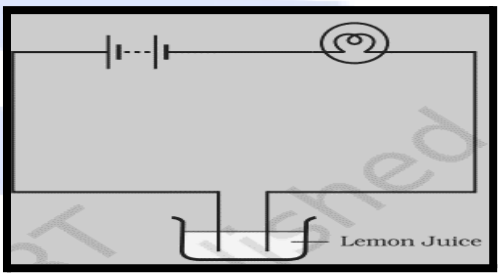
Introduction

- **Electric Current and Liquids:** Electric current is a flow of electric charge. We know that metals are good conductors of electricity, but can liquids also conduct electricity? This chapter explores the effects of electric current when it passes through liquids and highlights practical applications like electroplating and electrolytic refining.

1. Do Liquids Conduct Electricity?

- **Conductors and Insulators in Liquids:**
  - **Conductors:** Substances that allow electric current to pass through them. Examples: saltwater, vinegar, lemon juice.
  - **Insulators:** Substances that do not allow electric current to pass through them. Examples: distilled water, pure water, oil.
- **Reason for Conductivity in Liquids:**
  - Liquids conduct electricity if they contain ions (charged particles). These ions help carry electric current through the liquid.
- **Activity 1: Testing the Conduction of Electricity in Liquids**
  - **Objective:** To determine if different liquids can conduct electricity.
  - **Materials:** Bulb, battery, two electrodes, various liquids (saltwater, vinegar, distilled water).
  - **Procedure:**
    1. Set up a simple electric circuit with a battery, bulb, and two electrodes.
    2. Place the electrodes in different liquids one by one and observe whether the bulb glows.
  - **Observation:** If the bulb glows, the liquid is a conductor; if not, it's an insulator.

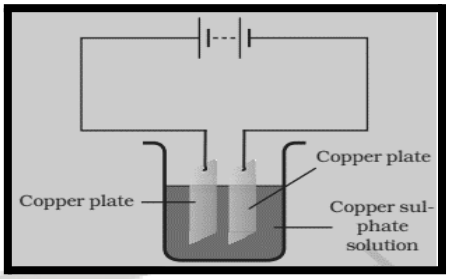
Key Insight: Distilled water does not conduct electricity because it lacks ions. Adding a substance like salt provides ions, making the solution conductive.



2. Chemical Effects of Electric Current

- **What Happens When Electric Current Passes Through a Conducting Liquid?**
  - **Chemical Reactions:** When electric current passes through a conducting liquid (electrolyte), it causes chemical reactions. This process is known as **electrolysis**.
  - **Examples of Chemical Effects:**
    - Formation of gas bubbles on the electrodes.
    - Deposition of metal on the electrodes.
    - Change in the colour of the solution.
- **Activity 2: Observing the Chemical Effects of Electric Current**
  - **Objective:** To observe chemical reactions caused by electric current in a solution.
  - **Materials:** Copper sulphate solution, copper electrodes, battery.
  - **Procedure:**

- Connect a copper electrode to each terminal of the battery.
- Place the electrodes in copper sulphate solution.
- Observe the colour change and any deposits on the electrodes.



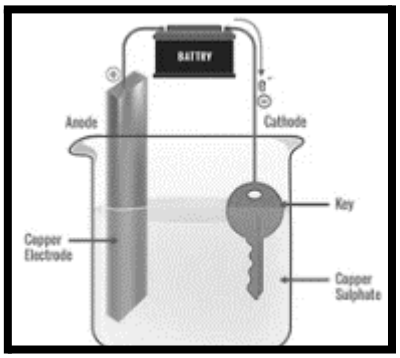
- **Observation:** Copper ions move to the negative electrode, causing a reddish deposit. The positive electrode slowly dissolves, showing the chemical effect of electric current.

3. Electroplating

- **Definition:** Electroplating is the process of depositing a thin layer of one metal onto another metal using electric current. This process is widely used to improve the appearance, resistance to corrosion, and other properties of materials.
- **How Electroplating Works:**
  - In electroplating, the object to be plated is connected to the negative terminal (cathode), while the metal for coating is connected to the positive terminal (anode).
  - When current flows through the electrolyte solution, metal ions from the anode dissolve in the solution and deposit onto the cathode.
- **Applications of Electroplating:**
  - **Jewellery**: To give a gold or silver coating to inexpensive metals.
  - **Car Parts and Bathroom Fittings**: To prevent corrosion.
  - **Food Cans**: Iron cans are coated with tin to prevent rusting.
  - **Kitchen Utensils and Cutlery**: Electroplating is used to coat these items to give a smooth and shiny appearance.

Activity 3: Electroplating a Key with Copper

- **Objective:** To demonstrate electroplating by coating an iron key with copper.
- **Materials:** Iron key, copper plate, copper sulphate solution, battery.
- **Procedure:**
  1. Connect the key to the negative terminal of the battery (cathode).
  2. Connect the copper plate to the positive terminal (anode).
  3. Place both into the copper sulphate solution.
  4. Observe the deposition of copper on the key.
- **Observation:** A thin layer of copper forms on the key, demonstrating the electroplating process.

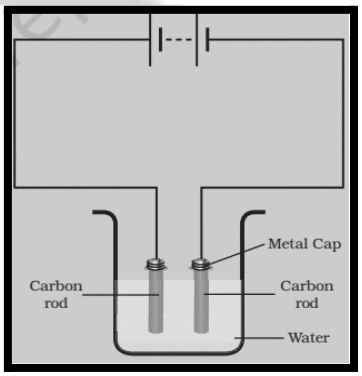


Q: Why do we electroplate iron with zinc?

A: Electroplating iron with zinc prevents rusting, as the zinc layer protects the iron from moisture and air.

4. Applications of Chemical Effects of Electric Current

- **Purification of Metals:** Electrolytic refining is used to purify metals such as copper and aluminium by using electricity. Impure metal is made the anode, and a pure metal electrode is the cathode.
- **Electrolysis of Water:** Passing electricity through water causes it to split into hydrogen and oxygen gas.
- **Battery Technology:** Batteries rely on chemical reactions between the electrolyte and electrodes to produce electricity.
- **Activity 4: Electrolysis of Water**
    - **Objective:** To demonstrate the breakdown of water using electric current.
    - **Materials:** Water, a small amount of acid or salt, battery, two test tubes, electrodes.
    - **Procedure:**
        1. Add a small amount of acid or salt to the water to make it conductive.
        2. Insert the electrodes connected to the battery.
        3. Collect gases in test tubes held above each electrode.
    - **Observation:** Hydrogen gas collects at the cathode and oxygen at the anode, indicating the chemical breakdown of water into its elements.



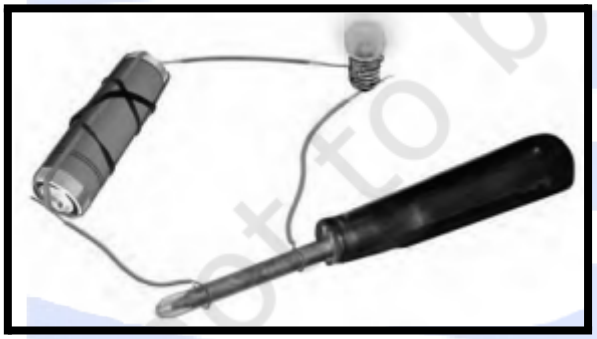
Q: Why is a small amount of acid or salt added to water for electrolysis?

A: Pure water does not conduct electricity well, so adding acid or salt introduces ions, allowing current to flow and electrolysis to occur.

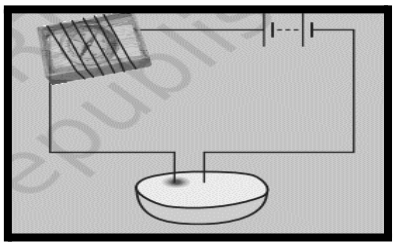
- **What is a Tester?**
  - A **tester** is a simple tool to check whether an object or substance conducts electricity.
  - A basic tester consists of a battery, connecting wires, and a small bulb or LED.
  - If the bulb glows when the tester's ends are placed in a substance, it indicates that the substance is conducting electricity.

    Activity 5: Construction of a Simple Tester:

  - Connect one end of a wire to the positive terminal of a battery and another wire to the negative terminal.
  - Attach the other end of the wires to a small bulb or LED.
  - When the tester's ends touch a conductive substance, current flows through the circuit, causing the bulb to light up.



- **Activity6: Testing Conductivity with a Potato**
  - **Materials:** Potato, two copper wires, a compass needle, a battery, and connecting wires.
  - **Procedure:**
    1. Cut a potato in half.
    2. Insert two copper wires (acting as electrodes) a short distance apart into the potato.
    3. Connect the other ends of the copper wires to the terminals of a battery and place the compass needle close to the wire.
    4. After some time, a greenish-blue spot may appear near the positive electrode (anode) due to chemical reactions and compass needle also show deflection.
  - **Observation:** The greenish-blue spot indicates that the potato is conducting electricity, confirming the chemical effect of electric current and deflection of compass needle indicates magnetic effect of electric current.



- **Activity7: Observing the Magnetic Effect of Electric Current in Liquid Conductor**
  - **Materials:** Compass needle, copper wire, beaker with saltwater solution, battery.
  - **Procedure:**
    1. Set up a circuit with a battery, copper wire, and a beaker containing saltwater solution.
    2. Place the compass needle close to the wire.
    3. Observe the movement of the compass needle when current flows through the wire.
  - **Observation:** The compass needle deflects when current flows, indicating a magnetic field is created around the wire. This magnetic effect is also produced in liquid conductors, as the current passing through them generates a magnetic field.