

Electrolysis in Aqueous Solutions

In this experiment, you will design and build several electrolytic cells. Your objective is to design three cells: one in which two gases are formed, one cell which will cause a metal to plate out on the cathode, and a third cell that will generate a halogen at the anode.

OBJECTIVES

In this experiment, you will

- Design and build electrolytic cells
- Experimentally collect evidence of electrolysis

AVAILABLE MATERIALS

9V battery or power supply
Alligator clips & leads
Distilled water
Copper strips
Zinc strips
Magnesium ribbon
Graphite rods
Copper wire
Paper clips
Glass petri dishes
50 mL or 100 mL beaker

The following solid salts or aqueous solutions:
ammonium chloride, lithium chloride,
potassium chloride, sodium chloride, calcium
chloride, manganese nitrate, copper(II)
nitrate, nickel(II) nitrate, lithium nitrate,
sodium sulfate, sodium citrate, or others as
available

PLANNING THE EXPERIMENT

As a lab group, discuss the following leading questions. You may refer to your notes...

1. What will you use for electrodes?
2. Which salt will you use for each cell? Be prepared to justify your choice.
3. How much water or solution will you use? How much salt will you use?
4. What will you determine which electrode is the anode and which electrode is the cathode?
5. Write out a step-by-step procedure and consult with your instructor. Incorporate any suggested changes to your plan and design an appropriate data table in your lab notebook before starting the experiment. Attach a copy of your written plan to your completed lab handout.

CONDUCTING THE EXPERIMENT

1. Obtain and wear goggles and lab aprons. CAUTION: Some of the salts may be skin or eye irritants. Check all labels before proceeding.
2. Carry out the procedure as planned. Record all relevant data and observations directly into your lab notebook.
3. If you made any changes to your original plan, note the changes in your lab notebook.
4. Clean up and dispose of solutions as directed by your instructor.

ANALYZE AND APPLY

1. Predict the half-reaction that will occur at each electrode during the electrolysis of the following aqueous solutions. Write the half-reaction in the space provided.

Solution	Cathode half-reaction	Anode half-reaction
Aqueous iron(II) chloride		
Aqueous cesium nitrate		
Aqueous ammonium iodide		

2. For each cell you constructed, what evidence of electrolysis did you observe?
3. For each cell you constructed, identify the anode and the cathode.
4. Write oxidation and reduction half reactions for each cell you constructed. Use these to write the overall equation for each electrolytic cell.
5. What is the sign of Gibb's free energy for the cells you constructed? Explain your answer. What does this tell you about the magnitude of the equilibrium constant for these reactions?
6. An electric current was passed through a solution of cesium phosphate. As the cell was running, a small amount of phenolphthalein was added to the cell. Describe the color changes that you would see at each electrode and explain your answer.