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Electrolysis Apparatus #501

Warning:

- **Intended for use in classroom settings under the supervision of qualified professionals.**
- **This product is not a toy and is not intended for children under the age of 13.**
- **This item contains latex.**
- **This item contains small parts.**
- **California Proposition 65 Warning: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.**

Introduction

The Electrolysis Apparatus is used to demonstrate that electrically conductive liquids can be decomposed and resolved into their constituent elements by means of unidirectional electric current. The gaseous components formed are trapped, and their relative volumes are measured.

Description

The assembled Electrolysis Apparatus is shown in the illustration. The glassware unit consists of two vertical tubes joined to a cross-tube near the bottom. Two graduated tubes are placed over the ends of the "H" tubes and are used to collect and measure gases. Each electrode assembly consists of platinum electrodes connected to a wire lead sealed within a glass tube, which passes through the rubber stopper. Lead wires protruding from the sealed glass tube are used to connect to a DC power supply.

Pre-Experiment Procedure

- Assemble the cast base and the vertical rod. Attach the "H" tube to the vertical upright support rod using the buret clamp.
- Slide the graduated tubes over the open ends of the "H" tube.
- Remove the rubber stoppers with the platinum electrode assemblies from the tubes in which they were packed.
- Insert an electrode in the open, tapered end of the "H" tubes. Carefully press upward on the rubber stoppers to ensure tight closures.
- Carefully straighten the lead wires protruding from the glass tubes and rubber stoppers.
- Connect the leads to a DC power supply such as a 6-volt battery. If a battery is used, install a knife switch on one lead as an on/off switch.

Since water is a poor conductor, prepare a small amount of 2% solution of sulfuric acid as follows. Measure 363 ml distilled water in a 500 ml borosilicate beaker with a spout. Carefully and slowly add 4 ml concentrated sulfuric acid. Stir to mix and allow to cool to room temperature. **(Always use caution when handling acid. Always add acid to water, not water to acid. Always wear eye protection.)**

Experiment

Add the solution to the "H" tube. Apply DC voltage and observe the bubbles forming at each electrode. The electrode where there is a greater volume of gas is the negative electrode called the cathode. The electrode with a smaller amount of bubbling is the positive electrode, the anode. There will be twice the rate of evolution of gas from the cathode as there is from the anode. The rate at which the gas is formed is determined by the voltage applied and the amount of sulfuric acid dissolved in the water.
When water ionizes two ions are formed, hydrogen ions (H^+) and Hydroxyl (OH^-). The hydrogen ions are attached to the cathode where they receive electrons to charge the hydrogen ion, which is dissolved in water to a hydrogen atom, a gas. Two hydrogen atoms unite to form a molecule of hydrogen gas which ascends to the top of the collection tubes. For every molecule of hydrogen gas formed, there are two electrons released from the cathode. In the meantime, the hydroxyl ions are being attracted to the anode. Two hydroxyl ions surrender their charge to the anode and form as a molecule of water and an atom of oxygen. Two more hydroxyl ions again surrender their charges and release another of oxygen which unites with the first to become a molecule of (O2) and bubbles to the top as a gas. Thus, the volume of hydrogen to oxygen is always 2 to 1. Under the same conditions of temperature and pressure, equal numbers of gas molecules occupy equal volume. The sulfuric acid decreases the resistance of the solution because it furnishes a large quantity of ions.

Light a taper (wood splint). Remove one of the collecting tubes. While the tube is still in the inverted position, bring its mouth over the lighted taper. A pale blue flame indicated the gas is hydrogen. Blow out the taper flame but leave the taper glowing. Hold the glowing taper close to the mouth of the opposite collecting tube. If the taper bursts into flame, the gas is oxygen.

Upon completion of the electrolysis demonstration, turn the power supply switch off. If a knife switch was used, open the knife switch. Disconnect the leads from the electrodes. Carefully remove the glassware unit from the support stand. Hold the unit upside down over a disposable plastic container so that the acid solution drains out. Remove the rubber stopper and electrode assemblies from the graduated tubes and set them aside. Carry the the glassware unit to the sink and rinse it in cold water. Drain it until dry and clamp it back on the stand. Retrieve the stopper and electrode assemblies, rinse with cold water and carefully dry. Restore these electrodes to the test tubes in which they were originally packed.