

Marking Guide: Enthalpy Changes and Calorimetry

Task

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

Curriculum alignment

This task assesses student understanding of energy changes in chemical reactions, drawn from the following outcomes:

- 30-A1.1k: recall the application of $Q = mc\Delta T$ (Outcome)
- 30-A1.3k: define enthalpy and molar enthalpy for chemical reactions (Outcome)
- 30-A1.5k: use and interpret ΔH and calculate energy changes in chemical reactions (Outcome)
- 30-A1.6k: predict the enthalpy change for chemical equations using standard enthalpies of formation (Outcome)
- 30-A1.7k: explain and use Hess' law to calculate energy changes for a net reaction from a series of reactions (Outcome)
- 30-A1.8k: use calorimetry data to determine the enthalpy changes in chemical reactions (Outcome)
- 30-A1.10k: classify chemical reactions as endothermic or exothermic, including photosynthesis, cellular respiration and hydrocarbon combustion (Outcome)
- 30-A2.2k: explain the energy changes that occur during chemical reactions, referring to bonds breaking and forming and changes in potential and kinetic energy (Outcome)
- 30-A2.3k: analyze and label energy diagrams of a chemical reaction, including reactants, products, enthalpy change and activation energy (Outcome)

These outcomes fall under the general outcomes to determine and interpret energy changes in chemical reactions (Topic) and to explain and communicate energy changes in chemical reactions (Topic), within the Energy, Change and Systems unit (Topic).

Rubric

Criterion	Beginning	Developing	Proficient	Exemplary
Calorimetry and heat transfer calculations	Applies $Q = mc\Delta T$ incorrectly or omits calorimetry data entirely (Outcome, Outcome).	Applies $Q = mc\Delta T$ with errors in variables or units; calorimetry data partially used (Outcome, Outcome).	Applies $Q = mc\Delta T$ correctly with proper units; calorimetry data used to determine enthalpy change (Outcome, Outcome).	Applies $Q = mc\Delta T$ with precision, justifies assumptions, and cross-checks calorimetry results against expected values (Outcome, Outcome).
Enthalpy definitions and ΔH notation	Defines enthalpy incorrectly or omits ΔH notation (Outcome, Outcome).	Defines enthalpy or molar enthalpy with minor inaccuracies; ΔH notation used inconsistently (Outcome, Outcome).	Defines enthalpy and molar enthalpy accurately; ΔH notation used correctly to communicate energy changes (Outcome, Outcome).	Defines enthalpy and molar enthalpy with precision and applies ΔH notation across multiple reaction contexts (Outcome, Outcome).

Hess' law and standard enthalpies of formation	Does not apply Hess' law or formation enthalpies, or applies them with major conceptual errors (Outcome, Outcome).	Applies Hess' law or formation enthalpies with arithmetic or conceptual errors (Outcome, Outcome).	Correctly predicts enthalpy change using standard enthalpies of formation and applies Hess' law to a series of reactions (Outcome, Outcome).	Applies Hess' law and formation enthalpies accurately, explaining the reasoning behind combining reaction equations (Outcome, Outcome).
Energy diagrams and classification of reactions	Labels energy diagrams incompletely; does not classify reactions as endothermic or exothermic (Outcome, Outcome, Outcome).	Labels most diagram components; classifies reactions with some errors; limited reference to bond breaking and forming (Outcome, Outcome, Outcome).	Labels reactants, products, enthalpy change and activation energy correctly; classifies reactions accurately, referencing bond and energy changes (Outcome, Outcome, Outcome).	Labels diagrams fully and accurately; explains classification with clear reference to bond breaking, bond forming, and potential and kinetic energy changes (Outcome, Outcome, Outcome).

Scoring

Assign each criterion a level from Beginning (1) to Exemplary (4). Add the four scores to produce a total out of 16.

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

Report the total alongside the four individual criterion levels so students can see strengths and areas for revision.

Notes for the teacher

- Distinguish between arithmetic slips and conceptual misunderstanding when scoring the calorimetry and Hess' law criteria; a single unit error should not drop a student a full level if the method is sound.
- When students select their own reaction examples (such as combustion or photosynthesis), confirm the classification against accepted thermochemical values before scoring [Outcome](#).
- Students should be able to analyze and label energy diagrams of a chemical reaction, including reactants, products, enthalpy change and activation energy [Outcome](#).
- Keep the illustrative examples in the source outcomes separate from required content; do not penalize students for choosing different reactions than those discussed in class.