Experiment 6

Aim

To show that acids, bases, and salts are electrolytes.

Theory

An electrolyte is a compound that, in solution or in the molten state, conducts an electric current and is simultaneously decomposed by it. The current in electrolytes is carried by the ions and not by the electrons as in metals. Electrolytes may be acid, bases, or salts. In this experiment we shall observe it by means of continuity test in an electric circuit that contains either an acid or a base or a salt solution as a part of it.

Materials Required

Hydrochloric acid (about 5 mL), sodium hydroxide flakes (about 100 mg), sodium chloride (about 5 g), distilled water, four beakers (250 mL), four dry cells of 1.5 V each with a cell holder (or a battery of 6 V or a battery eliminator), a torch bulb of 6 V with a torch bulb holder, a rubber cork, two iron nails, a plug key, connecting wires, and a piece of sand paper.

Procedure

1. Using a sand paper, clean the insulation layers from the ends of connecting wires.

2. Take a dry rubber cork and fix two iron nails in it at a distance. The two nails will work as two electrodes. Also connect these two nails, separately, with connecting wires.
3. Draw a circuit diagram for performing a continuity test in an electric circuit that contains either an acid or a base or a salt solution as a part of it (see Fig. 6.1). Observe how different components like the dry cells (or battery or battery eliminator), torch bulb, a plug key, and the solution are connected in the circuit.
4. Take nearly 100 mL distilled water in each of the four beakers (250 mL). Label them as beakers A, B, C, and D respectively.
5. Add about five drops of hydrochloric acid in distilled water in beaker A to get an acidic solution; add about 100 mg flakes of sodium hydroxide in beaker B to get a basic solution; and add about 2 - 3 g of sodium chloride salt (about half a teaspoon) in water in beaker C to get a sodium chloride salt solution. Do not add anything in the distilled water in beaker D.

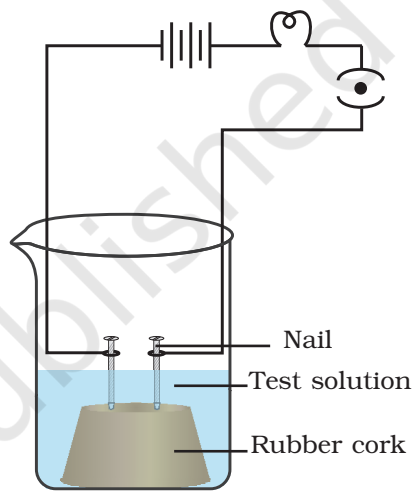

Fig. 6.1 : *Continuity test through an electrolyte*

6. Set up the electric circuit by connecting different components with the help of connecting wires. Do not dip the rubber cork (in which two iron nails are fixed and connected in the circuit) in any beaker. Insert the key into the plug. Check whether the torch bulb glows. It does not. Does it mean that the electric circuit is yet not complete or the dry rubber cork does not conduct electricity? Remove the key from the plug.
7. For observing the continuity test through the dil. hydrochloric acid (say), place the rubber cork in the beaker A such that the two iron nails are partially dipped in the solution.
8. Insert the key in the plug and allow the current to flow in the circuit containing dil. hydrochloric acid solution as a component. Does the bulb glow now? Yes, it glows. It means that the electric circuit is now complete and that the hydrochloric acid conducts electricity. Thus it is an electrolyte. Record your observation.

9. Remove the key and take out the rubber cork from the beaker A. Wash the rubber cork and make it dry using a clean cloth.
10. Repeat the experiment for the continuity test through the dil. sodium hydroxide solution, sodium chloride solution, and distilled water by successively dipping the rubber cork in beakers B, C, and D respectively.

OBSERVATIONS

Sl.No.	Experiment	Observations	Inference
	Electric continuity test through		
1.	Beaker A: dil. hydrochloric acid solution	Bulb glows or not?	
2.	Beaker B: dil. sodium hydroxide solution	Bulb glows or not?	
3.	Beaker C: sodium chloride solution	Bulb glows or not?	
4.	Beaker D: distilled water	Bulb glows or not?	

RESULTS AND DISCUSSION

Infer from the observations that acids, bases and salts are electrolytes. Discuss the following dissociation reactions:

$$HCl\ (aq) \longrightarrow H^+\ (aq) + Cl^-\ (aq)$$

$$NaOH\ (aq) \longrightarrow Na^+\ (aq) + OH^-\ (aq)$$

$$NaCl\ (aq) \longrightarrow Na^+\ (aq) + Cl^-\ (aq).$$

PRECAUTIONS

- The ends of the connecting wires must be cleaned and connected tightly with the other components of the circuit.
- The acidic concentration in the distilled water must be highly dilute otherwise the nails will start reacting with the acid.
- The nails must be partially dipped inside the liquid while performing electric continuity test.
- The rubber cork must be washed and dried after every test and before dipping it in another liquid solution.

Note for the Teacher

- In place of four cells of 1.5 V each, a 6 V battery or a battery eliminator may also be used. Please make sure that if a 6 V source is used in the circuit, a torch bulb of 6 V must be used. This experiment can also be performed with 3 V source preferably with a 3 V torch bulb.
- In place of a torch bulb, a galvanometer or an ammeter (0 - 3 A) may also be used to perform the continuity test. Please also connect a resistor of about 1 or 2 W resistance in series with the galvanometer or ammeter.
- Experiment Nos. 48 to 51, involve observations with electric circuits. It is advised that students may be suggested to perform any of these experiments before performing this experiment.
- In place of hydrochloric acid solution, sulphuric acid solution may also be used.

Questions

- Though sodium chloride and potassium chloride crystals are composed of ions. Why do they not conduct electricity?
- How does an alcoholic solution of potassium hydroxide conduct electricity?
- How does the hydrochloric acid solution proves to be a better conductor of electricity than acetic acid solution (CH_3COOH)?
- Which substance is used as an electrolyte in lead storage battery and which one in dry cells.
- What are the current carriers in electrolytes?