

## CHEMICAL EFFECT OF CURRENT

## INTRODUCTION

Your parents and teachers always warn you not to touch the electrical switches with wet hands, as you are likely to get a severe electric shock.

It is just possible that a drop of water may trickle inside the electric switch and make contact with electric wire. The water on our hands always contains small amount of salt dissolved in it. This makes the water good conductor of electricity. Thus, the electric current from the switch flows through the water and enters your body. The flow of electric current in your body gives an electric shock.

**CAUTION :** Do not touch the electric switch with wet hands, just for the fun or to check the above statement. It can be highly dangerous.

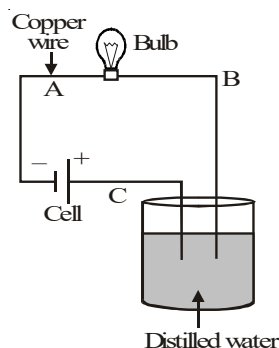
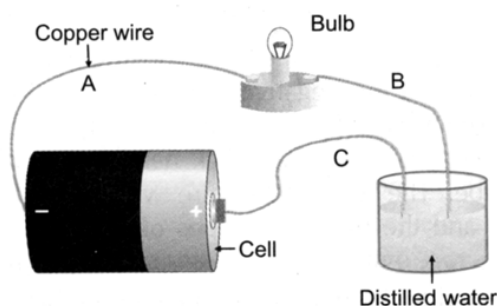
Let us perform the following activities to find out which of liquids conduct electricity and which of them do not conduct electricity.

## ACTIVITY

To find out whether distilled water conducts electricity or not.

**Materials required :**

- A dry cell.
- Three insulated copper wires A, B and C with bare ends
- a 1 volt bulb fixed in a bulb holder
- a beaker
- distilled water
- cellotape.



**Method :** Half fill the beaker with distilled water. Connect the bare ends of the copper wires A, B and C through a bulb with the help of cellotape.

Touch the bare ends of the wires B and C with one another. We will observe that bulb glows, thereby showing that all the parts of circuit are conducting electricity.

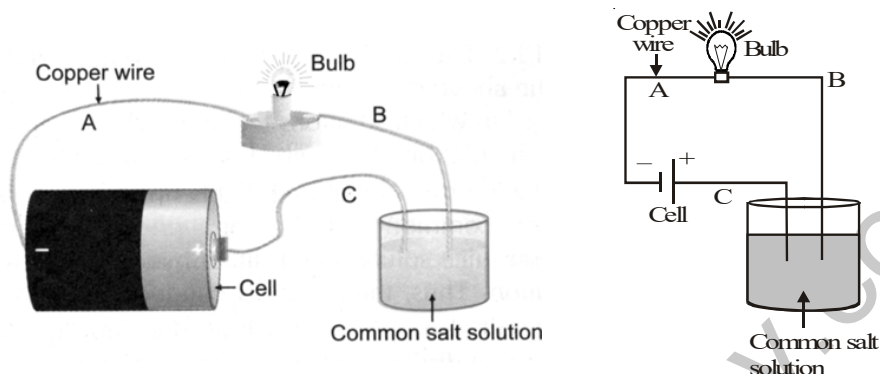
Dip the bare ends of the wires B and C in the distilled water. We will observe that the bulb does not glow.

Thus, the activity clearly proves that distilled water does not conduct electricity.

## ACTIVITY

To show that the addition of salts, acids or alkalis, make the distilled water a conductor of electricity.

**MATERIALS REQUIRED :** All materials as in activity 1 and ● common salt ● sulphuric acid ● sodium hydroxide. ● a glass rod and a dropper.



**METHOD:** Proceed as in Activity 1 and confirm that distilled water does not conduct electricity. Now take a spoonful of common salt and add it into distilled water. Dissolve the common salt by stirring it with a glass rod.

Dip the bare ends of the wires B and C in the above solution. You will observe that bulb lights up. Thus, the activity proves that addition of common salt in water makes it a conductor of electricity.

Pour off the common salt solution and rinse the beaker with distilled water. Half fill the beaker with distilled water and add to it about 10 drops of sulphuric acid. On dipping the bare ends of wire B and C in the above solution you will observe that bulb lights up. This proves that acids on dissolving in distilled water make it a conductor of electricity.

Similarly, if we repeat the activity by adding 10 drops of sodium hydroxide solution in distilled water, the bulb will light up, thereby proving that alkalis on dissolving in distilled water make it conductor of electricity.

## ACTIVITY

To find electrically conducting liquids and non-conducting liquids.

**Materials required :** ● A dry cell. ● three insulated copper wire A, B and C with bare ends. ● cello tape ● 1 volt bulb fixed in a bulb holder. ● 100 cc beaker containing distilled water. ● tap water ● common salt solution. ● vinegar solution ● lemon juice solution. ● alcohol petrol. ● kerosene oil ● mustard oil and dilute hydrochloric acid solution.

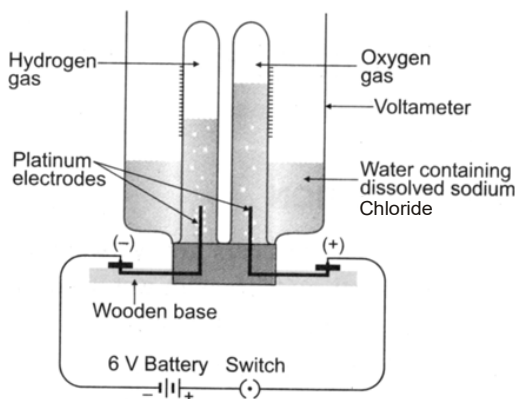
**Method :** Set up the apparatus as in Activity 1 or 2. Dip the bare ends of the wires B and C in the above mentioned solutions one by one, and record in which solutions the bulb lights up and in which solutions the bulb does not light up.

We will observe that bulb lights up in case of tap water, common salt solution, vinegar solution, lemon juice solution and dilute hydrochloric acid solution. Thus, these liquids conduct electricity. We will also observe that bulb does not light up in case of distilled water, alcohol, petrol, kerosene oil and mustard oil. Thus, these liquids do not conduct electricity.

## ACTIVITY

To show chemical reaction takes place when electric current is passed through common salt solution in water.

**Materials required :** ● A cup shaped voltameter with platinum electrodes. ● common salt solution in distilled water. ● a matchbox. ● 6 volt battery ● a switch.



**Method :** Take the given voltameter. It consists of a cup-shaped glass vessel from the bottom of which arise two platinum electrodes. These electrodes are connected to brass terminals fixed on the wooden base.

Fill  $\frac{3}{4}$  of the voltameter with water containing dissolved common salt. The dissolved common salt makes the water electrically conducting.

Fill each of the test tube of the voltameter with common salt solution and then invert them over the platinum electrodes as shown in Fig., taking care that no water flows out of them. This can be achieved by placing the thumb on, the mouth of test tubes and then removing the thumb under the common salt solution in the voltameter.

Put the switch in off position and then connect the terminals of 6-volt battery to the voltameter as shown in Fig.. Now put the switch in on position.

We will observe that tiny bubbles of colourless gases arise from both the electrodes and collect in the test tubes. Furthermore, the gas collected at the platinum terminal connected to the negative terminal of the battery is twice in volume as compared to the gas collected at the platinum terminal connected to the positive terminal of the battery.

The gas collected on the platinum terminal connected to the **negative terminal** of the battery is **hydrogen gas**. This gas can be easily tested by bringing a burning matchstick near the mouth of test tube. The gas catches fire with a loud pop sound and the matchstick goes off.

The gas collected on the platinum terminal connected to the **positive terminal** of the battery is **oxygen gas**. This gas can be easily tested by introducing the glowing end of the matchstick in the test tube, when the matchstick bursts into flame.



## PROBLEMS

## A. Match The Following :

Column-A	Column-B
Distilled water	Good conductor
Tap water	Chromium
Electroplating	Electroplating with nickel silver
EPNS	Bad conductor

## B. Fill In The Blanks :

- i. Most liquids that conduct electricity are solutions of ..... and .....
- ii. Distilled water is a ..... conductor of electricity.
- iii. Tap water is a ..... conductor of electricity.
- iv. The passage of an electric current through a solution causes chemical .....
- v. Copper gets deposited on the plate connected to ..... terminal of the battery.
- vi. The process of depositing a layer of any desired metal on another metallic object, by means of electricity, is called .....

## C. Write True Or False For The Following Statements :

- a. Distilled water is a good conductor of electricity.
- b. Iron is used for electroplating.
- c. EPNS is written on objects plated with silver.
- d. Chromium is used for electroplating because it is a cheap metal.

## D. Select The Odd One Out Giving Reason :

- a. Gold, silver, iron.
- b. Distilled water, salt solution, acid.
- c. Sulphuric acid, sodium hydroxide, distilled water

## E. Tick The Correct Option :

- A bad conductor of electricity is
 

(a) Distilled water	(b) copper sulphate	(c) silver nitrate	(d) sulphuric acid.
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- Electroplating is not done with
 

(a) Silver	(b) zinc	(c) gold	(d) iron.
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- Artificial jewellery is usually coated with
 

(a) Gold	(b) zinc	(c) chromium	(d) copper.
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- Chromium plating is done because, chromium
 

(a) Is expensive	(b) has a shiny appearance
(c) gets corroded	(d) does not resist scratches.

**ELECTRICAL CONDUCTIVITY**

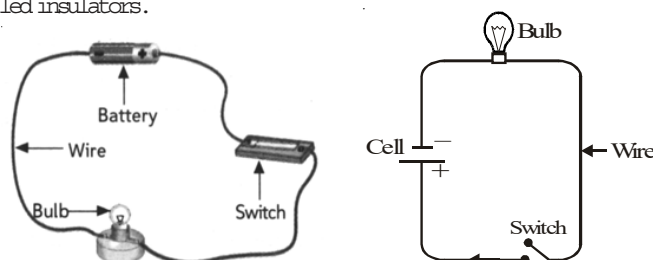
Materials that allow electricity to flow through them easily are called conductors. Materials that do not allow electricity to flow through them easily are called insulators.

**Examples of conductors:**

**Metals, graphite (a form of carbon)**

**Examples of insulators:**

**Rubber, plastic, wood, glass**



The difference between conductors and insulators is explained by a term called electrical conductivity.

Electrical conductivity is a measure of the ability of a substance to carry electric current.

Substances that are good conductors of electricity have high electrical conductivity as compared to substances that are poor electrical conductors (also called insulators). Some liquids, but not all, are also good conductors of electricity.

**Semi conductor :** Those substance whose conductivity lies between the conductor and insulators are called semi conductor. e.g. Silicon, germanium are semi conductors, semi conductor may become conductor by increasing its temperature.

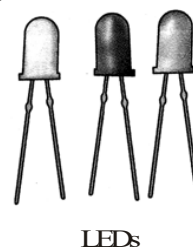
**CONDUCTIVITY OF WATER**

We are often advised to avoid handling electrical appliances with wet hands. Do you know why?

By itself, pure water is a poor conductor of electricity. But the water that we use in our houses is not pure water. Generally, water (tap water, pond water, well water, etc.) contains a lot of impurities, most of which are usually dissolved salts. The presence of even a small amount of impurity makes water a good conductor of electricity. Touching an electrical appliance with wet hands could, therefore, be dangerous. We are more likely to get an electric shock if you touch an electric appliance with wet hands than with dry hands because wet skin has many times more conductivity than dry skin. Remember, getting an electric shock can be a very serious matter. Should an electric current pass through our body, it could result in very serious consequences, even death. So, always take care while handling electrical plugs and gadgets.

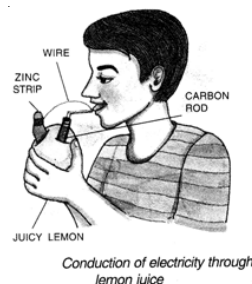
**LIGHT EMITTING DIODE (LED)**

An electric bulb is used in the electric circuit to confirm the flow of current in the circuit. However, the electric bulb may not glow if the electric current is weak. We use an LED in place of the electric bulb in case of weak electric current. In other words, LED glows even when a weak electric current flows through it. An LED has two wires attached to it. These wires are called leads. One lead is slightly longer than the other. It must be kept in mind that while connecting to a circuit the shorter lead is always connected to the negative terminal of the battery and the longer lead is connected to the positive terminal of the battery. It must be ensured that the free ends of the LED do not touch each other. LEDs are available in many colours such as red, green, yellow, blue, white and are increasingly being used for many applications. LEDs are increasingly being used for lighting.



**ACTIVITY****ELECTRICITY CONDUCTS THROUGH LEMON JUICE**

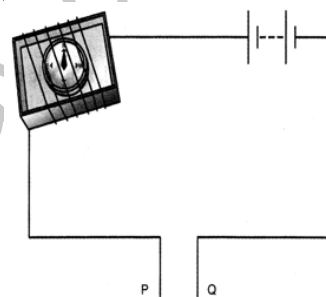
Take an old used cell. Tear off a piece of zinc strip and carbon rod from it. Wash the strip of zinc you tore from the cell and clean it with a sand paper. Connect a wire to one end of the zinc strip. Now take a juicy lemon, cut a slit in it and push the zinc strip in it. Cut another slit and push in the carbon rod. Your cell is ready. now test this cell with the tip of your tongue as shown in fig. What do you feel? You will feel a slight tickling because your tongue is conducting electricity. The activity suggests that electricity conducts through lemon juice, an acidic solution.

**MAKING A TESTER USING THE MAGNETIC****EFFECT OF CURRENT**

We have learnt that an electric current produces a magnetic field. What happens to compass needle when it is kept near a wire carrying electric current? The magnetic needle will show deflection. The deflection is observed even if the current is weak. Thus, we can make a tester using the magnetic effect of current.

Take the tray from inside a discarded matchbox. Now wrap an electric wire 4-5 times around the tray. Gently place a small compass needle inside it. Join one free end of the wire to the terminal of a battery and the other end of the wire is left free. Now take another wire and join it with the other terminal of the battery.

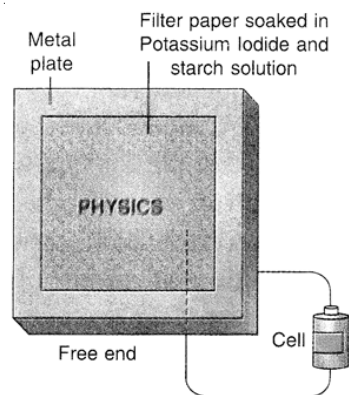
The free ends of the two wires P and Q are joined momentarily. The compass needle shows some deflection. We have prepared a tester which can be used to detect the current flowing through a circuit.

**MAKING AN ELECTRIC PEN**

Have you even thought of writing with the help of electricity? Amazing, isn't it? let us perform the following activity.

You would need potassium iodide solution, starch solution (both available in your school laboratory), filter paper or tissue paper, metal sheet (copper), a battery and two connecting wires. Mix potassium iodide and starch solution and soak the filter paper in it. Spread the filter paper on the metal sheet. Attach the connecting wires to the terminals of the battery. Connect the wire coming from the positive terminal of the battery, to the metal plate (as shown in the fig.) and leave the other wire (connected with the negative terminal) free.

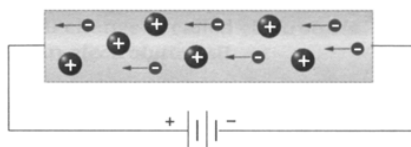
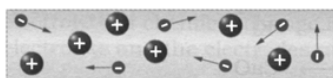
Now write a word on the filter paper with the free end. You can see blue colour ink will appear at the places where it has been written. This is because the circuit is completed only when the wire touches the filter paper. This touching leads to the dissociation of KI (potassium iodide) which produces iodine. On reaction with starch, iodine forms blue-black colour. The electric pen was developed during Edison's research into telegraphy.

**ELECTRICITY THROUGH DIFFERENT SUBSTANCES**

All substances are made up of atoms, which have charged particles called electrons and protons. We know that electricity in all forms is due to the charges on these particles. When charged particles move in an orderly fashion, we get an electric current.

**CONDUCTION IN SOLIDS**

Among solids, metals are good conductors of electricity. In metals, some electrons are not very tightly bound to the atoms. They move about randomly in different directions within the metal. When a voltage is applied across a piece of a metal, these electrons move in an orderly fashion in one direction. This flow of electrons is the current in the metal. In most other solids, electrons are tightly bound to the atoms and are not easily available to flow. So, they do not conduct electricity well.



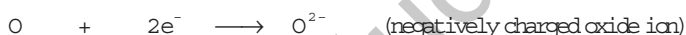
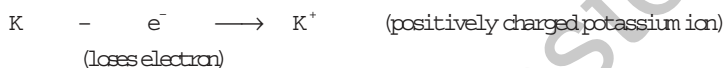
The randomly moving electrons in a metal bar start moving in an orderly fashion in one direction when a voltage is applied.

**CONDUCTION IN LIQUIDS**

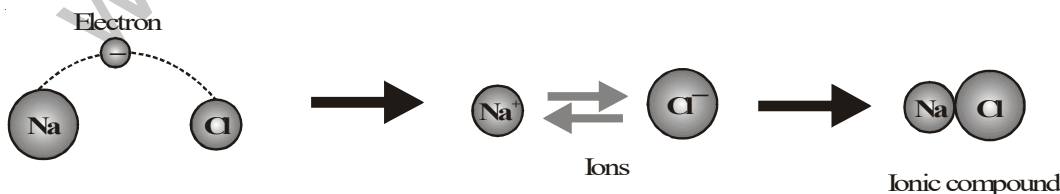
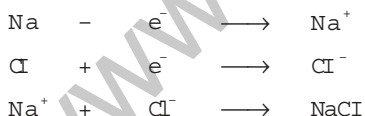
Molten metals and mercury (a liquid metal) conduct electricity. The current through them is constituted by the flow of electrons. Other liquids conduct electricity because they have ions.

Under some conditions, an atom may lose one or more electrons, which get added to another atom. The atom that loses an electron (or electrons) has more protons than electrons. So, it becomes positively charged. And the atom that gains the electrons has more electrons than protons. So, it becomes negatively charged.

**An atom or a radical that becomes charged by losing or gaining one or more electrons is called an ion.**

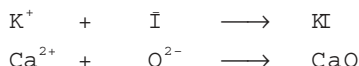


Ions carrying opposite charges tend to attract and hold on to each other. This may lead to the formation of compounds called ionic compounds. For example, a sodium atom may lose an electron, which is gained by a chlorine atom. Thus, a positively charged sodium ion ( $\text{Na}^+$ ) and a negatively charged chloride ion ( $\text{Cl}^-$ ) are formed. These come together to form the ionic compound  $\text{NaCl}$ .



**Fig. : The formation of sodium chloride**

Similarly, potassium iodide and calcium oxide are formed when their oppositely charged ions come together.



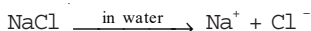
Some more examples of ions and the compounds they form are given in Table.



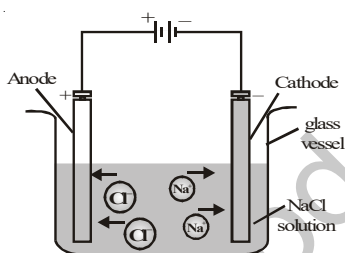
## IONS AND SOME COMPOUNDS THEY FORM

Positive ions	Negative ions	Compounds
$\text{Na}^+, \text{K}^+, \text{Ca}^{2+}, \text{Cu}^{2+}$	$\text{Cl}^-, \text{I}^-, \text{O}^{2-}, \text{OH}^-, \text{NO}_3^-$ $\text{SO}_4^{2-}, \text{CO}_3^{2-}$	$\text{NaCl}, \text{KCl}, \text{KI}, \text{CaO}, \text{Na}_2\text{O}, \text{KOH},$ $\text{NaOH}, \text{KNO}_3, \text{CuSO}_4, \text{Na}_2\text{CO}_3$

When an ionic compound is dissolved in water, it splits into its component ions. A liquid or a moist paste that has ions in it is called an electrolyte. When common salt ( $\text{NaCl}$ ) is dissolved in water, it splits into  $\text{Na}^+$  and  $\text{Cl}^-$  ions. A solution of common salt is therefore an example of an electrolyte. In general, acids and solutions of salts and bases are electrolytes.



The ions are free to move about in an electrolyte. When a voltage is applied across electrodes placed in the electrolyte, the ions start moving in an orderly fashion. The positive ions move towards the cathode (negative electrode) and the negative ions move towards the anode (positive electrode). Their flow constitutes a current through the electrolyte. That is why liquids that have ions, such as acids and solutions of salts and bases, conduct electricity.



## HOW THE ELECTRIC CURRENT BRINGS ABOUT CHEMICAL CHANGE IN WATER

A very, very small amount of water decomposes on its own to form positively charged hydrogen ( $\text{H}^+$ ) ions and negatively charged hydroxyl ( $\text{OH}^-$ ) ions. However, their number remains same and hence the water remains electrically neutral.

When electric current is passed through water, the hydrogen ( $\text{H}^+$ ) ions are attracted towards negatively charged platinum terminal. Here, they gain electric charges to form neutral hydrogen atoms. The hydrogen atoms subsequently join to form hydrogen molecule.

Conversely, on the passage of electric current, the hydroxyl ( $\text{OH}^-$ ) ions are attracted towards positively charged platinum terminal. Here, they lose electric charges to form neutral hydroxyl ions, which unite to form oxygen gas.

## GENERAL TERMS ASSOCIATED WITH THE PASSAGE OF CURRENT THROUGH SOLUTIONS

- Electrolyte** : A solution of a chemical compound which conducts electric current and at the same time undergoes a chemical change is called electrolyte.

**Examples :**

- i. Aqueous solutions of all acids, such as  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  etc.
- ii. Aqueous solutions of all alkalis, such as  $\text{NaOH}$ ,  $\text{KOH}$ , etc.
- iii. Aqueous solution of salts, such as common salt, copper sulphate, sodium nitrate, zinc chloride, etc.

- Non-electrolyte** : A solution of a chemical compound which does not conduct electric current and hence does not undergo any chemical change is called non-electrolyte.

**Examples :** Petrol, kerosene oil, diesel oil, vegetable oils, chloroform, carbon tetrachloride, alcohol, ether, benzene, distilled water, etc.

- Electrolysis** : The process due to which a solution of a chemical compound conducts electric current and at the same time undergoes a chemical change is called electrolysis.



4. **Electrodes** : The metal wires/plates/rods through which the current enters or leaves an electrolyte are called electrodes.
5. **Cathode** : The electrode connected to the negative terminal of a cell/battery is called cathode.
6. **Anode** : The electrode connected to the positive terminal of a cell/battery is called anode.
7. **Ions** : The electrically charged atoms/group of atoms formed when a chemical compound is dissolved in water are called ions.
8. **Cations** : The positively charged ions formed when a chemical compound dissolves in water are called cations. During electrolysis, the cations are discharged at cathode by taking electric charges from it.
9. **Anions** : The negatively charged ions formed, when a chemical compound dissolves in water are called anions. During electrolysis, the anions are discharged at anode by losing electric charges to it.
10. **Voltameter** : An apparatus in which electrolysis is carried out, such that it consists a vessel, two electrodes and electrolyte is called voltameter.

### ELECTROPLATING

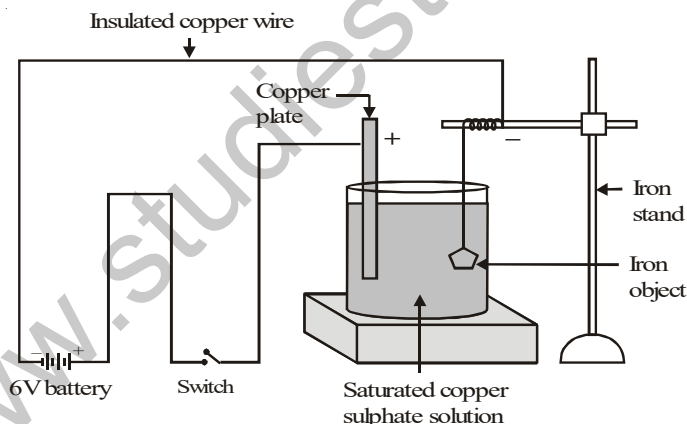
One of the uses of chemical effect of an electric current is electroplating. During electroplating the metal surface of a given article is coated with a thin layer of superior metal with the help of electric current.

Let us perform the following activity in order to show electroplating of an iron object.

#### ACTIVITY

To electroplate an article of iron with copper.

**Materials required** : ● A glass container or 500 cc beaker. ● copper sulphate crystals. ● distilled water  
● concentrated sulphuric acid ● a copper plate ● a 6 volt battery. ● a switch  
● three insulated copper wires with bare ends. ● a glass rod. ● an iron object.



#### Copper plating of an iron object.

#### METHOD

- (i) Half fill the given glass vessel with distilled water. To the distilled water add copper sulphate crystals and stir with glass rod, till the crystals stop dissolving. The solution so obtained is saturated copper sulphate solution.
- (ii) In the above solution place a copper plate connected to an insulated copper wire through a switch. Tie the bare end of another copper wire to iron object and then immerse it in copper sulphate solution. Complete the electrical circuit as shown in Fig.
- (iii) Switch on the current and wait for 5-15 minutes.
- (iv) Switch off the current and take the iron object out from copper sulphate solution.

You will notice that its surface is coated with a thin layer of copper which is reddish in colour.

**HOW IS THIN LAYER OF COPPER METAL DEPOSITED ON THE GIVEN OBJECT?**

The saturated copper sulphate solution contains the following cations and anions.

**Cations :** The positively charged cations are copper ions ( $\text{Cu}^{2+}$ ) from copper sulphate and hydrogen ions ( $\text{H}^+$ ) from water.

**Anions :** The negatively charged anions are hydroxyl ions ( $\text{OH}^-$ ) from water and sulphate ions ( $\text{SO}_4^{2-}$ ) from copper sulphate.

When the electrical current is switched on, the cations start migrating towards the cathode and the anions towards the anode.

At the cathode the positively charged copper ions gain electrical charges to form copper atoms which deposit themselves on the surface of iron object. Thus, a thin layer of copper is deposited on iron objects.

The hydrogen ion do not discharge. Why? You will learn more about it in higher classes.

At anode, none of the negatively charged anions (hydroxyl and sulphate ions) discharge. Instead, the copper atoms on the copper plate lose their charges to form copper ions ( $\text{Cu}^{2+}$ ) which enter in the copper sulphate solution.

Thus, on the whole the anode loses copper atoms to form copper ions and the cathode gains same number of copper ions to form copper atoms,

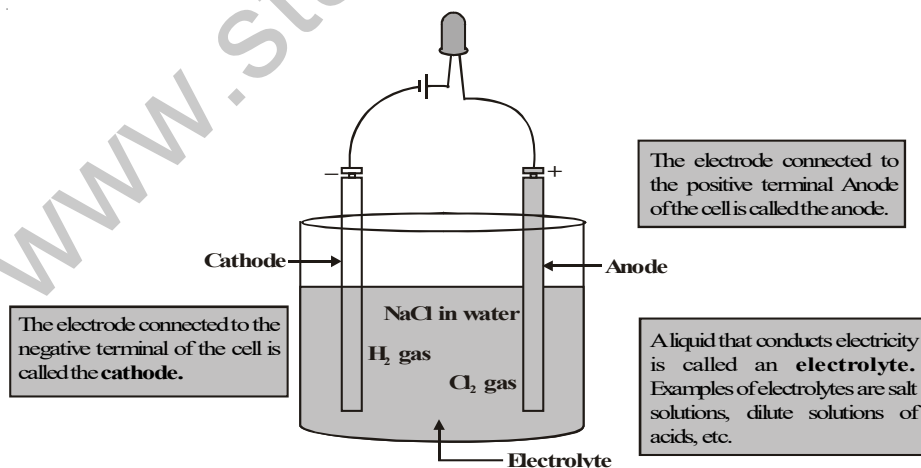
**ELECTROLYSIS AND ELECTROLYTIC CELL**

It was found by Sir Humphry Davy that when electric current was passed through certain substances, they underwent a chemical change to give new substances. This is called electrolysis.

Thus, the production of a chemical reaction by passing an electric current through an electrolyte is called electrolysis.

Let us now understand the mechanism by which electric current passes through an electrolytic cell and how electrolysis occurs.

Figure shows how an electrolytic cell works. We dip two plates or rods made of a conducting material (like graphite, copper, etc.) in the liquid (called the electrolyte). These plates are called electrodes. One of them is called the cathode (connected to the negative terminal of the cell), and the other one is called the anode (connected to the positive terminal of the cell). The ends of the two electrodes are connected to a cell/battery.

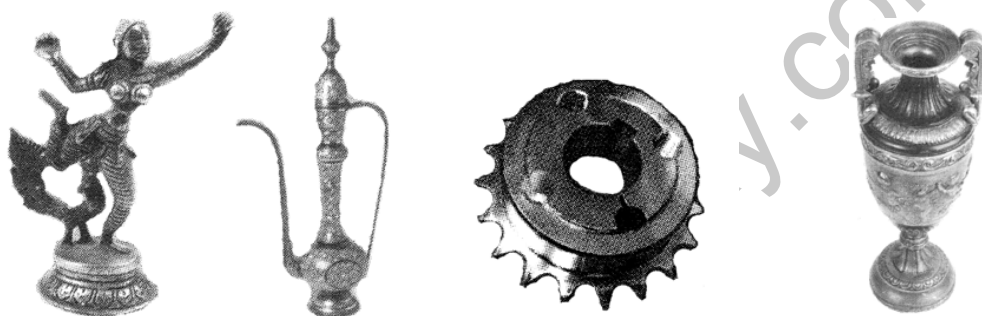


When we switch on the electric current, the electrolyte dissociates into positive ions and negative ions. The positive ions, called the cations, move towards the cathode and the negative ions, called the anions, move towards the anode.

At the cathode, the cations take up electrons and become neutral. The anions move to the anode and give up electrons.

### USES OF ELECTROPLATING

1. **Decoration purposes :** Some metals give better look and finish. Therefore, the objects of not so expensive metals are generally electroplated with expensive metals such that they look more attractive and beautiful. For example, a flower vase of brass if electroplated with silver looks more decorative.
2. **Protection against corrosion :** More reactive metals tend to get rusted often. To protect the objects made of such reactive metals, they are electroplated with less reactive metals. For example, iron can be protected against rusting by electroplating it with nickel and zinc. Brass objects are protected against corrosion by chromium electroplating.
3. **Repairing Finer Machine parts :** Finer (small and precisely made) parts of certain machines cannot be repaired to ordinary methods involving welding, etc. Such like parts are repaired by depositing the desired metal at the proper location electrolytically.



Some electroplated objects

### LET US SUMMARISE

- Materials are classified as good or poor conductors of electricity.
- Distilled water does not conduct electricity.
- Most liquids that conduct electricity are solutions of acids, bases and salts.
- When two metal rods, called electrodes, are placed in a solution-called electrolyte-and current is passed through it, the current is conducted through the solution and the phenomenon is called electrolysis.
- The positive electrode through which current enters is called anode the negative electrode is called cathode.
- The phenomenon of causing chemical changes by passing electricity is called chemical effects of current.
- The method of purifying metals by using electricity is called electrorefining. metals such as zinc, copper, silver, gold, nickel, aluminium, etc. are refined by electrical method.
- The process of depositing a thin layer of a metal on any conducting substance by the process of electrolysis is known as electroplating.

## CHOOSE THE CORRECT OPTION IN EACH OF THE FOLLOWING

1. When electric current is passed through acidulated water, the gases produced are :  
(A) Hydrogen and oxygen (B) Hydrogen and ozone  
(C) Oxygen and hydrogen peroxide (D) None of these
2. The object to be electroplated is made :  
(A) Cathode (B) Anode (C) Cathode or anode (D) Anode only
3. The method of purifying metals by passing electricity is called :  
(A) Electrolysis (B) Electroplating (C) Electrowinning (D) None of these
4. During purification of metals, the refined metal is obtained at the :  
(A) Cathode (B) Anode (C) Surface of electrolyte (D) Both (A) & (B)
5. During electrolysis, the electrolyte undergoes :  
(A) A physical change (B) A chemical change (C) Either (A) or (B) (D) None of these
6. Which of the following is a non-electrolyte?  
(A) Salt solution (B) Lemon juice (C) Distilled water (D) Tap water
7. Which of the following is an electrolyte?  
(A) Alcohol (B) Benzene (C) Sulphuric acid (D) Kerosene oil
8. Which of the following is used to carry out electrolysis?  
(A) Voltmeter (B) Ammeter (C) Voltmeter (D) All of these
9. In an electrolytic cell, the electrode that is connected to the positive terminal of the battery is called :  
(A) Cation (B) Cathode (C) Anion (D) Anode
10. The process by which a chemical change takes place in a substance when electric current is passed through it is called :  
(A) Electrolysis (B) Electroplating (C) Electrodes (D) Thermionic conduction
11. Adding a soluble metallic salt to water :  
(A) Increases its electrical conductivity (B) Decreases its electrical conductivity  
(C) Never produces any change in the conductivity (D) None of these
12. Electroplating is a method of :  
(A) Making plates using electricity  
(B) Plating a metal with another metal  
(C) Coating any object with an electrically conducting plate  
(D) Coating a metal with another metal by passing an electric current
13. An electrolyte is :  
(A) A light electric cell (B) A liquid that conducts electricity  
(C) A metal (D) None of these
14. A bad conductor of electricity is :  
(A) Distilled water (B) Copper sulphate (C) Silver nitrate (D) Sulphuric acid
15. Electroplating is not done with :  
(A) Silver (B) Zinc (C) Gold (D) Iron

16. Artificial jewellery is usually coated with  
(A) Gold (B) Zinc (C) Chromium (D) Copper
17. Chromium plating is done because, chromium :  
(A) Is expensive (B) Has a shiny appearance  
(C) Gets corroded (D) Does not resist scratches
18. When common salt is added to distilled water, the water becomes a :  
(A) Good conductor (B) Bad conductor (C) Moderate conductor (D) Both (A) & (B)
19. Which of the following does not involve any chemical effects of current?  
(A) Electroplating (B) Electrorefining (C) Dispersion (D) None of these
20. The process by which an electrolyte is decomposed with the help of electricity is :  
(A) Electroplating (B) Electrorefining (C) Electrolysis (D) None of these
21. The object to be electroplated is made :  
(A) Cathode (B) Anode (C) Cathode or anode (D) None of these
22. The method of purifying metals by passing electricity is called :  
(A) Electrolysis (B) Electroplating (C) Electrorefining (D) Voltmeter
23. Which of the following is used to test the flow of weak electric current through a circuit?  
(A) LED (B) Battery (C) Voltmeter (D) Cathode
24. Negatively charged electrode is known as :  
(A) Cathode (B) Anode (C) Insulator (D) Cathode or insulator
25. During purification of metals, the refined metal is obtained at the :  
(A) Cathode (B) Anode (C) Surface of electrolyte (D) None of these
26. How many leads does an LED have?  
(A) 2 (B) 3 (C) 4 (D) 8
27. The longer end of LED is always connected to the ..... of the battery?  
(A) Positive terminal (B) Negative terminal (C) Centre (D) Insulator
28. An LED is a type of :  
(A) Resistor (B) Tester (C) Battery (D) Bulb
29. Jewellers electroplate silver and gold on :  
(A) Expensive metals (B) Less expensive metals (C) All alkali metals (D) All of these
30. Tin cans, used for storing food, are made by electroplating tin onto :  
(A) Lead (B) Gold (C) Iron (D) Chromium

ANSWER KEY															
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	A	C	B	B	C	C	C	D	A	A	D	B	A	D
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	A	B	A	C	C	A	C	A	A	A	A	A	B	B	C

## EXERCISE - 2

## CHEMICAL EFFECT OF CURRENT

## FILL IN THE BLANKS

- Water mixed with salts is a ..... conductor of electricity.
- For electricity to flow in a medium, we need ..... charges in the medium.
- Impurities in water generally ..... its conductivity.
- In liquids, electrical conductivity is generally due to .....
- Cations carry ..... charge.
- Anions are attracted to the .....
- $\text{Na}^+$  is a .....
- The branch of science that deals with the interrelation between chemical phenomena and electricity is called .....
- The method of coating a metal with a layer of another metal using electric current is called .....
- ..... is a measure of the ability of a substance to carry electric current.
- Most liquids that conduct electricity are solutions of ....., ..... and .....
- Distilled water is a ..... conductor of electricity.
- Tap water is a ..... conductor of electricity.
- The passage of an electric current through a solution causes chemical .....
- Copper gets deposited on the plate connected to ..... terminal of the battery.
- The process of depositing a layer of any desired metal on another metallic object, by means of electricity, is called .....
- The chemical effects of current involve transformation of ..... energy into ..... energy.
- During electrolysis, an electrolyte undergoes a ..... change.
- ..... is used for making artificial jewellery.
- Liquids that conduct electricity are solutions of acids, bases and .....
- ..... is the process by which an electrolyte is decomposed with the help of electricity.
- Salt makes distilled water a ..... conductor of electricity.
- Liquid that conducts electricity is called a/an .....
- The process by which an electrolyte is decomposed with the help of electricity is known as .....
- The electrode connected to the negative terminal is known as .....

## WRITE TRUE OR FALSE THE FOLLOWING STATEMENTS

- Electrolysis is carried out in an electrolytic cell.
- Cathode is a negative terminal.
- Acidulated water conducts electricity.
- The chemical effects of current involve transformation of electrical energy into thermal energy.
- Addition of sodium hydroxide in distilled water makes it non-electrolyte.
- Lemon juice cannot conduct electricity.
- Distilled water is a good conductor of electricity.
- Iron is used for electroplating.
- EPNS is written on objects plated with silver.
- Chromium is used for electroplating because it is a cheap metal.
- Acids, bases and salts do not conduct electricity.
- Electrode connected to positive terminal is called anode.
- Items to be electroplated from the cathode.
- Electrorefining is based on chemical effects of current.
- Lemon juice is a good conductor of electricity.

## MATCH THE ITEMS IN COLUMN-A WITH THE ITEMS IN COLUMN-B

	Column-A		Column-B
1.	(A) Corrosion	i	Positive electrode
	(B) Anode	ii	Good conductor of electricity
	(C) Aluminium	iii	Negative electrode
	(D) Distilled water	iv	Electroplating
	(E) Cathode	v	Electroplating

	Column-A		Column-B
2.	(A) Negative electrode	i	Electrolyte
	(B) Positive electrode	ii	Artificial jewellery
	(C) $\text{CuSO}_4$ (aq)	iii	Non-electrolyte
	(D) Electroplating	iv	Cathode
	(E) Kerosene	v	Anode

	Column-A		Column-B
3.	(A) Distilled water	i	Good conductor
	(B) Tap water	ii	Chromium
	(C) Electroplating	iii	Electroplating with silver
	(D) EPNS	iv	Bad conductor

## FIND THE ODD ONE OUT GIVING REASON

- Gold, silver, iron.
- Distilled water, salt solution, acid.
- Sulphuric acid, sodium hydroxide, distilled water.
- Electroplating, electrolysis, hydrolysis, refining of metal.
- Salt water, tap water, copper sulphate, distilled water.
- Electrodes, cathode, anode, diode.

## ANSWER KEY

## ● FILL IN THE BLANKS :

1. Good 2. Free 3. Increase 4. Irons 5. Positive 6. Cathode 7. Cation 8. Electrochemistry 9. Electroplating  
 10. Electrical conductivity 11. acids, bases, salts 12. Bad 13. Good 14. reactions 15. Negative 16. Electroplating  
 17. Electrical, Thermal 18. Chemical 19. Gold silver chromium 20. Salts 21. Electrolysis 22. Good  
 23. Electrolysis 24. Electrolysis 25. Cathode

## ● WRITE TRUE OR FALSE FOR THE FOLLOWING :

1. T      2. T      3. T      4. T      5. F      6. F      7. F      8. F      9. T      10. T  
 11. F      12. T      13. T      14. T      15. T

## ● MATCH THE FOLLOWING :

(A) (A) → iv ; (B) → i ; (C) → ii ; (D) → v ; (E) → iii;    (B) (A) → iv ; (B) → v ; (C) → i ; (D) → ii ; (E) → iii;  
 (C) (A) → iv ; (B) → i ; (C) → ii ; (D) → iii



## SUBJECTIVE ANSWER TYPE QUESTIONS

## SHORT ANSWER TYPE QUESTIONS

1. What do you call the liquids which conduct?
2. What do you call the liquids which do not conduct?
3. Name a liquid which conducts.
4. Name a liquid which does not conduct.
5. Name a metal which is used for electroplating.
6. Name the non-metal that is a good conductor of electricity.
7. What is the name give to the positive electrode?
8. What is the name give to the negative electrode?
9. Name the gas that burns with 'pop' sound.
10. Give one example of a liquid that is a good conductor of electricity and name a liquid that is a poor conductor of electricity \_\_\_\_\_ and \_\_\_\_\_
11. Name the gases present in water. \_\_\_\_\_ and \_\_\_\_\_
12. Name the process by which water can be broken up into  $H_2$  and  $O_2$  by passing electricity.
13. Do all liquids conduct electricity?
14. What do you mean by electrolysis?
15. Distinguish between cathode and anode.
16. What is meant by an electrolytic solution?
17. What is acidulated water?
18. What do you mean by an electrolytic cell?
19. Distinguish between cathode and anode.
20. What is meant by an electrolytic solution?

## ANSWER THE FOLLOWING IN BRIEF

1. Distilled water does not conduct what we can do to make it conducting.
2. When the free ends of a tester are placed in a liquid, the magnetic needle in it shows deflection. What can you say about the conductivity of the liquid?
3. Why firemen shut off the electricity connection of a house which has caught fire?
4. White deposit can be seen in containers used for storing water. Explain why these deposits occur.
5. What are anions and cations? Give examples.
6. What is electrolysis? What is it useful in industry?
7. Define the following : (i) electrolyte (ii) electrolysis (iii) electroplating.
8. What are the use of electroplating?
9. Why do we get electric shock?
10. A pencil sharpened at both ends can be used as a conductor in laboratories. Why?
11. What is electrical conductivity?
12. We are advised to use rubber soled slippers while working with electrical goods. Why?
13. What do you mean by chemical effect of current?
14. How can we get  $H_2$  and  $O_2$  from water?
15. Distinguish between electrolytes and non-electrolytes. Give examples.
16. What is electrowinning? Briefly explain the process with the help of a labelled diagram.
17. What is electroplating?
18. What do you mean by an LED?

19. Does pure water conduct electricity? If not, what can we do to make it conducting?
20. Is it safe for the electrician to carry out electrical repairs outdoors during heavy downpour? Explain.

**ANSWER THE FOLLOWING IN APPROPRIATE DETAIL**

1. Explain the electrolysis of water with the help of a labelled diagram. Also write the chemical reactions taking place at the electrodes.
  2. What is electroplating? What are the essential steps involved in the electroplating of an article? Draw a labelled diagram to explain the process.
  3. What do you understand by electrolysis? Briefly explain various terms involved in the process of electrolysis.
  4. Briefly explain the applications of electroplating. How will you protect metals from getting corroded?
  5. Explain with the help of an experiment that electricity conducts through lemon juice.
  6. Explain the electrolysis of water with the help of a labelled diagram. Also write the chemical reactions taking place at the electrodes.
  7. What is electroplating? What are the essential steps involved in the electroplating of an article? Draw a labelled diagram to explain the process.
  8. What do you understand by electrolysis? Briefly explain various terms involved in the process of electrolysis.
  9. Explain, with the help of a diagram, how electroplating of an object is done.
  10. A tester is used to check the conduction of electricity through two liquids, labeled P and Q. It is found that the magnetic needle of the tester deflects by a small amount for only liquid P. Which liquid is a better conductor of electricity and why?
-

## EXERCISE-4

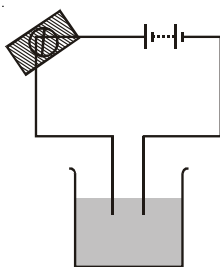
BASED ON NCERT

## EACH QUESTION 1 MARKS

1. What are conductors?
- A. Materials which allow electric current to flow through them are called conductors.
2. What are insulators?
- A. Materials which do not allow electric current to flow through them are called insulators.
3. Is distilled water a conductor or an insulator?
- A. Distilled water is an insulator because there are no salts dissolved in it.
4. Classify the following liquids into conductors and insulators : lemon juice, distilled water, tap water, milk.
- A. Conductors : lemon juice, tap water.  
Insulators : distilled water, milk
5. Define electroplating?
- A. electroplating is the process of depositing a layer of any desired metal on another metallic object by means of electricity.
6. Is air an insulator or conductor of electricity?
- A. Air is an insulator of electricity.
7. What is LED?
- A. LED is light emitting diode.
8. Name the gases formed when electric current is passed in water containing a few drops of acid?
- A. Hydrogen and Oxygen
9. What is CFL?
- A. Compact Fluorescent lamps.
10. What is an electric pen?
- A. It is a device for writing on the surface with special compounds and material using the electrical property of ions.

## EACH QUESTION 2 MARKS

1. When the free ends of a tester are dipped into a solution, the magnetic needle shows deflection. Can you explain the reason?
- A. Yes, the solution does conduct electricity. Compass needle shows deflection due to magnetic effect of electric current.
2. Name three liquids, which when tested in the manner shown in figure, may causes the magnetic needle to deflect.

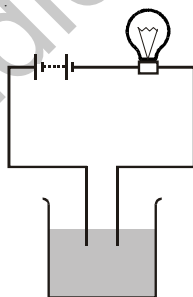


- A. The compass needle will show deflection with tap water, lemon juice and sodium chloride solution.
3. A tester is used to check the conduction of electricity through two liquids, labelled A and B. It is found that the bulb of the tester glows brightly for liquid A while it glows very dimly for liquid B. You would conclude that
- i. Liquid A is better conductor than liquid B.
- ii. Liquid B is a better conductor than liquid A.
- iii. Both liquids are equally conducting.
- iv. Conducting properties of liquids cannot be compared in this manner.
- A. i. Liquid A is a better conductor of electricity because the bulb glows more in it.

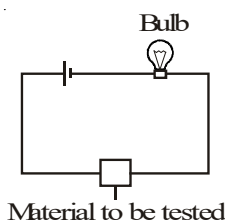
4. Does pure water conduct electricity? If not, what can we do to make it conducting?
- A. As pure water is free of salts and thus it is an insulator so to make pure water conducting, we can add some salts or acid to it.
5. In case of a fire, before the firemen use the water hoses, they shut off the main electrical supply for the area. Explain why they do this.
- A. Firemen shut off the main electrical supply for the area because water is a good conductor of electricity and the firemen can get electrocuted.
6. Is it safe for the electrician to carry out electrical repairs outdoors during heavy downpour? Explain.
- A. No, it is not advisable for wiremen to carry out electrical repairs during heavy downpour because water is a good conductor of electricity and the person can get shock.
7. A child staying in a coastal region tests the drinking water and also the seawater with his tester. He finds that the compass needle deflects more in the case of seawater. Can you explain the reason?
- A. The sea water contains more salts dissolved in it as compared to the tap water. So, the deflection of the compass needle is more.
8. Paheli had heard that rainwater is as good as distilled water. So she collected some rainwater in a clean glass tumbler and tested it using a tester. To her surprise she found that the compass needle showed deflection. What could be the reasons?
- A. The rainwater showed deflection with tester because it is not as pure as distilled water. Distilled water does not have any salts dissolved in it, but rain water may have some impurities in it.
9. Why the iron cans are electroplated with tin?
- A. Tin is less reactive than iron. Thus food, stored in iron cans, is prevented from being spoilt by the iron by electroplating it by tin.
10. What is the disadvantage of electroplating done in the factories?
- A. The disposal of the used conducting solution is hazardous and can cause environmental pollution. There are specific disposal guidelines for environmental protection.

**EACH QUESTION 3 MARKS**

1. The bulb does not glow in the setup shown in figure. List the possible reasons. Explain your answer.



- A. It cannot be said for sure that liquid does not conduct electricity because :
  - a) may be the cells are weak
  - b) may be the current is so weak that it does not heat the filament of the bulb, so that it can glow.
2. How can you make a tester for testing whether a given material is a conductor or an insulator?
- A. A tester can be made by attaching one free end of the wire to a terminal of a battery and another wire from other terminal of the battery to a bulb. The two free ends of wire are connected to the material to be tested.



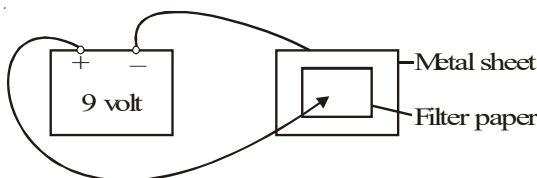
3. The bulb in the tester does not glow when current is passed through it. What can be the possible reasons for this?
- A. The possible reasons for this are :
  - Ⓐ the connections may be loose
  - Ⓑ the bulb may be defective.
  - Ⓒ the cells may be defective
4. The liquid is a conductor and the circuit is also complete, but the bulb does not glow. Why?
- A. The bulb does not glow even though the circuit is complete because the current is too small. The filament of the bulb is heated due to current and then it glows.
5. If the current in the circuit is small, how can we test its presence?
- A. We can test the presence of the small current by using a LED instead of the bulb.
6. During electrolysis of water, why does hydrogen collect on cathode and oxygen collect on anode?
- A. When electric current is passed in water hydrogen ions ( $H^+$ ) move towards cathode and get collected over it. Hydroxyl ions ( $OH^-$ ) move towards the anode and oxygen is collected on it.
7. Give three applications of chemical effect of current.
- A. (a) Electroplating (b) Refining of impure metals. (c) Refining of metal are for obtaining pure metal.
8. What is the objective of electroplating?
- A. Ⓐ Decoration of articles by giving them a layer for e.g., silver plating on cutlery.  
Ⓑ Protection of the surface of base metals which corrode for e.g., iron is plated with chromium.  
Ⓒ Artificial jewellery is plated with silver or gold.
9. Iron is a strong metal used for making bridges. Can we do electroplating on it to protect it from corrosion? Why?
- A. We prefer not to do electroplating on iron used for bridges because it is very costly. Instead the iron can be galvanised or painted.
10. Which properties of chromium make it useful for electroplating on iron? Why we cannot make the whole article with chromium?
- A. Chromium has a good shine, it resists scratches and is corrosion resistant. We cannot make the whole article from it because it is a very costly metal.

#### EACH QUESTION 5 MARKS

1. What is the basic principle of electric pen? Explain how it can be used for writing.
- A. Electric charge on ions is used for writing with an electric pen.

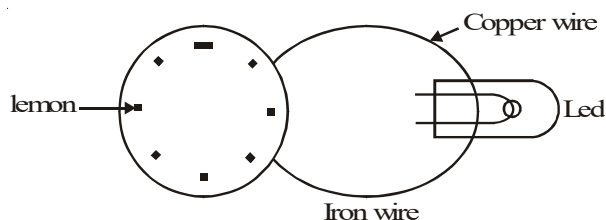
Method :

- i. Take a filter paper soaked in potassium iodide solution to which a pinch of starch is added.
- ii. Place the filter paper on a metal sheet.
- iii. Connect the negative terminal of battery to the metal sheet.
- iv. Write on the paper with the end of the wire connected to the positive terminal.



⚡ The writing appears on the paper. This happens because when current is passed the  $K^+$  ions are attracted to the metal sheet. The iodide ions ( $I^-$ ) react with starch to turn blue black.

2. Dinesh wants to study the chemical effect of current at home. How can he do it?
- A. Dinesh can study the chemical effect of current at home very easily. Take two pieces of copper wire and iron wire. Place them in fresh lemon fruit. Attach the free ends of the wires to a LED. LED glows showing the flow of current.



3. Give some uses of LED. How should LED be connected?
- A. ☐ as indicators in electrical appliances.  
☐ as a point source of light in laser beam torches.  
☐ LEDs emitting white light can be used instead of bulbs.
4. What is the difference between current flowing through metals and current flowing through liquids?
- A. In metals electric current is conducted by flow of electrons. In liquids, the movement of charged particles (ions) carry current from anode to cathode terminals. Electrolytes conduct current at a slow rate than metals.
-

Tick (✓) the correct choice among the following :

- Current is the flow of :  
(A) Matter (B) Electrons (C) Protons (D) Charge
- In electrolytic solutions, carrier of charge is :  
(A) Proton (B) Electron (C) Neutron (D) Ion
- Insulators :  
(A) Conduct electricity (B) Do not conduct electricity  
(C) Conduct electricity only at low temperature (D) Conduct electricity at room temperature
- Which of the following is an insulator?  
(A) Wood (B) Iron (C) Carbon (D) Silver
- In a cell, electrons move from :  
(A) Positive electrode to negative electrode  
(B) negative electrode to positive electrode  
(C) Both (A) and (B)  
(D) Electrons do not move and only negative charge moves from one place to another place
- When an electron moves from negative electrode to positive electrode :  
(A) Negative charge moves from negative electrode to positive electrode.  
(B) Positive charge moves from positive electrode to negative electrode.  
(C) No charge flows from either electrode to other electrode.  
(D) Both (A) and (B)
- When the ends of metal wire are not connected to a battery :  
(A) Electrons move from positive electrode to negative electrode.  
(B) Electrons move from negative electrode to positive electrode.  
(C) Electrons move in random directions  
(D) Protons move in random direction in such a way that their net movement in a unit volume is zero.
- Which of the following statements are true ?  
(A) During electrolysis, charge flows through electrolyte solution via electrons.  
(B) The randomly moving electrons in a metal wire will start moving in a particular direction when a potential difference is applied across it.  
(C) A negatively charged particle has higher electric potential than a positively charged particle  
(D) Charge flows only through negative charge carriers like electrons.
- A cell converts :  
(A) Electrical energy into chemical energy. (B) Chemical energy into electrical energy.  
(C) Magnetic energy into electrical energy. (D) Electrical energy into mechanical energy.
- An electrolyte :  
(A) Has positive charge (B) Has negative charge  
(C) Should be able to conduct charge without dissociating (D) Should be able to form positive and negative ions.
- \_\_\_\_\_ present in the lemon juice acts as electrolyte :  
(A) Sulphuric acid (B) Nitric acid (C) Hydrochloric acid (D) Citric acid
- Anode is :  
(A) Positively charged electrode (B) Negatively charged electrode  
(C) Wire used to connect the electrodes (D) Electrolyte which conducts electricity
- Cathode is :  
(A) Positively charged electrode (B) negatively charged electrode  
(C) A positively charged ion formed in the electrolyte (D) A negatively charged ion formed in the electrolyte
- Copper electrode :  
(A) Donates electrons to hydrogen ions (B) Accepts electrons from hydrogen ions  
(C) Donates electrons to sulphate ions (D) Accepts electrons from sulphate ions



15. When copper rod donates electrons to hydrogen ions, it gains \_\_\_ charge.  
(A) Positive (B) Negative (C) No charge (D) Can't say
16. The electrolyte in dry cell is :  
(A) Copper sulphate (B) Zinc sulphate (C) Sulphuric acid (D) Ammonium chloride
17. In dry cell \_\_\_ acts as positive terminal.  
(A) Carbon rod (B) Manganese dioxide  
(C) Manganese dioxide and powdered carbon (D) Metal cap on the carbon rod
18. The common dry cell produces a voltage of :  
(A) 1.5 V (B) 30 V (C) 60 V (D) 3 V
19. When electric current is flown through a conductor, some amount of :  
(A) Electrical energy is converted into heat energy (B) Electrical energy is converted into mechanical energy  
(C) Mechanical energy is converted into electrical energy (D) Heat energy is converted into electrical energy
20. Nichrome is an alloy made of :  
(A) Nickel and chromium (B) Nitrogen and chromium  
(C) Nitrogen, chlorine and chromium (D) Nickel, chromium and manganese
21. When current is passed through molten sodium chloride :  
(A) Sodium is deposited at the positive electrode and chlorine gas is formed at the negative electrode  
(B) Sodium is evaporated and chloride ions are formed at the negative electrode.  
(C) Sodium is deposited at the positive electrode and chlorine is deposited at the negative electrode  
(D) Sodium is deposited at the negative electrode and the chlorine gas is formed at the positive electrode.
22. Splitting a compound using electricity is called :  
(A) Electrolysis (B) Electrolyte (C) Electrodynamics (D) None of these
23. A bulb in an electric circuit glows due to :  
(A) Magnetic effect of current (B) Heating effect of current  
(C) Chemical effect (D) Conduction of current
24. LEDs are extensively used to replace bulbs because :  
(A) It consumes less electricity (B) Have longer life  
(C) Has more power (D) All of the above
25. Which of the following is a good conductor of electricity?  
(A) Tap water (B) Distilled water (C) Sea water (D) Rain water
26. A compass placed in an electric field will be deflected due to :  
(A) Heating effect of current (B) Magnetic effect of current  
(C) Conducting effect (D) Resistance of the needle to the electric field
27. The most common industrial application of chemical effect of electric current is :  
(A) Electroplating (B) Galvanising (C) Anodising (D) Electrolysis
28. The process of depositing a layer of any desired metal on another material by passing electric current is called :  
(A) Electrolysis (B) Electroplating (C) Chromium plating (D) Galvanising
29. Tin cans, used for storing food are made by electroplating :  
(A) Chrome onto tin (B) Iron onto tin (C) Tin onto iron (D) Chrome onto iron
30. To protect iron from corrosion and rust, it is coated by :  
(A) Tin (B) Copper (C) Zinc (D) Mercury

ANSWER KEY															
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	B	A	B	D	C	B	B	D	D	A	B	A	A
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	D	A	A	A	D	A	B	D	C	B	A	B	C	C