

Calorimetry Lab Report Marking Guide

Task

Students conduct a calorimetry investigation and write a lab report that determines the molar enthalpy of a reaction from their data.

Curriculum alignment

This task assesses the following outcomes from Chemistry 30, Unit A: Thermochemical Changes.

- 30-A1.1k: recall the application of $Q = mc\Delta T$ (Outcome)
- 30-A1.2s: perform calorimetry experiments to determine the molar enthalpy change of chemical reactions, using thermometers or temperature probes appropriately (Outcome)
- 30-A1.3k: define enthalpy and molar enthalpy for chemical reactions (Outcome)
- 30-A1.8k: use calorimetry data to determine the enthalpy changes in chemical reactions (Outcome)
- 30-A1.5k: use and interpret ΔH , ΔH_f° , ΔH_c° and calculate energy changes in chemical reactions (Outcome)
- 30-A1.4s: use appropriate SI units, fundamental and derived units, and significant digits, and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate results (Outcome)
- 30-A1.3s: analyze data and apply mathematical and conceptual models to develop and assess possible solutions (Outcome)

Rubric

Criterion	Beginning	Developing	Proficient	Exemplary
Experimental procedure and data collection (Outcome)	Records temperature readings inconsistently; procedure steps missing or out of order.	Records temperature data with some gaps; procedure described but lacks detail on technique.	Records temperature data accurately using thermometer or probe correctly; procedure clearly described.	Records precise, consistent temperature data; procedure justifies technique choices and controls for heat loss.
Calculation of heat transfer and molar enthalpy (Outcome, Outcome, Outcome)	Applies $Q = mc\Delta T$ incorrectly; molar enthalpy not calculated or calculated with major errors.	Applies $Q = mc\Delta T$ with minor errors; molar enthalpy calculated but mass-to-mole conversion is flawed.	Applies $Q = mc\Delta T$ correctly; calculates molar enthalpy accurately from calorimetry data.	Applies $Q = mc\Delta T$ correctly; molar enthalpy calculations correct, showing all steps and correct unit conversions throughout.
Communication: units, significant digits, and ΔH , ΔH_f° , ΔH_c° notation (Outcome, Outcome)	Omits units or significant digits; ΔH , ΔH_f° , ΔH_c° notation missing or used incorrectly.	Uses units and significant digits inconsistently; ΔH , ΔH_f° , ΔH_c° notation present but applied with errors.	Uses correct SI units and significant digits; applies ΔH , ΔH_f° , ΔH_c° correctly to represent energy change.	Uses correct units, significant digits, and ΔH , ΔH_f° , ΔH_c° throughout, with clear tables and graphs supporting the data.

Analysis and interpretation of results (Outcome, Outcome)	Provides no discussion of accuracy or sources of error; conclusion unsupported by data.	Identifies one source of error without explaining its effect on results.	Identifies sources of error and explains their effect on the calculated molar enthalpy.	Evaluates sources of error, compares result to an accepted value, and explains discrepancies with reference to experimental limitations.
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Scoring

Assign each of the four criteria a level: Beginning (1 point), Developing (2 points), Proficient (3 points), or Exemplary (4 points). Add the four scores for a total out of 16.

- 4 to 7: Beginning
- 8 to 10: Developing
- 11 to 13: Proficient
- 14 to 16: Exemplary

Report the overall level to the student along with the total score, so the score and the descriptive level match.

Notes for the teacher

- Check that the reported molar enthalpy carries the correct sign and matches whether the reaction is endothermic or exothermic before scoring the calculation criterion.
- Apply the significant digits standard consistently across all lab reports in the class, since calorimetry data often carries only two or three significant figures.
- When a student's error analysis blames only human error, hold the analysis criterion at Developing rather than Proficient. Look for reference to heat loss to the surroundings or calorimeter heat capacity.
- Score the procedure and calculation criteria independently. A student can execute the experiment well and still make a calculation error, or vice versa.