Core practical: aqueous electrolysis comparison

Student activity • practical and reasoning

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The question

Can changing the dissolved ions change the cathode product?

Compare aqueous copper(II) sulfate and potassium sulfate using low-voltage DC and inert carbon electrodes. Record actual evidence and distinguish observed bubbles from identified gases.

Equipment

- Goggles, two 100 cm^3 beakers, measuring cylinder and two separate clean carbon-electrode pairs
- Teacher-checked current-limited 6 V DC supply, leads/clips and electrode holders
- 30 cm^3 each 0.50 mol dm^{-3} $CuSO_4$ and 0.50 mol dm^{-3} K_2SO_4, labelled waste vessels

Goggles; power off before adjustments. Keep clips dry and electrodes apart. No flames, sealed cells or gas collection; collect all copper waste.

Course coverage: Chemistry only: 1.60C with 1.58C–1.59C. Two non-halide electrolytes; named chloride/acid examples are covered in Lesson 111.

Plan, model or apparatus sketch

Draw the open beaker, separated carbon electrodes, dry clips and 6 V DC supply. Label anode (+), cathode (–) and ionic movement.

Method and reasoning

Read the whole sequence before starting

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1. Wear goggles. With power off, measure 30 cm^3 copper sulfate into its labelled beaker. Secure two carbon electrodes apart so they cannot touch; keep clips above liquid.

2. Label negative cathode and positive anode. Ask the teacher to check the dry leads, spacing and 6 V DC setting before switching on.

3. Observe for up to three minutes, recording the electrode signs, any deposit and bubbles. Switch off immediately if the liquid or leads warm noticeably or the apparatus behaves unexpectedly.

4. Switch off before touching leads or moving electrodes. Set the copper apparatus aside for labelled collection.

5. Repeat with a separate clean electrode pair and 30 cm^3 potassium sulfate under the same conditions. Do not transfer copper-coated electrodes into the second test.

6. Switch off, compare actual observations and write predicted half-equations. Do not collect, ignite, smell or mix gases; discuss what extra approved evidence would identify them.

Cleanup

• Switch off and disconnect. Staff collect labelled solutions and electrodes; rinse only into designated waste, clean benches and wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Predictions, not substitute observations: $CuSO_4$ gives copper at the cathode and oxygen at an inert anode; K_2SO_4 gives hydrogen at the cathode and oxygen at the anode. Gas bubbles alone do not identify either gas. Graphite may erode, so record unexpected particles honestly.

Electrolyte	Cathode observations	Anode observations
$CuSO_4(aq)$		
$K_2SO_4(aq)$		
Comparison / uncertainty		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Describe your actual electrode observations.

2. Write copper’s reduction equation.

3. Write hydrogen formation from water at the K_2SO_4 cathode.

4. Write oxygen formation at the anode in acidic or hydroxide form.

5. Why must the second electrode pair be clean?

6. Why do equal time and voltage not establish equal gas amounts?