

Enthalpy Changes and Calorimetry

Task

Students present a labelled model or report on enthalpy changes and calorimetry.

Curriculum alignment

Students demonstrate achievement of the following outcomes:

- Define enthalpy and molar enthalpy for chemical reactions ([Outcome](#))
- Recall the application of $Q = mc\Delta T$ for heat transfer ([Outcome](#))
- Use calorimetry data to determine the enthalpy changes in chemical reactions ([Outcome](#))
- Use and interpret ΔH to communicate and calculate energy changes in chemical reactions ([Outcome](#))

Rubric

Criterion	Beginning	Developing	Proficient	Exemplary
Definition and notation	Attempts to define enthalpy or ΔH , notation with significant gaps or errors.	Defines enthalpy and ΔH , with omissions or imprecision. Partial understanding evident.	Defines enthalpy and molar enthalpy clearly. Uses ΔH , notation correctly in calculations and communication.	Defines enthalpy and molar enthalpy with precision. Applies ΔH , notation fluently across multiple contexts and calculations.
Heat transfer calculation	Applies $Q = mc\Delta T$ with errors in formula use, unit conversion, or variable identification.	Applies $Q = mc\Delta T$ mostly correctly. Minor errors in calculation or unit handling. Shows understanding of variables.	Applies $Q = mc\Delta T$ correctly to analyse heat transfer. Converts units accurately. Identifies all variables appropriately.	Applies $Q = mc\Delta T$ accurately, efficiency. Explains the role of each variable. Handles complex unit conversions seamlessly.
Calorimetry data analysis	Attempts to use calorimetry data but analysis is incomplete or contains major errors in logic.	Uses calorimetry data to determine enthalpy changes with minor computational or conceptual errors.	Uses calorimetry data accurately to determine enthalpy changes. Calculations are correct and method is clearly shown.	Analyses calorimetry data with precision. Determines enthalpy changes correctly. Identifies and addresses experimental limitations or sources of error.
Model or report clarity	Model or report is disorganized. Labels are missing or inaccurate. Explanations lack clarity.	Model or report is mostly organized. Most labels are present and accurate. Explanations are generally clear but lack some detail.	Model or report is well-organized and clearly labelled. Explanations are logical and support the chemistry concepts.	Model or report is exceptionally clear and well-labelled. Explanations are thorough, logical, and demonstrate deep conceptual understanding.

Scoring

Assign each criterion a level: Beginning (1), Developing (2), Proficient (3), or Exemplary (4).

A total of 4–7 indicates beginning/needs intervention; 8–11 indicates developing performance; 12–14 indicates proficient performance; 15–16 indicates exemplary performance.

Notes for the teacher

- **Consistency in calculation assessment.** When marking $Q = mc\Delta T$, verify that the student has correctly identified the mass of the substance that absorbs or releases heat (usually water in a calorimeter), not the mass of the fuel or reactant. This is a common source of error. For example, if a student burns 2 g of ethanol in a calorimeter and heats 100 g of water by 5 °C, use $m = 100$ g (water) and $\Delta T = 5$ °C, not the mass of the fuel.
- **Calorimetry context.** Accept models or reports based on combustion calorimetry ([Resource](#)) or solution calorimetry ([Resource](#)). The method differs, but the principle of using $Q = mc\Delta T$ remains the same. Assess the logic of the method chosen, not adherence to a single procedure.
- **Sign convention.** Students must use negative Q , for exothermic reactions and positive Q , for endothermic reactions. Check that the sign is justified by the data or explanation, not guessed. If a student calculates Q correctly but assigns the wrong sign to Q , mark the criterion "Definition and notation" as Developing at best.
- **Labelling standards.** For models, require labels for reactants, products, energy released or absorbed, and the calorimeter components (if shown). For reports, require a clear statement of the reaction studied, the measured temperature change, and the calculated Q , volume of fuel, and mass of water.