

TOPICS COVERED

- 14.1 Electrical Conductivity: Types of Material, Electric Tester, Liquid as Conductor of Electricity
- 14.2 Chemical Effects of Electric Current: Electrolysis and Electroplating.

IMPORTANT POINTS TO REMEMBER

- Materials which allow electric current to pass through them are called **good conductors** of electricity, e.g. iron, copper, silver, aluminium, gold, etc.
- Materials which do not allow electric current to pass easily through them are called **bad conductors** of electricity, e.g. rubber, wood, asbestos, plastic, etc.
- **LED** stands for Light Emitting Diode. It is enclosed in a glass housing; with two wires (called lead) coming out. One lead is slightly longer than another. An LED can glow even in the presence of weak current.
- When electric current passes through a conductor, the temperature of conductor increases. This is called **heating effect of electric current**.
- When electric current passes through a conductor, the conductor behaves like a magnet. This is called magnetic effect of electric current.
- Tap water, lemon juice, vinegar, salt solution, etc. are good conductors of electricity. Most liquids which conduct electricity are solutions of acid, base or salt. Distilled water, honey, milk, vegetable oil, etc. are bad conductors of electricity.
- Passage of an electric current through a conducting solution causes chemical reaction.
- The process of depositing a layer of a desired metal on any other material by means of electricity is called **electroplating**.
- Electroplating is used for applying a layer of a desirable metal on any other metallic or non-metallic object.
- Many harmful chemicals are created during electroplating. Disposal of these chemicals is a big problem.

14.1 ELECTRICAL CONDUCTIVITY: TYPES OF MATERIAL, ELECTRIC TESTER, LIQUID AS CONDUCTOR OF ELECTRICITY

Conductors: Materials that allow electricity to flow through them easily are called conductors. *Example:* Metals, Graphite (non-metal).

Insulators: Materials that do not allow electricity to flow through them easily are called insulators. *Example:* Rubber, plastic, wool etc.

Electrical Conductivity: It is the ability of a substance to carry electric current. Substances that are good conductors of electricity have high electrical conductivity.

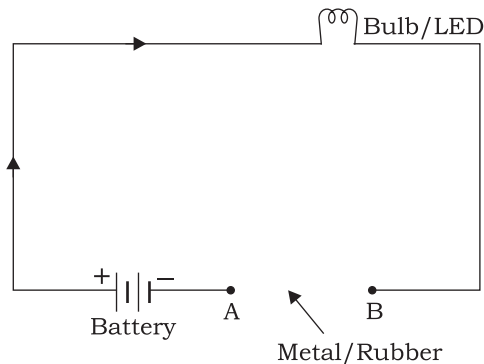
Electric Tester: It consists of an electric cell, a torch bulb fitted in a holder, connecting wires. It is used to test whether a particular material allows electric current to pass through it or not.

Checking an electric tester: Join the free ends A and B of the tester and complete the circuit. If the bulb does not glow, it means.

1. Connections are loose.
2. The bulb is fused.
3. The cell is used up.

Light Emitting Diode (LED): It is similar to a bulb which runs on very low voltage. It glows even when a weak electric current flows through it.

Liquids as Conductor of Electricity: When the two ends A and B of the tester are immersed in the liquid, if the bulb glows, it means it is a conductor of electricity. On the basis of several experiments, it is concluded that some liquids conduct electricity, while some do not conduct electricity. Examples are tabulated in a table below.



Materials	Bulb Glows/Does Not Glow	Good/Poor Conductor
Distilled water	Does not glow	Poor conductor
Tap water	Glow	Good conductor
Lemon juice	Glow	Good conductor
Alcohol	Does not glow	Poor conductor
Petrol	Does not glow	Poor conductor
Dilute sulphuric acid	Glow	Good conductor

The liquids that conduct electricity are mostly the solutions of acids, bases and salts.

Exercise 14.1

I. Very Short Answer Type Questions (1 Mark)

1. Give one word for the following:

- (a) A material which conducts electric current _____.
- (b) A material which does not conduct electric current. _____
- (c) A bulb which runs on very low voltage. _____

2. Fill in the blanks:

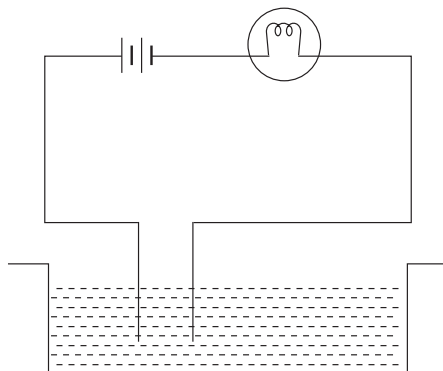
- (a) Most liquids that conduct electricity are solutions of _____, and _____.
- (b) Alcohol is a _____ conductor of electricity.
- (c) Acidified water is a _____ of electricity.
- (d) Addition of caustic soda in distilled water makes it a _____ of electricity.

II. Short Answer Type Questions-1 (2 Marks)

3. What are conductors? Name any two conductors.
4. What is LED?
5. How can you make distilled water to conduct electricity?
6. How can you check an electric tester?
7. When the free ends of a tester are dipped into a solution, the magnetic needle shows deflection. Can you explain the reason? (NCERT)
8. Give two uses of LED's.
9. Why do you think some liquids can conduct electricity while some cannot conduct electricity?
10. In case of a fire, before the fireman use the water hoses, they shut off the main electrical supply for the area. Explain why they do this. (NCERT)
11. 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? (NCERT)
12. Is it safe for the electrician to carry out electrical repairs outdoors during heavy downpour. Explain. (NCERT)
13. Paheli had heard that rain water is as good as distilled water. So she collected some rain water in a clear glass tumbler and tested it using a tester. To her surprise she found that the compass needle showed deflection. What could be the reason? (NCERT)

III. Short Answer Type Questions-2 (3 Marks)

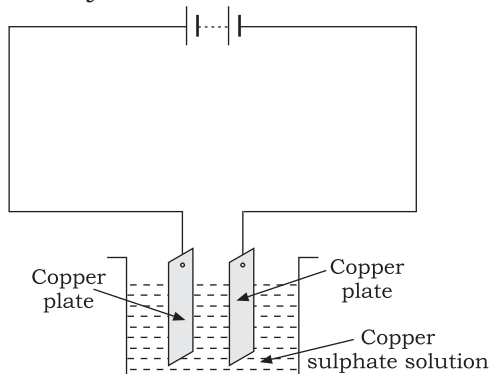
14. In the given figure, the bulb does not glow. List the possible reasons.
15. An electric current is passed through a conductive solution. List any three possible observation.
16. Will a solution of sugar in distilled water conducts electricity? Explain.
17. Does pure water conduct electricity? If not, what can we do to make it conducting. (NCERT)



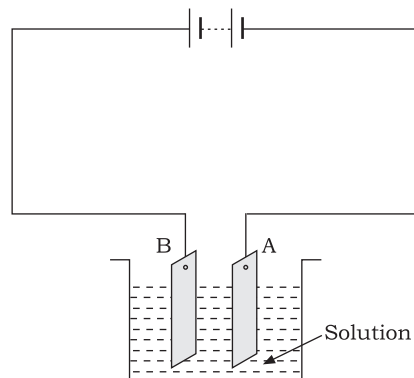
IV. Long Answer Type Questions (5 Marks)

18. Observing that the bulb does not glow, Boojho changed the circuit by placing a magnetic needle in place of bulb. He observed deflection in the magnetic compass.
 - (a) What does the deflection in the magnetic needle indicate?
 - (b) Why did the bulb not glow?
 - (c) What would be the effect of increase in the number of turns in the coil wound around the magnetic compass?
 - (d) What will be observed if the number of cells are increased in the circuit?
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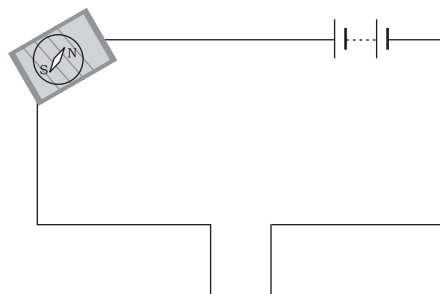
- 19.** With the help of an activity, show that addition of salts, acid and bases make the distilled water a good conductor of electricity.
- 20.** To find whether a given liquid shows high electrical conductivity or not. Explain with the help of activity.
- 21.** In the circuit given in the Figure, Boojho observed that copper is deposited on the electrode connected to the negative terminal of the battery. Paheli tried to repeat the same experiment. But she could find only one copper plate. Therefore, she took a carbon rod as negative electrode. Will copper be still deposited on the carbon rod? Explain your answer. *(NCERT Exemplar)*



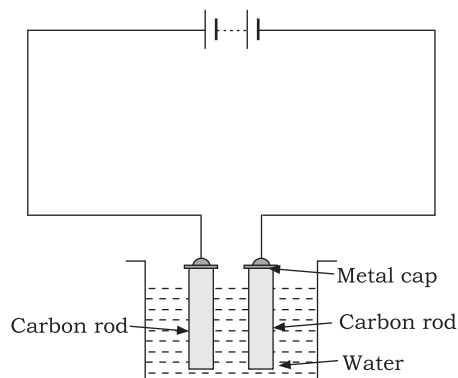
- 22.** Observe the circuit given in the Figure. Boojho set up this circuit for purification of copper. What will be the nature of – (i) plate A (ii) plate B (iii) the solution. *(NCERT Exemplar)*



- 23.** Observe the following circuit given in Figure. Current does not flow in the circuit if there is a gap between the two wires. Does it indicate that air is a poor conductor of electricity? Does air never conduct electricity? Explain. *(NCERT Exemplar)*



- 24.** Boojho made the circuit shown in Figure. He wanted to observe what happens when an electric current is passed through water. But he forgot to add a few drops of lemon juice to water. Will it make any difference to his observations? Explain.

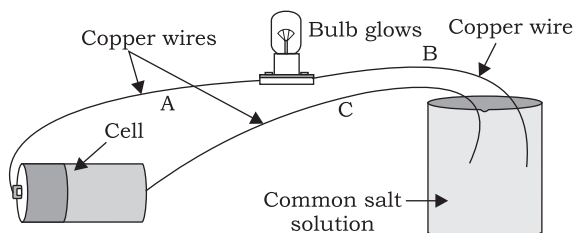


ANSWERS

- (a) conductor (b) insulator (c) LED
- (a) acids, bases, salts (b) poor
(c) good conductor (d) good conductor
- Materials that allow electricity to flow through them easily are called conductors. Example: Copper, Graphite.
- LED (Light Emitting Diode) is similar to a bulb which runs on very low voltage. It glows even when a weak electric current flows through it.
- By adding salt to distilled water and salt solution consist of ions which help to conduct electric current.
- Join the free ends A and B of the tester and complete the circuit. If the bulb does not glow, it means.
(a) Connections are loose.
(b) The bulb is fused.
(c) The cell is used up.
If bulb glows then the tester is ready to use.
- The solution is a good conductor of electricity hence current in the circuit shows its magnetic effect which causes deflection of magnetic needle.
- (a) For lighting as LED bulbs and tubes.
(b) In decorative lamps.
- Solutions of acids, bases and salts have charged atoms which can carry current by their movement while the liquids which does not have such charged atoms cannot conduct electricity.
- Water is a good conductor of electricity, so, the fireman shut off the main electrical supply so that they do not get electric shock.
- Seawater contains dissolved salts which make it a good conductor of electricity hence the compass needle deflects more while drinking water does not have as much dissolved salts in it, hence, compass needle does not deflect much.
- Water is a good conductor of electricity, so, during downpour he will get an electric shock if he carry out electrical repairs.
- Rain water is no more consider as distilled water. This is due to the fact that exhausts from automobiles, factories are released in the atmosphere which mixed with the water vapour and comes down as acid rain. Hence it conducts electricity.
- (a) Bulb may be fused.
(b) Connections are loose.
(c) The solution is a poor conductor of electricity.
- (a) Formation of bubbles.
(b) Change in the colour of solution.
(c) Deposition of metal on electrodes.
- No, sugar is not an electrolyte since it does not contain any charged atoms. It consists of molecules.
- Pure water does not conduct electricity. It can be made conducting by adding salts which dissolve in it, as salts are good conductors of electricity.
- (a) It indicates the presence of current in the circuit.
(b) The bulb did not glow because the current was not sufficient enough to glow the bulb.
(c) Deflection will increase.
(d) Deflection in the compass will increase further.
- Aim:** To show that the addition of salts, acids and bases make the distilled water a good conductor of electricity.
Things needed: Three connecting wires, a battery (or cell), a torch bulb (or LED), three beakers, some distilled water, common salt, dilute sulphuric acid, sodium hydroxide (base), a glass rod and dropper.
Note: Conduct this activity under the supervision of some elderly person, because the use of acid is involved in it.
Method:
(i) Take three beakers. Pour some distilled water in each of them. Add a little common salt to the distilled water in the first beaker. Add a few drops of

dilute sulphuric acid in the first beaker. Add a few drops of dilute sulphuric acid in the second beaker with the help of a dropper. Add a few drops of sodium hydroxide (base) to distilled water in the third beaker with a dropper.

- (ii) Take three connecting wires A, B and C. Connect the wires to a battery and a torch bulb.
- (iii) Dip the bare ends of the wires B and C in the first beaker, containing salt dissolved in distilled water. What do you observe?
- (iv) Now, dip the bare ends of the wires B and C in the second beaker, containing dilute sulphuric acid dissolved in distilled water.
- (v) Now, dip the bare ends of the wires B and C in the third beaker, containing sodium hydroxide (base) dissolved in distilled water.



To show that distilled water containing salt conducts electricity.

Observation:

- (i) You observe that the bulb lights up when wires are dipped in distilled water containing common salt. The liquid between the two ends of the tester allows the electric current to pass and the circuit of the tester becomes complete. Due to this, the current flows in the circuit and the bulb glows. This shows that addition of common salt in distilled water makes it a good conductor of electricity.
- (ii) You observe that the bulb lights up, when wires are dipped in distilled water containing dilute sulphuric acid. This shows that addition of dilute sulphuric acid in distilled water makes it a good conductor of electricity.

- (iii) You observe that the bulb lights up, when wires are dipped in distilled water containing sodium hydroxide. This shows that addition of sodium hydroxide in distilled water makes it a good conductor of electricity.

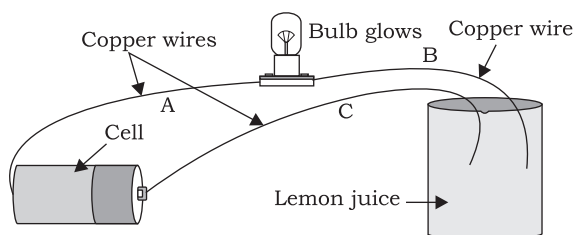
Conclusion: Addition of salts, acids and bases makes the distilled water a good conductor of electricity.

20. **Aim:** To find whether a given liquid is a good conductor of electricity or a poor conductor of electricity.

Things needed: A dry cell, three insulated copper wires A, B and C with bare ends, cellotape, a bulb fixed in the bulb holder, a 100 mL beaker, tap water, vinegar, lemon juice, alcohol, petrol, kerosene oil, mustard oil, dilute hydrochloric acid and dilute potassium hydroxide.

Method:

- (i) Connect the bare ends of the insulated copper wires A, B and C through a dry cell and 1-volt bulb with the help of cellotape. Touch the bare ends of the wires B and C with each another. If the bulb glows, the electric tester is working.
- (ii) Dip the bare ends of the wires B and C of electric tester in lemon juice. You observe that bulb glows. This shows the juice is a good conductor of electricity. Take out the ends of the tester from the lemon juice, dip them in distilled water and wipe them dry.
- (iii) Repeat the activity with other liquids, must wash, wipe and dry the ends of electric tester after testing each liquid.



Lemon juice conducts electricity.

Observation:

Good and poor conductors

Materials	Bulb Glows/Does Not Glow	Good/Poor Conductor
Lemon juice	Bulb glows	Good
Tap water	Bulb glows	Good
Vinegar	Bulb glows	Good
Alcohol	Bulb does not glow	Poor
Petrol	Bulb does not glow	Poor
Kerosene oil	Bulb does not glow	Poor
Mustard oil	Bulb does not glow	Poor
Dilute hydrochloric acid	Bulb glows	Good
Dilute potassium hydroxide	Bulb glows	Good

21. Yes, copper from the copper plate

connected to positive terminal will be dissolved into the copper sulphate solution for electroplating which in turn will be deposited on the carbon rod from the copper sulphate solution.

22. (a) plate A – Pure copper
(b) plate B – Impure copper
(c) the solution – Copper sulphate
Copper from impure copper plate is transferred to the pure copper plate by the process of electroplating.
23. Yes, air is a poor conductor of electricity. But under certain conditions like during lightning, air may conduct electricity.
24. If the water is distilled water and does not contain lemon juice then no current will pass through the circuit. But if the water is salty, then a weak current will pass through the circuit and bubbles of hydrogen gas will be observed on the negative electrode.

14.2 CHEMICAL EFFECTS OF ELECTRIC CURRENT: ELECTROLYSIS AND ELECTROPLATING

Terms Associated with Chemical Effects of Current

- Ions:** Electrically charged atoms or groups of atoms are called ions. Positively charged ions are called cations, while negatively charged ions are called anions.
- Electrolytes:** Chemical compounds whose molecules ionise into positively and negatively charged ions in a solution are called electrolytes.
- Electrodes:** The metal rods or plates through which current enters or leaves the electrolyte are called electrodes. They are of two kinds:
Cathode: The electrode connected to the negative terminal of a cell/battery is called cathode.
Anode: The electrode connected to the positive terminal of a cell/battery is called anode.
Electrolytic cell: A glass or plastic container containing two electrodes and the electrolyte is called electrolytic cell.

When an electric current is passed through an electrolyte, the chemical reaction takes place. This is called the chemical effect of electric current.

Electrolysis: The decomposition of an electrolyte when electric current is passed through it is called electrolysis.

When current is passed through the acidified water, the hydrogen (H^+) ions move towards the negativity charged terminal of the battery. The hydrogen ion gain electrons supplied by the electric current and form neutral hydrogen atoms. These hydrogen atoms join to form molecule. On the other hand, the hydroxyl ions

(OH⁻) move towards the positively charged terminal where they lose electrons to get neutralised and form oxygen gas.

Uses of Electrolysis

- (a) Extraction of metals from their ores.
- (b) Manufacture of chemicals.
- (c) Refining of Metals (Electrolytic Refining)

Electroplating: The method of coating the metal's surface of a given article with a thin layer of superior metal with the help of electric current is called electroplating.

Uses of Electroplating: It is done for various purposes. Here are a few examples:

- (a) *Decoration:* Metals used for making jewellery like gold and silver are very expensive. The artificial jewellery made from less expensive metals is electroplated with more expensive metals like gold and silver to make them look expensive.
- (b) *Protection:* Iron objects are electroplated with chromium, nickel or zinc to protect them from rusting.

Exercise 14.2

I. Very Short Answer Type Questions (1 Mark)

1. Give one word for the following:

- (a) Metal used for decorative electroplating. _____
- (b) Method of coating the metal's surface with superior metal. _____
- (c) Chemical reaction taking place when an electric current passes through an electrolyte. _____
- (d) A chemical used as an electrolyte during the electroplating of an object with copper. _____
- (e) A process of obtaining pure metal from impure metal is _____
- (f) A solution which conducts electricity and at the same time undergoes a chemical change. _____
- (g) The metal wire/plate/rod through which currents enters or leaves an electrolyte. _____
- (h) A positively charged ion is _____

2. Fill in the blanks:

- (a) When an electric current is passed through an aqueous solution it causes _____ effects.
 - (b) If you pass current through copper sulphate solution, copper gets deposited at _____.
 - (c) The process of depositing a layer of any desired metal on another metal by means of electricity is _____.
 - (d) _____ is done on many objects such as car parts, bath taps.
 - (e) The process in which zinc is used to coat the iron objects _____.
 - (f) The process of _____ is used in the extraction of metals.
 - (g) The electrode connected to the negative terminal of a battery is _____.
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II. Short Answer Type Questions-1 (2 Marks)

3. Why is a layer of zinc coated with iron?
4. Boojho made the circuit and observed that the bulb did not glow. On Paheli's suggestion he added one more cell in the circuit. The bulb now glows. Explain.
5. What do you mean by 'chemical effect of current'?
6. Name the three effects of electric current.
7. Why is tin electroplated on iron to make cans for storing food?
8. What is an electrolyte? Give example.
9. Name the effect of current responsible for the glow of the bulb in an electric current.

III. Short Answer Type Questions-2 (3 Marks)

10. In the electroplating of copper on an iron spoon, what is made (a) anode (b) cathode (c) electrolyte.
11. After doing the activity of electroplating of an iron strip a student interchanged the connection of the electrodes. What do you think will happen now?

IV. Long Answer Type Questions (5 Marks)

12. List four application of electrolysis.
13. In what ways are the chemical effects of current used?
14. Describe the electroplating of copper on an iron strip.
15. With the help of an activity, show the chemical effect of electric current.

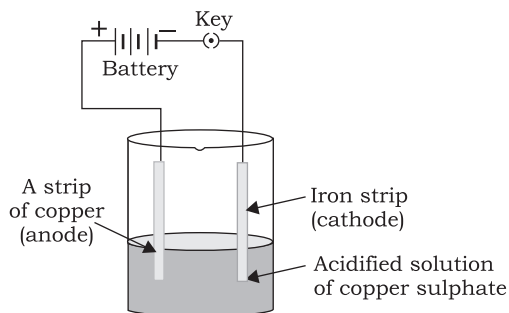
ANSWERS

1. (a) Chromium (b) Electroplating
(c) Electrolysis
(d) Copper sulphate solution
(e) Electrolysis (f) Electrolyte
(g) Electrode (h) Cation
 2. (a) Chemical (b) Cathode
(c) Electroplating (d) Electroplating
(e) Electroplating (f) Electrolysis
(h) Cathode
 3. To prevent it from rusting.
 4. Adding another cell increases the flow of current which is sufficient for the bulb to glow.
 5. When an electric current is passed through an electrolyte, the chemical reaction take place. This is called the chemical effect of electric current.
 6. (a) Heating effect (b) Magnetic effect
(c) Chemical effect
 7. During humid atmosphere, iron can get rusted. Hence iron cans are coated with this which does not corrode.
 8. Chemical compounds whose molecules ionise into positively and negatively charged ions in a solution are called electrolytes.
 9. Chemical effect of current.
 10. Cathode – Iron spoon, Anode – Copper rod, Electrolyte – Copper sulphate solution.
 11. Current will not flow.
 12. (a) Extraction of metals from their ores.
(b) Manufacturing of chemicals
(c) Refining of metals
(d) Electroplating
 13. (a) In electrolysis, where the decomposition of an electrolyte when electric current is passed through it.
(b) In electroplating, which is the method of coating the metal's surface of a given article with a thin layer of superior metal with the help of electric current.
 14. **Aim:** To perform electroplating on an object with copper.
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Things needed: A glass beaker, a copper strip, an iron strip, a battery, copper sulphate solution, connecting copper wires, a switch (key), a sand paper, dilute sulphuric acid.

Method: Fill three fourth of the beaker with copper sulphate solution. Add few drops of dilute sulphuric acid in the solution. Connect the copper strip to the positive terminal of the battery. Clean the iron strip with sand paper and connect it to the negative terminal of the battery through a switch.

Dip copper strip and iron strip in the copper sulphate solution. Take care that they do not touch each other. Switch on and let the current pass through the solution for half an hour.



Electroplating of copper on an iron strip.

Observation: You observe deposition of thin layer of copper on the iron strip.

15. **Aim:** To study the chemical effect of electric current.

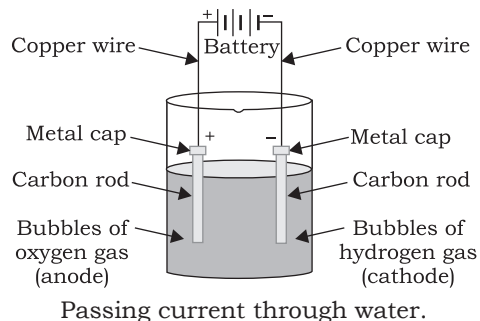
Things needed: Two carbon rods, copper wire, battery, beaker, common salt and tap water.

Method:

- (a) Take some water in a beaker. Add a pinch of common salt to the water. This

will make solution conduct electricity.

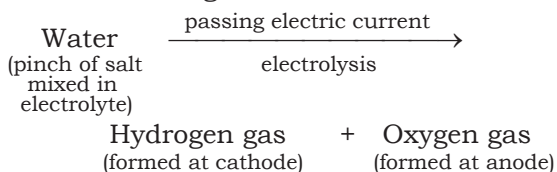
- (b) Break, open two dry discarded cells. Take carbon rods carefully from these cells. Clean their metal caps with sand paper.
 (c) Wrap copper wires around the metal caps of the carbon rods and join them to a battery. Here, these carbon rods are used as electrodes.



- (d) Now, immerse the electrodes in the solution present in the beaker. Make sure that metal caps of the carbon rods are outside water.

Observation: You can see gas bubbles near electrodes after some time. Further tests confirm that the gas evolved at the cathode is hydrogen and that at the anode is oxygen.

Conclusion: In this activity, there is decomposition of the electrolyte (water have impurities like salt) bringing about the following chemical reaction:



Did You Know?

- LED are increasingly being used for lighting. A large number of LEDs are grouped together to form a LED light source. LED light sources are preferred to light bulbs and fluorescent tubes because they consume less energy and function for longer time.
- Electrolysis is also used to purify water.

HOTS & VALUE BASED QUESTIONS

1. What are the purposes for electroplating of one metal on other one? Give two examples. **(HOTS)**
2. An electrode 'A' is connected to the positive terminal of a battery and electrode 'B' to the negative terminal. When current is passed through conducting seawater answer the following:
 - (a) Give the names given to the electrodes A and B
 - (b) Name the gases collected near positive and negative terminal. **(HOTS)**
3. Why should copper sulphate solution be acidified during copper electroplating? **(HOTS)**
4. What are the factors that shows the chemical reaction takes place in electrolyte due to passage of electric current? **(HOTS)**
5. Rita's mother bought an immersion rod to make water hot during winter season. Rita observed the immersion rod was made up of copper rod had a shining reddish colour. Her mother used it to heat a bucket of water everyday for three months during winter. After three months Rita observed a coating of white substance which became more prominent with time. She asked her mom about the reason.
 - (a) What explanation was given by her mother?
 - (b) What were the values shown by her mother? **(VBQ)**
6. Raj and his friend Rahul have got their garden fenced with iron rods. Raj saw the next day that Rahul was painting the iron fence. Rahul suggested Raj to do the same to increase the longevity of the iron rods by preventing corrosion. Raj argues that it was waste of time and his iron rods are quite strong.
 - (a) Whose opinion is correct according to you?
 - (b) Are there any other ways to prevent corrosion other than painting? **(VBQ)**

ANSWERS

1. Electroplating is done for various purposes:
 - (a) *Decoration:* Metals used for making jewellery like gold and silver are very expensive. The artificial jewellery made from less expensive metal is electroplated with more expensive metals like gold and silver to make them look expensive.
 - (b) *Protection:* Iron objects are electroplated with chromium, nickel or zinc to protect them from rusting.
 2. (a) A – Anode (+ve terminal)
B – Cathode (-ve terminal)
 - (b) Hydrogen towards cathode
Oxygen at anode.
 3. To make the solution more conducting.
 4. (a) Formation of bubbles at the electrodes.
 - (b) Deposition of metal on electrodes.
 - (c) Change of colour may occur due to the solution.
 5. (a) Deposition of salt from water.
 - (b) Mom is intelligent, has a scientific bent of mind.
 6. (a) Rahul is correct because iron gets rusted during humid and rainy season. By painting, he is preventing iron from getting rusted.
 - (b) By electroplating, galvanisation, anodising and greasing.
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