Core practical: copper sulfate crystals

Teacher / technician

YEAR 10 / LESSON 55 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Supervised student preparation with staff-managed warm bath. No direct flame or heating to dryness. Crystallisation/collection extends beyond one session.

Coverage and delivery

Shared core: 2.39 and 2.42. Soluble salt from an insoluble reactant; pure, dry hydrated copper(II) sulfate crystals. Drying/crystal collection needs a later follow-up.

Allow about 60 minutes. Follow the student sequence and use the answers to check reasoning.

Requisition • class of 30, working in 15 pairs

Item	Per pair / setup	Class total
Booklet / writing tools	1 per learner	30 sets
Glassware / filtration / dish / holder	1 set per pair	15 sets; 40 filter papers
Eye protection / absorbent paper	1 each; paper as needed	30 protectors; class supply
1.0 M H_2SO_4 / CuO	10 cm^3 / max 0.90 g	200 cm^3 / 15 g incl. spare
Warm water bath / heat mats	Shared supervised stations	Capacity for 15 beakers; 15 mats
Copper-waste containers / wash bottles	Shared; deionised water	Labelled liquid/solid streams

Immediate safety

Wear eye protection. Avoid acid contact and CuO dust; report spills. Hot vessels can burn even without a flame. Staff manage the water bath and collect all copper-containing residues; never taste or take crystals home.

Preparation and delivery

Read alongside the student method

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1. For 15 pairs, supply 150 cm³ 1.0 M sulfuric acid and up to 13.5 g CuO; prepare 200 cm³ acid and 15 g CuO including spare. Staff portion the powder and assess dust control; pupils do not weigh from stock.

2. Provide 15 sets of beaker, cylinder, rod, spatula, supported funnel, receiver and labelled shallow dish; two filter papers per pair plus spare (40 total), wash bottles and absorbent paper. Ensure sufficient supervised bath capacity at 50–60 °C.

3. Trial the CuO grade and warming time. The calculated CuO requirement is 0.80 g per pair; 0.90 g offers a small excess. Persistent solid alone is not sufficient evidence if the reaction has not been allowed time.

4. Use the exact reagent SDS/local assessment. Prevent acid splashes, CuO dust and contact with hot vessels. Use indirect warming; no Bunsen flame, boiling or evaporation to dryness. Staff manage bath transfers.

5. Plan approximately 60 minutes for setup, reaction, filtration and beginning concentration; book a later 10–15 minute collection/drying observation. Slow evaporation is acceptable; do not promise crystals within the first lesson.

6. Retain all mother liquor, filtrates, copper solids and contaminated papers in labelled copper-waste streams under the school plan. Keep product dishes labelled and secure; crystals are not taken home.

Close of lesson

- Return copper-containing liquids/solids and used filters to the labelled staff waste containers.
- Leave labelled dishes in the designated tray for the follow-up; wash hands after clearing the station.

Check before teaching

Check the cards, reference data and quantities against this requisition. Keep the staff answer guide separate until the checking stage. Supplied numerical practice datasets are labelled examples; they are not class measurements.

Answers and teaching notes

Expected explanations • do not give as experimental observations

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• Excess base consumes the acid. Unreacted insoluble CuO is retained by the filter; dissolved copper sulfate passes through.

• Copper does not release hydrogen from dilute sulfuric acid under these conditions; CuO is a basic oxide and reacts by acid–base chemistry.

• The filtrate contains the desired soluble salt. The black residue is mainly excess CuO, not the salt crystals.

• Strong heating can cause spitting and remove water of crystallisation. Concentrate gently, then cool/evaporate slowly and blot surface liquid.

• n(acid)=1.0×0.0100=0.0100 mol. CuO needed=0.0100×80=0.80 g. Theoretical $CuSO_4 \cdot 5H_2O$=0.0100×250=2.50 g; this is a ceiling, not a target reading.

• Adhering mother liquor can contaminate/inflate mass. A little cold water removes surface solution but dissolves some product. Salt remaining in mother liquor and transfer losses lower recovery.

References and provenance

Pearson Chemistry specification

RSC soluble-salt practical

Prepared 22 November 2026. Original wording, tables and questions. Sources inform the concepts and technique; the lesson scope and classroom quantities are explicitly described here. No laboratory trial or final school risk approval is claimed.