion and effects of 'wear and tear' and scratches.

Practical applications of Electroplating

To minimize the cost

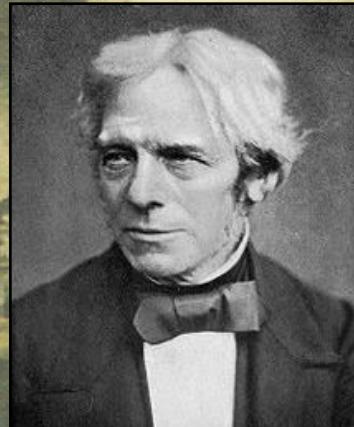
We know that some of the metals like gold, silver, platinum and nickel are very expensive.



It may not be economical to make the whole object out of these metals, so the object is made from a less expensive metal.

Michael Faraday

- ❖ Coming from a humble background, Faraday discovered a method of liquifying chlorine and benzene.
- ❖ He also discovered the phenomenon of electro-magnetic induction, magneto-optical effect and diamagnetism.
- ❖ He formulated the laws of electrolysis in 1857.
- ❖ The world salutes him as one of the greatest geniuses of all times.



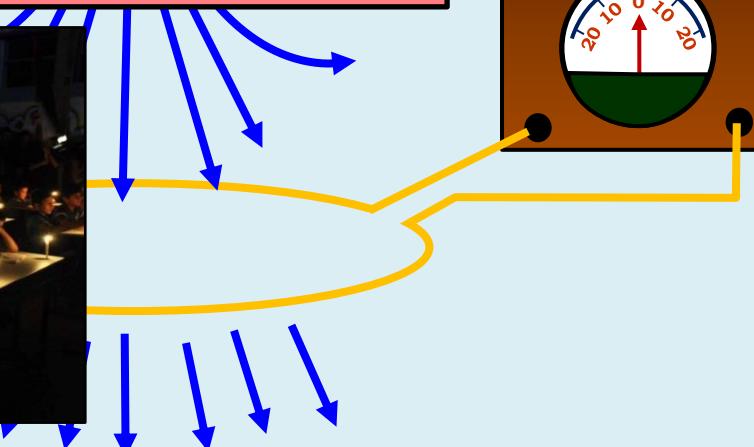
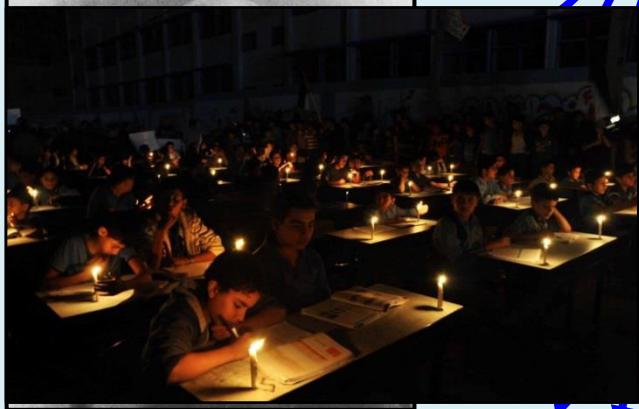
British Physicist

Electro-magnetic induction

S

This phenomenon is now, the basis of production of all large scale electricity produced in the world.

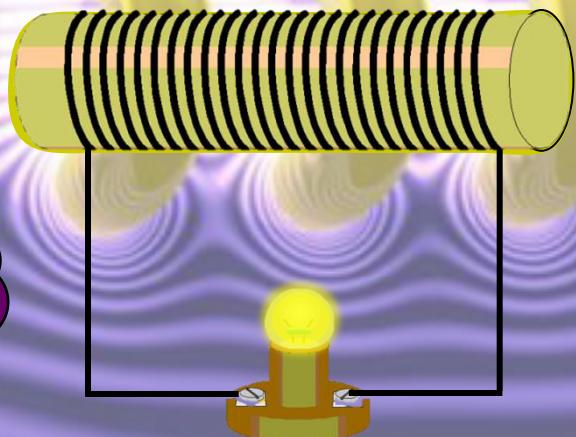
It is because of this reason that it is often said:
had there been no Faraday there would have been no electricity.



Electro-magnetic induction

Faraday showed that we can get electricity from magnetism.

To understand Faraday's discovery, let us perform an activity.



The bulb
glows

Questions

1. Prepare a list of objects around you that are electroplated.
2. Why articles are electroplated?
3. Name two metal objects which have a coating of another metal.
4. Write a note on Michael Faraday.
5. Describe an experiment to demonstrate that we can get electricity from magnetism.



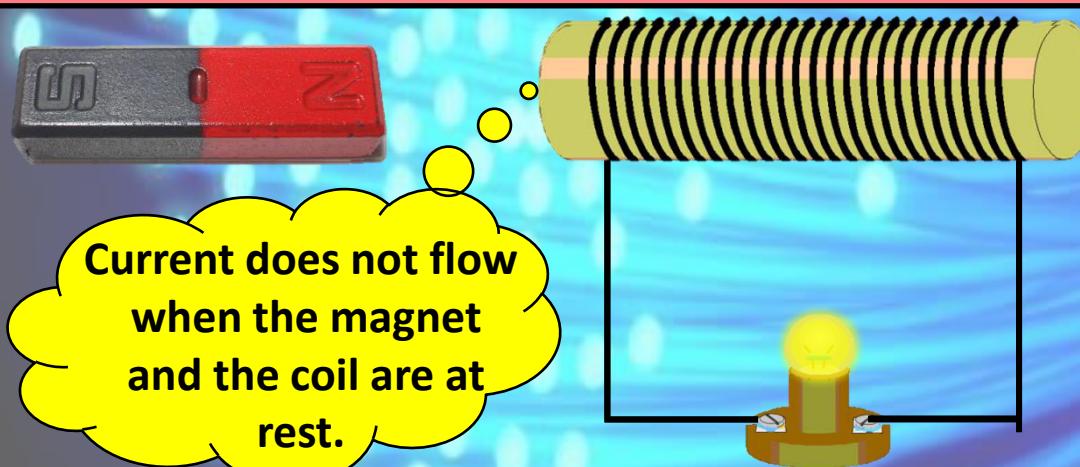
Electric current and Its chemical effects

- **Electro-magnetic induction**

Electro-magnetic induction

Their experimental observations can be summed up as follows:

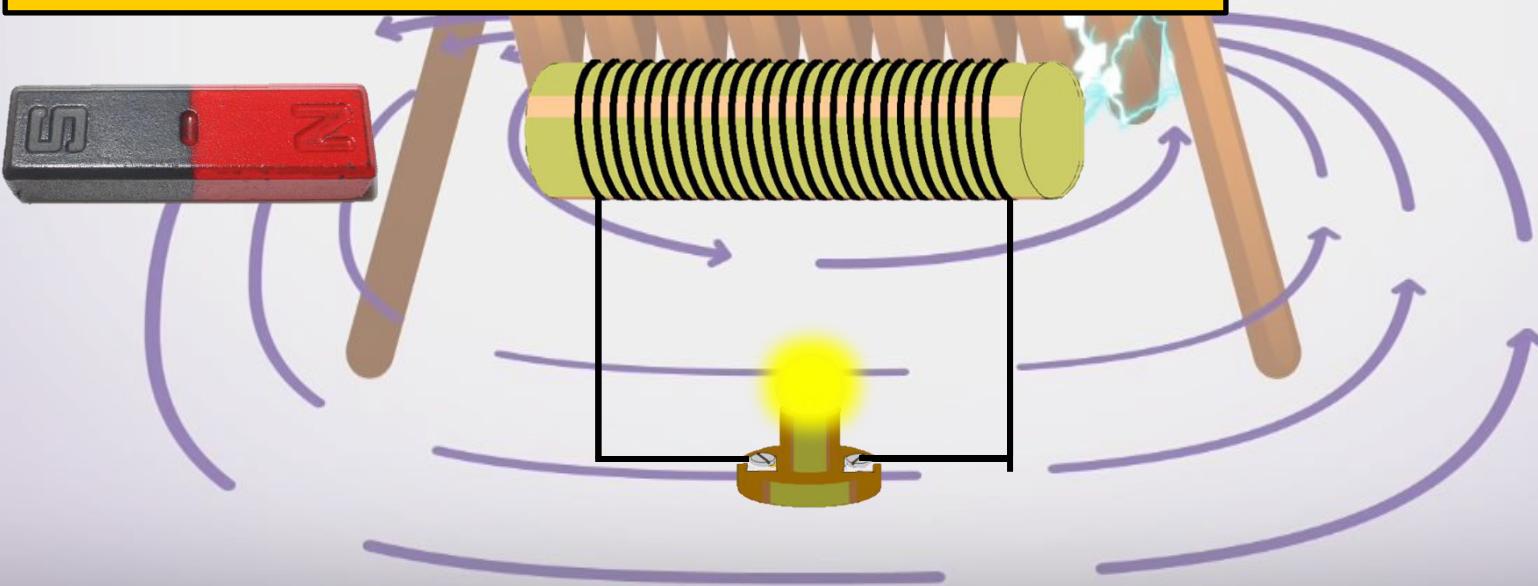
2. The flow of current stops as soon as the magnet and the coil are at rest with respect to each other.
current flows through the coil.



Electro-magnetic induction

Their experimental observations can be summed up as follows:

The faster is the relative motion between the magnet and the coil the more is the current that flows through the coil.

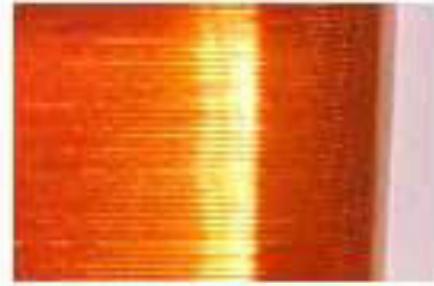


Electro-magnetic induction

Their experimental observations can be summed up as follows:

The phenomenon of electro-magnetic induction forms the underlying principle of all modern day generators and transformers.

Galvanometer



Questions

- 1. What do you mean by electromagnetic induction?**
- 2. List the experimental observations of electromagnetic induction.**



Thank You