

Splitting compounds with electricity

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Lab

Name: _____ Date: _____ Class: _____

When a current flows through copper(II) sulfate solution, copper moves from one plate to the other. How much copper is moved, and does the amount depend on the current? You measure the mass changes at five currents, then use the numbers to find how many electrons are needed for each copper atom and how much charge one mole of electrons carries.

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Aim

To find how the mass of copper deposited on the cathode depends on the current when copper(II) sulfate solution is electrolysed with copper electrodes for a fixed time.

Equipment

- Low-voltage variable power supply (0 to 6 V d.c.)
- Ammeter (0 to 1 A) and connecting leads
- Two copper plates, about 2 cm × 6 cm
- 250 cm³ beaker with 150 cm³ of 0.5 mol/dm³ copper(II) sulfate solution
- Balance reading to 0.01 g, stopwatch, fine sandpaper, water and paper towel

Safety

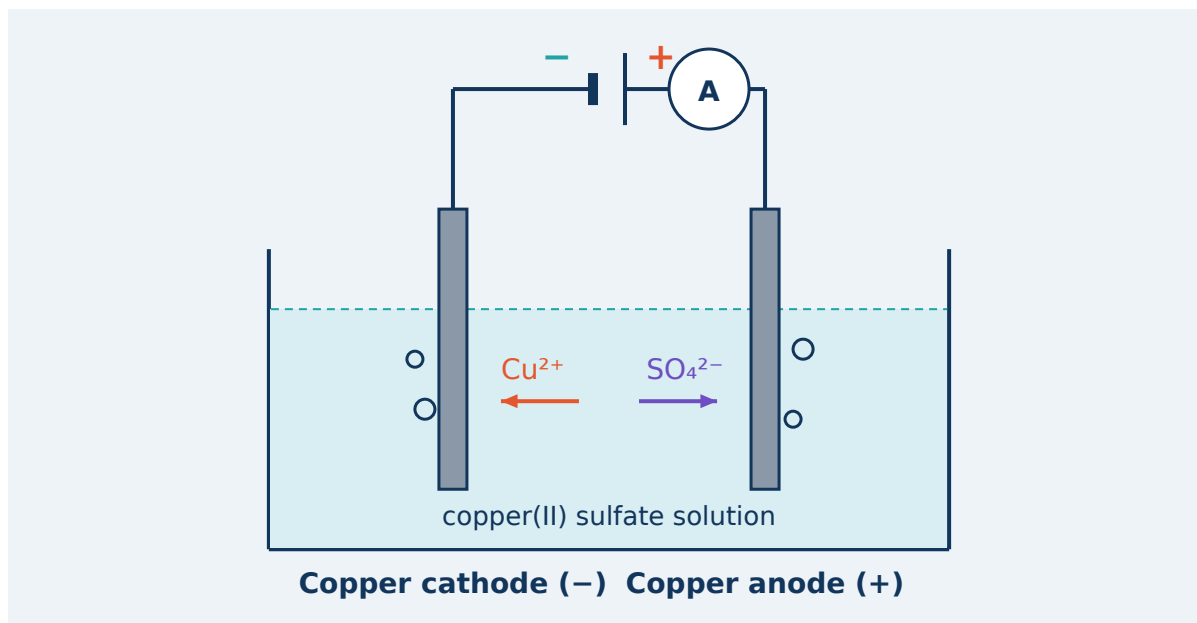
Safety

Wear safety goggles. Copper(II) sulfate solution is harmful if swallowed and irritates the eyes, so wash hands afterwards. Keep the supply at 6 V or less and switch off before touching the plates.

Method

1. Clean both plates with sandpaper, rinse with water, dry and weigh each. Record the masses.
2. Set up the circuit as shown, with the ammeter in series, and mark which plate is joined to the negative terminal.
3. Switch on and adjust the supply until the ammeter reads 0.20 A. Start the stopwatch.
4. Keep the current steady for 1800 s (30 minutes), adjusting the supply if it drifts.
5. Switch off, remove the plates, rinse gently, dry them and reweigh both.

6. Use fresh clean plates and repeat for 0.40, 0.60, 0.80 and 1.0 A.



Copper plates in copper(II) sulfate solution with an ammeter in series.

Results

Sample results for 1800 s at each current:

Current / A	Time / s	Cathode gain / g	Anode loss / g
0.20	1800	0.11	0.12
0.40	1800	0.23	0.24
0.60	1800	0.34	0.36
0.80	1800	0.45	0.47
1.00	1800	0.57	0.59

Analysis questions

Question 1 Plot the graph

Plot the cathode gain (y-axis) against current (x-axis) and draw the line of best fit.

1. Describe the shape of the graph.
2. State the relationship between current and mass.

Question 2 Find the gradient

Use the point at 1.00 A to calculate the gradient in g per ampere for 1800 s. State what the gradient means.

Question 3 Moles of electrons

Using the 1.00 A result (Ar: Cu = 64):

1. Calculate the moles of copper deposited.
2. Write the cathode half equation.
3. Calculate the moles of electrons that flowed.

Question 4 Charge per mole of electrons

Charge in coulombs equals current $\times$ time.

1. Calculate the charge for the 1.00 A run.
2. Calculate the charge carried by one mole of electrons.
3. Compare with the accepted value of 96 500 C/mol and find the percentage difference.

Question 5 Anode and cathode

The anode lost slightly more mass than the cathode gained at every current.

1. Write the half equation at the anode.
2. Suggest two reasons for the small difference.

Question 6 Uncertainty

The balance reads to 0.01 g.

1. Calculate the percentage uncertainty in the 0.11 g reading.
2. Calculate the percentage uncertainty in the 0.57 g reading.
3. Explain which result is more reliable.

Question 7 Conclusion and improvements

State the conclusion of the lab and suggest two improvements to make the results more accurate.