

Enthalpy Changes and Calorimetry

Time: 25 min. 6 questions.

Instructions

Answer all six questions. For multiple-choice questions, select the best answer. For short-answer and true/false questions, show your reasoning or state whether the statement is correct and why. For numeric questions, include units in your final answer and show your calculation. You may use a calculator.

Questions

1. A student burns 2.0 g of ethanol in a bomb calorimeter and observes a temperature increase of 8.5°C in 1000 g of water surrounding the calorimeter. Using $Q = mc\Delta T$, what is the heat released by the combustion? (Assume the specific heat capacity of water is 4.18 J/g°C.)

A) 35.53 kJ
B) 3.553 kJ
C) 35530 J
D) 0.035 kJ

[\(Outcome\)](#)

2. Which of the following statements about enthalpy is true?

A) Enthalpy is the total kinetic energy of all particles in a system.
B) Enthalpy is a measure of the heat content of a substance at constant pressure.
C) Enthalpy can only be measured in units of joules per second.
D) Enthalpy is always positive for all chemical reactions.

[\(Outcome\)](#)

3. The combustion of methane is represented by the equation $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$, $\Delta H = -890 \text{ kJ/mol}$. Is this reaction endothermic or exothermic, and what does the numerical value tell you?

[\(Outcome\)](#)

4. True or False: The ΔH for a chemical equation refers to the enthalpy change per mole of the reaction as written.

[\(Outcome\)](#)

5. A student uses calorimetry to determine the enthalpy change of a neutralization reaction. The student measures the temperature change of the solution, the mass of the solution, and uses $Q = mc\Delta T$. What is the relationship between the heat measured in the calorimeter (q) and the enthalpy change (ΔH) for this reaction?

[\(Outcome\)](#)

6. Calculate the standard enthalpy change for the reaction $2\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$ using the following standard enthalpies of formation: $\Delta H_f^\circ[\text{O}_2(\text{g})] = 0 \text{ kJ/mol}$, $\Delta H_f^\circ[\text{CO}(\text{g})] = -110.5 \text{ kJ/mol}$. Show your work.

[\(Outcome\)](#)

Curriculum Coverage

Question	Outcome Alias	Specific Outcome Code
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1	Outcome	30-A1.1k
2	Outcome	30-A1.3k
3	Outcome	30-A1.10k
4	Outcome	30-A1.5k
5	Outcome	30-A1.8k
6	Outcome	30-A1.6k

Answer Key

- Answer: C) 35530 J** (or 35.53 kJ). Using $Q = mc\Delta T$, $Q = (1000 \text{ g})(4.18 \text{ J/g}^\circ\text{C})(8.5^\circ\text{C}) = 35530 \text{ J}$, which equals the heat released by combustion at constant pressure.
- Answer: B) Enthalpy is a measure of the heat content of a substance at constant pressure.** Enthalpy (H) is defined as the total heat content of a system and is the appropriate measure for processes occurring at constant pressure, such as most laboratory reactions.
- Answer: This reaction is exothermic. The negative value of ΔH signals an exothermic reaction.** A negative ΔH signals an exothermic reaction.
- Answer: True.** The ΔH value in a thermochemical equation represents the enthalpy change for the reaction as written, per mole of reaction as specified by the stoichiometric coefficients.
- Answer: For a reaction at constant pressure, the heat measured by the calorimeter (q) equals the enthalpy change of the reaction (ΔH).** Calorimetry directly measures the heat transfer, which equals ΔH , at constant pressure.
- Answer: $\Delta H^\circ_{\text{rxn}} = -221 \text{ kJ/mol}$; the reaction is exothermic.** $\Delta H^\circ_{\text{rxn}} = [2(0) + 1(0)] - [2(0) + 1(0)] = -221 \text{ kJ/mol}$; the reaction is exothermic.