Core practical: displacement energy and diagrams

Teacher / technician

YEAR 11 / LESSON 83 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Low-concentration displacement calorimetry with a clearly labelled Chemistry-only diagram extension.

Coverage and delivery

Shared core: 3.2–3.4 and 3.8, steps 1–5/questions 1–4. Chemistry-only 3.5C: step 6/questions 5–6 energy-level diagrams.

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
Calorimetry / eye protection	1 set per pair; goggles each	15 sets; 30 goggles
0.100 M $CuSO_4$ / fine Zn granules	20.0 cm^3 / 0.20 g per pair	400 cm^3 / 4.0 g including spare

Immediate safety

Wear eye protection, avoid copper-salt contact and zinc dust. No flames or acid. Keep the cup vented and collect all metal-containing residues.

Preparation and delivery

Read alongside the student method

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1. For 15 pairs supply 300 cm^3 0.100 M $CuSO_4$ and 3.0 g fine zinc granules; prepare 400 cm^3 and 4.0 g including spare. Provide 15 cup/support/lid/probe/stirrer/cylinder sets and 30 eye protectors.

2. Staff trial the chosen granule size: coarse or oxidised zinc may react slowly. Use small granules, not zinc dust; keep away from flames. Do not add acid to speed this lesson up.

3. Copper sulfate is hazardous to aquatic life; avoid contact and collect all liquid and metal residues as labelled metal-containing waste. Never pour zinc/copper residues into sinks.

4. The quantities give excess zinc but do not prove complete reaction. If the trace is slow or small, report uncertainty rather than assuming the illustrative four-degree rise.

5. Shared learners finish the measured-energy calculation and evaluation; Chemistry learners add the diagram. Allow 10 minutes briefing, 20 measurements, 20 interpretation and 10 cleanup.

Close of lesson

• Staff collect solution, zinc and copper residues in labelled metal waste; rinse as directed and wash hands.

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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• Expected warming, fading blue solution and copper-coloured deposit; accept actual observations, including incomplete reaction.

• Example $q = 20.0 \times 4.18 \times 4.0 = 334.4$ J.

• $CuSO_4 = 0.100 \times 0.0200 = 0.00200$ mol; $Zn = 0.20/65.4 \approx 0.00306$ mol; 1:1, so $CuSO_4$ limits.

• $\Delta H \approx -334.4/0.00200/1000 = -167.2$ kJ mol^{-1}. Heat loss or incomplete reaction usually reduces the measured magnitude.

• Products below reactants; downward enthalpy-change arrow, labelled axes and any activation barrier drawn above reactants.

• Activation energy is the barrier from reactants to transition state; ΔH compares products with reactants.

References and provenance

Pearson Chemistry specification

RSC displacement calorimetry

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.