

Enthalpy Changes and Calorimetry

Time: 25 min. 6 questions.

Instructions

Answer all six questions. For multiple choice, select the best answer. For short answer, write a complete sentence or brief explanation. For the true or false question, state whether the statement is true or false and give a one-sentence reason. For the numeric question, show your calculation and include units in your final answer.

Questions

- Which of the following statements best describes the relationship between enthalpy and molar enthalpy?
A) Enthalpy is the total energy of a system; molar enthalpy is the enthalpy change per mole of a specified substance in the reaction.
B) Enthalpy and molar enthalpy are identical terms used interchangeably in thermochemistry.
C) Enthalpy is measured in joules; molar enthalpy is measured only in calories.
D) Enthalpy applies only to exothermic reactions, while molar enthalpy applies to endothermic reactions.
([Outcome](#))
- Consider the following balanced thermochemical equation: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ $\Delta H = -572 \text{ kJ}$. Explain what the negative sign in this ΔH value tells you about the reaction. ([Outcome](#))
- True or false: A negative ΔH value indicates that a reaction is endothermic and absorbs energy from the surroundings. ([Outcome](#))
- Which process is classified as exothermic?
A) Photosynthesis
B) Melting ice at 0°C
C) Cellular respiration
D) Evaporation of water
([Outcome](#))
- In a calorimetry experiment, a student burns 1.0 g of a hydrocarbon fuel and observes that the temperature of 1000 g of water increases by 6.5°C . Using $Q = mc\Delta T$, $c = 4.18 \text{ J/(g}\cdot^\circ\text{C)}$, calculate the heat released by the fuel in kilojoules. ([Outcome](#))
- A student performs a calorimetry experiment where 50 g of hot water at 80°C is mixed with 50 g of cold water at 20°C in an insulated container. Using $Q = mc\Delta T$, $c = 4.18 \text{ J/(g}\cdot^\circ\text{C)}$, determine the final equilibrium temperature of the mixture. ([Outcome](#))

Curriculum Coverage

Question	Outcome Alias	Outcome Description
1	Outcome	Define enthalpy and molar enthalpy for chemical reactions
2	Outcome	Write balanced equations for chemical reactions that include energy changes
3	Outcome	Use and interpret ΔH , ΔH_f° , ΔH_c° to communicate and calculate energy changes

4	Outcome	Classify chemical reactions as endothermic or exothermic
5	Outcome	Use calorimetry data to determine the enthalpy changes in chemical reactions
6	Outcome	Apply $Q = mc\Delta T$ to heat transfer

Answer Key

- A**, Molar enthalpy is the enthalpy change expressed per mole of a specified reactant or product, whereas enthalpy is the total energy content; this distinction is central to the definition ([Outcome](#)).
- The negative sign indicates that the reaction is exothermic and releases 572 kJ of energy to the surroundings for every 2 moles of hydrogen gas that react.** The ΔH indicates both the magnitude and direction of energy change in the reaction ([Outcome](#)).
- False**, A negative ΔH indicates an exothermic reaction that releases energy to the surroundings; an endothermic reaction has a positive ΔH ([Outcome](#)).
- C**, Cellular respiration is exothermic because it releases energy from the breakdown of glucose and other organic molecules; photosynthesis and evaporation are endothermic, and melting ice requires heat input ([Outcome](#)).
- 27.2 kJ**, Using $Q = mc\Delta T$ $Q = 1000 \text{ g} \times 4.18 \text{ J/(g}\cdot^{\circ}\text{C)} \times 6.5^{\circ}\text{C} = 27,170 \text{ J}$; converting to kilojoules: $27,170 \text{ J} \div 1000 = 27.2 \text{ kJ}$ ([Outcome](#)).
- 50°C**, Heat lost by hot water equals heat gained by cold water; $50 \text{ g} \times 4.18 \text{ J/(g}\cdot^{\circ}\text{C)} \times (80^{\circ}\text{C} - T) = 50 \text{ g} \times 4.18 \text{ J/(g}\cdot^{\circ}\text{C)} \times (T - 20^{\circ}\text{C})$, which simplifies to $80^{\circ}\text{C} - T = T - 20^{\circ}\text{C}$, giving $T = 50^{\circ}\text{C}$ ([Outcome](#)).