

Enthalpy Changes and Calorimetry

30 minutes, 3 stages

Enthalpy is the heat energy released or absorbed during a chemical reaction at constant pressure. When you measure temperature changes in a calorimeter, you are collecting evidence of enthalpy change. Understanding how to calculate enthalpy from calorimetry data is essential to predicting whether reactions are exothermic or endothermic and to evaluating the energy content of fuels and reactions in real systems ([Topic](#), [Outcome](#)).

Stage 1: Heat Transfer Calculations (10 min)

Use the equation $Q = mc\Delta T$ to solve these problems ([Outcome](#)). Show your work for each calculation.

Problem 1: A calorimeter contains 250 g of water. The temperature rises from 18.5°C to 24.3°C when a reaction occurs inside. The specific heat capacity of water is 4.18 J/(g·°C). Calculate the heat transferred to the water.

Problem 2: In a combustion calorimetry experiment, 150 g of water absorbs 8460 J of heat. If the initial temperature is 20.0°C, what is the final temperature? (Use $c = 4.18 \text{ J/(g}\cdot\text{°C)}$.)

Problem 3: A student burns a peanut in a simple calorimeter and measures a temperature change of 6.2°C in 200 g of water. Calculate the heat released by the peanut. Express your answer in joules and kilojoules.

Stage 2: Enthalpy and ΔH , ΔH_{f} and ΔH_{c}

Answer the following questions in complete sentences.

Question 1: Define enthalpy and explain why chemists use the symbol ΔH , ΔH_{f} and ΔH_{c} to change in a reaction ([Outcome](#), [Outcome](#)).

Question 2: In calorimetry, when a reaction releases heat to the water in the calorimeter, the water temperature increases. Is ΔH for the reaction positive or negative? Explain your reasoning.

Question 3: A student performs a calorimetry experiment and calculates that the heat absorbed by the water is 5400 J. The reaction consumed 0.50 mol of a reactant. Calculate the molar enthalpy (enthalpy per mole of reactant) and include the correct sign ([Outcome](#)).

Stage 3: Interpreting Calorimetry Data (8 min)

Read the scenario and answer the questions.

A student constructs a simple polystyrene-cup calorimeter to measure the enthalpy change when solid calcium chloride dissolves in water. The student measures 100 g of water at 21.0°C, adds 5.0 g of calcium chloride, and stirs. The temperature rises to 27.5°C. The specific heat capacity of the solution is approximately 4.18 J/(g·°C), and the total mass of the solution is 105 g.

Task 1: Calculate the heat absorbed by the solution using $Q = mc\Delta T$ ([Outcome](#)).

Task 2: The dissolution of calcium chloride consumed 0.050 mol of CaCl_2 . Calculate the molar enthalpy for this reaction ([Outcome](#)).

Task 3: Is this reaction exothermic or endothermic? How do you know?

Self-check

1. You measure a temperature increase of 5.0°C in 300 g of water during a calorimetry experiment. Without calculating, explain whether the heat value Q will be positive or negative, and what sign ΔH ,

will have for the reaction that caused this temperature change.

2. Explain the relationship between the heat transferred to the water (measured by $Q = mc\Delta T$) and the enthalpy change of the chemical reaction occurring in the calorimeter.