Edexcel Chemistry GCSE

CP 4: Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes

Notes

Electrolysis of Copper Sulfate Solution

Aim

Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes.

Equipment list

- Graphite electrodes
- Copper electrodes
- Crocodile clips and wires
- Power pack
- 250 cm^3 beaker
- 2 test tubes
- Wooden splint and matches
- Digital balance
- Ammeter
- Variable resistor

Chemicals required

- Copper sulfate solution
- Propanone
- Distilled water

Method

Inert electrodes:

1. Pour copper sulfate solution into a beaker so that it is half full.
2. Place two inert graphite electrodes into the beaker and attach to a power supply using crocodile clips and wires.
3. Fill 2 test tubes with copper sulfate solution and place over each electrode (see figure 1).
4. Turn on the power and record any observations.
5. Use a glowing splint to test any gas that has collected in the test tubes. Record any observations.

Copper electrodes:

1. Measure the mass of a copper electrode and attach to the negative terminal of the power supply. Repeat with a second copper electrode, attaching it to the positive terminal. Record the masses.
2. Pour copper sulfate solution into a beaker. Place the copper electrodes in the beaker (see figure 2).
3. Turn on the power supply, making sure the electrodes don't touch. Turn off the power after about 20 minutes.
4. Remove each electrode, washing in distilled water then propanone. Leave the liquid to evaporate from the electrodes before measuring the mass of each one. Record the results, ensuring you know which electrode is which.
5. Repeat steps 1-4 with fresh electrodes and copper sulfate solution. Change the current using the variable resistor.

Key points

- For the second experiment copper electrodes take part in the reactions during electrolysis so they are not inert. At the positive electrode, copper ions are lost so the mass decreases. At the negative electrode, copper atoms are formed so the mass increases.
- The electrodes must not touch when carrying out electrolysis otherwise the current will flow from one electrode to the other without passing through the solution.

Diagrams

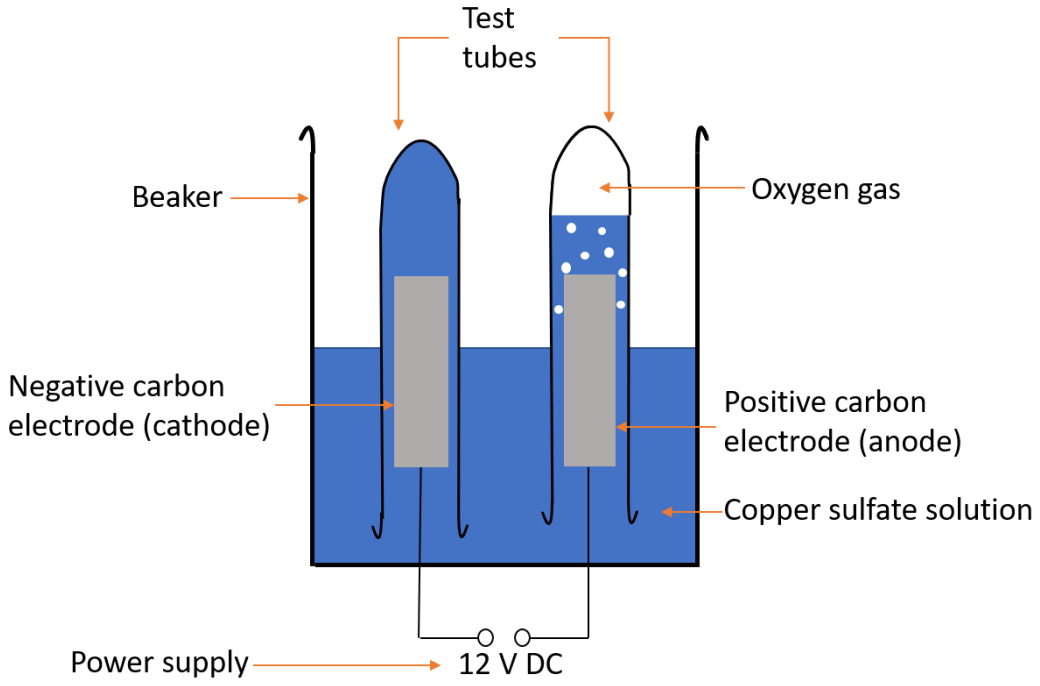

Figure 1: Experiment setup using inert electrodes

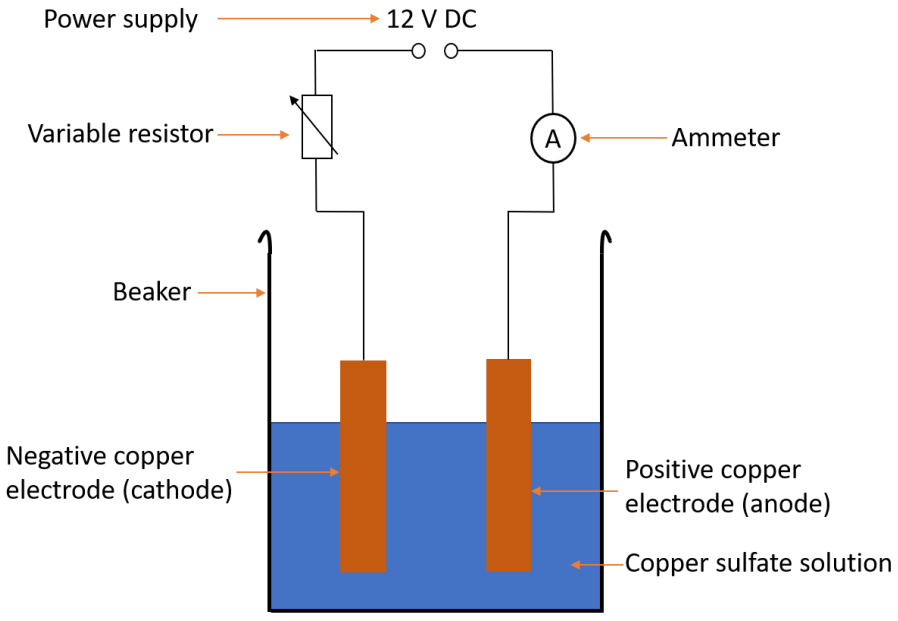

Figure 2: Experiment setup using copper electrodes

Safety precautions

- Copper sulfate can cause skin and eye irritation. Wear gloves and safety goggles and wash skin if it comes into contact with the solution.
- Propanone is flammable so keep away from naked flames. Use in a well ventilated room.
- Clear up any chemical spillages or broken glassware immediately.

Analysis of Results

Inert electrodes:

	Negative Electrode	**Positive Electrode**
Observation	Brown/pink solid forms	Bubbles of colourless gas form
Gas Test	N/A	Gas relights a glowing splint

Copper metal is deposited on the negative electrode and oxygen gas is produced at the positive electrode.

Copper electrodes:
The mass gained by the negative electrode is equal to the mass lost from the positive electrode.
Copper is deposited on the negative electrode and copper ions are lost from the positive electrode.
Mass gained by the negative electrode is directly proportional to the current.