Core practical: combustion calorimetry

Teacher / technician

YEAR 11 / LESSON 84 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Approximate classroom energy capture, not a standard combustion-enthalpy measurement.

Coverage and delivery

Shared core: 3.2–3.4 and 3.8, combustion calorimetry. Ethanol is a named fuel here; its Chemistry-only reaction chemistry is not required.

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
Staff-filled ethanol burners	About 15 cm^3 per burner	15 capped burners; 250 cm^3 fuel prepared by staff
Water / balance	100 cm^3 per pair; shared balance	2 L water; balances

Immediate safety

Ethanol is highly flammable. Wear eye protection and tie hair back; snuff with the cap using tongs. No hot-burner refilling; cool before weighing and keep ventilation around the flame.

Preparation and delivery

Read alongside the student method

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1. Provide 15 stable calorimetry sets with metal vessels, probes/stirrers, mats and ventilated shields, plus 30 eye protectors and shared balances. One run uses 1.5 L water across 15 pairs; provide 2 L including spare.

2. Staff fill and inspect 15 suitable spirit burners away from ignition sources, each with a working cap and about 15 cm^3 pure ethanol (225 cm^3 total; prepare 250 cm^3). Do not bring bulk fuel to lit benches or allow pupil refilling.

3. Ethanol is highly flammable and its flame can be hard to see. Check local fire/spill procedures, burner integrity and supervision; use tongs for hot caps. Keep shields ventilated and never fully enclose the flame.

4. This is a single-fuel investigation. If denatured alcohol is substituted, record the mixture identity and do not claim an exact pure-ethanol molar value. No methanol is issued.

5. Allow 10 minutes checks, 20 heating/cooling, 20 calculations and 10 cleanup. A local trial is required; do not move hot burners to the balance.

Close of lesson

• Staff confirm every flame is extinguished, collect cooled capped burners and store fuel safely. Leave hot calorimeters to cool before emptying water.

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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- Example $\Delta T = 20.0\ °C$; $q = 100.0 \times 4.18 \times 20.0 = 8360\ J = 8.36\ kJ$.
- Mass loss = 0.80 g; $8.36 / 0.80 = 10.45\ kJ\ g^{-1}$, approximately $10\ kJ\ g^{-1}$ to 2 s.f.
- $n \approx 0.80 / 46.0 = 0.01739\ mol$; $\Delta H \approx -8.36 / 0.01739 = -480.7\ kJ\ mol^{-1}$, about $-4.8 \times 10^{2}\ kJ\ mol^{-1}$.
- Energy goes into calorimeter, air and supports as well as water; q(water) alone underestimates release.
- Evaporated unburned fuel increases measured mass loss without heating the water, lowering apparent energy per gram.
- Use a suitable lid/insulation and ventilated draught shield, reduce uncontrolled draughts and repeat consistently; never enclose the flame.

References and provenance

Pearson Chemistry specification

RSC combustion calorimetry 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.