# Pre-Lab Information

Purpose Explore the use of electrolysis to separate water into hydrogen gas and oxygen gas.

Time Approximately forty-five minutes

Question How can electrolysis be used to separate a compound into its components?

Hypothesis If an electrical current is applied to water containing an electrolyte, then the water will decompose into hydrogen gas and oxygen gas because an oxidation-reduction reaction will occur.

Half-Reactions (Oxidation) 2H2O(l) ⟶ O2(g) + 4H+(aq) + 4e–   
(Reduction) 2H2O(l) + 2e–⟶ H2(g) + 2OH–(aq)

Summary You will apply an electric current to water containing an electrolyte to separate water into hydrogen and oxygen gas in an oxidation-reduction reaction.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Check glassware such as test tubes and petri dishes for cracks and chips prior to use.
* If you are unfamiliar with how the electrolysis apparatus works, ask your teacher to demonstrate.
* Make sure the power supply is not connected while setting up the electrolysis apparatus.
* Do not touch bare wires connected to a power source or the terminals of a power source.
* Use the right gear, such as chemically resistant gloves, when performing the experiment.
* Report all accidents—no matter how big or small—to your teacher. If sodium sulfate or pH indicator   
  is spilled on your skin or clothing, wash it with water immediately and inform your teacher.

# Procedure

1. **Gather Materials**

|  |  |  |
| --- | --- | --- |
| * Glass petri dish * Distilled water * 2-3 g sodium sulfate * Glass stirring rod * Phenol red solution | * Dropper or transfer pipet * Two small test tubes * Microscope slide cover slip * Two test tube clamps on a ring stand * Metric ruler | * Two platinum or stainless steel insulated electrodes * 9-volt battery or DC power supply * Two power supply leads |

1. **Add an Electrolyte to Water to Ensure Conductivity**
   1. Fill a petri dish with distilled water nearly to the rim.
   2. Add a small spatula full of sodium sulfate (Na2SO4) to the water in the petri dish. This salt will act as an electrolyte to help the water conduct electricity. Stir with a glass stirring rod until dissolved.
   3. Add a few drops of phenol red pH indicator and mix with the glass stirring rod.
   4. Place the petri dish on the base of a ring stand.
2. **Set Up the Petri Dish and Test Tubes**
   1. Using a transfer pipet, fill two test tubes completely with saltwater from the petri dish. (The petri dish should still be at least half full of saltwater.)
   2. Place a microscope slide cover slip over the top of one test tube, making sure that there are no air bubbles trapped at the top. Invert the test tube and place it into the petri dish so that it is submerged in the saltwater. Carefully remove the microscope slide cover slip.
   3. Tilt the tube approximately 30° to 45°, keeping the mouth of the tube completely underwater.
   4. Use a clamp to secure the test tube in position.
   5. Repeat the process with the second test tube and a second clamp.
3. **Connect and Apply Electric Current**
   1. Gently slide the tip of one electrode into the mouth of a submerged test tube. Do not move the mouth of the test tube above the water or you will need to refill the tube.Repeat with the other electrode and second submerged test tube.
   2. Connect the + side of a 9-volt battery (or DC power supply) to the anode (+ electrode) and the – side of the battery to the cathode (– electrode).
   3. Observe for about five to ten minutes. Record any observations at both the anode and cathode in the data table. Observations should include the amount of bubbles in the test tubes, color changes, appearance of new substances, etc.
   4. When one of the test tubes is half full of gas, disconnect the electrodes from the power supply and remove them from the solution.
4. **Measure the Amount of Gas in Each Test Tube**

Without removing the test tube from the solution, hold the test tube up vertically and measure the height (in mm) of gas in the tube. Repeat the same measurement with the other test tube.

1. **Observe Your Teacher Testing the Gases with Burning Toothpicks**
   1. Watch as your teacher tests the smaller quantity of gas with a toothpick burning with a glow. Record observations in the data table.
   2. Watch as your teacher tests the larger quantity of gas by passing a burning toothpick (flame is okay) in the opening of the test tube. Record observations in the data table.

**SAFETY NOTE:** While testing, your teacher should point the ends of the test tubes away from everyone. Also, it is important to act quickly, lest the gases escape or mix with air.

1. **Dispose of All Materials According to the Directions of Your Teacher**

# Data

Record your data either in your lab notebook or in the space below.

|  |  |  |
| --- | --- | --- |
|  | **Cathode** | **Anode** |
| **Initial color** |  |  |
| **Final color** |  |  |
| **Other observations** |  |  |
| **Height (mm)  of gas in test tube** |  |  |
| **Result when heat/flame introduced** |  |  |
| **Gas produced at this electrode** |  |  |

In your analysis and conclusion, be sure to:

* include the equation of the reaction at the cathode.
* include the equation of the reaction at the anode.
* justify your answers by comparing the volume of gas present in the test tubes as well as the   
  pH changes.