Electrolytes and Nonelectrolytes

Various solutions are tested for conductivity using a homemade conductivity tester.

Application

Solutions • Conductivity • Physical Properties • Electrolytes

Theory

Compounds that conduct an electric current in aqueous solution or molten state are electrolytes. All ionic compounds are electrolytes. Sodium chloride and copper(II) sulfate are water soluble electrolytes. Insoluble ionic compounds including barium sulfate and silver chloride can conduct electricity when melted. Nonelectrolytes (those compounds that do not conduct electricity in solution or molten state) include most organic compounds, sucrose (cane sugar), alcohol and glycerol. Nonelectrolytes do not conduct electricity because they generally are not composed of ions.

Not all electrolytes conduct an electric current to the same degree. Sodium chloride is considered a strong electrolyte since it is an excellent conductor. When dissolved, a strong electrolyte almost completely dissociates into ions. A solution of sodium chloride consists entirely of Na^+ and Cl^- ions in a water solution. In contrast, weak electrolytes such as lead(II) chloride, ammonia water and water itself are only slightly ionized in solution and do not conduct very well. [Lead(II) chloride is only weak because of its limited solubility. When dissolved in hot water it is a good conductor.]

Materials

Conductivity apparatus (see Preparation)

50-mL Beakers, 8

Distilled water

Wash bottle filled with distilled water

Sodium chloride, NaCl, 5 g

0.1 M Potassium chloride, KCl, 5 g

0.1 M Hydrochloric acid, HCl, 5 mL

0.1 M Acetic acid, $HC_2H_3O_2$, 5 mL

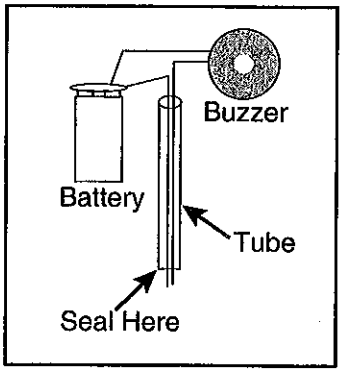
0.1 M Ammonia water, NH_3, 5 mL

Sugar, 5 g

Ethyl or methyl alcohol, 5 mL

Stirring rod

Labels



Safety Precautions

Hydrochloric acid, ammonia water and acetic acid are severely corrosive to eyes, skin, and other tissue and toxic by ingestion and inhalation. When making solutions, always add acid (or base) to water, never the reverse; considerable heat of dilution will occur. Wear chemical splash goggles, chemical-resistant gloves and a chemical-resistant apron. It is recommended to refrain from using a conductivity apparatus that uses AC power.

Conductivity Apparatus Preparation

A homemade conductivity apparatus can be easily constructed using materials purchased at a local electronics or hobby store.

Piezo pulsing buzzer, 3–28 VDC, 12 mA

Battery, 9-volt

Battery clip, V

Wire, 24 ga.

Pen barrel or similar plastic tube

Silicone seal

Electrical tape

Soldering gun and solder

Connect the buzzer in series with the battery clip and test leads using a soldering gun. Strip the ends of the test lead about 0.5 cm. Pass the leads through the tube allowing them to protrude about 1 cm. Seal this end of the tube with silicone seal. Tape the tube and the buzzer to the battery.

To use the conductivity apparatus, simply insert the tips of the leads into the solution to be tested. Strong electrolytes produce a scream while weak electrolytes produce a faint sound.

Demonstration

Label the beakers. Add 25 mL distilled water to each beaker. The first beaker will serve as a control. To the second beaker dissolve 5 g sodium chloride, NaCl. Continue by dissolving each of the other substances in their respective beakers.

Test each of the solutions for relative conductivity by immersing the electrodes of the conductivity apparatus into the solutions. Between each test be sure to rinse the electrodes with distilled water.

Disposal

All solutions can be flushed down the drain with excess water.

Reference

Offutt, M. *The Little Screamer—Conductivity Probe.* Published by Chem 5 Woodrow Wilson Institute. 1990.