

Enthalpy Changes and Calorimetry

Time: 20 min. 6 questions.

Instructions

Answer all six questions. For multiple choice questions, select the best answer. For short answer questions, write a complete explanation. For the true or false question, state whether the claim is true or false and briefly justify your answer. For the numeric question, show your calculation and include units. You may use a calculator.

Questions

1. A student burns 2.5 g of ethanol in a bomb calorimeter. The temperature of 1000 g of water surrounding the bomb rises by 8.2°C. Using $Q = mc\Delta T$ by the combustion? (Assume the specific heat capacity of water is 4.18 J/g°C.)

- A) 8.6 kJ
B) 34.2 kJ
C) 86 kJ
D) 342 kJ

([Outcome](#))

2. A chemical reaction absorbs 45 kJ of energy from the surroundings. Write the ΔH value for this reaction and explain what the sign tells you about whether the reaction is endothermic or exothermic. ([Outcome](#))
3. True or false: In an exothermic reaction, the enthalpy of the products is greater than the enthalpy of the reactants. ([Outcome](#))
4. The combustion of methane is written as $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$, $\Delta H = -890 \text{ kJ}$. What does the negative sign indicate, and why is this reaction important for energy use in society? ([Outcome](#), [Outcome](#))
5. A student collects the following calorimetry data: mass of water = 500 g, initial temperature = 20.0°C, final temperature = 24.5°C, specific heat capacity of water = 4.18 J/g°C. Calculate the heat absorbed by the water in kilojoules. ([Outcome](#), [Outcome](#))
6. An energy diagram shows that reactants are at 150 kJ, products are at 80 kJ, and the activation energy is 60 kJ. Is this reaction endothermic or exothermic, and what is the enthalpy change? ([Outcome](#))

Curriculum Coverage

Question	Outcome Alias	Specific Outcome
1	Outcome	Recall the application of $Q = mc\Delta T$ for the analysis of heat transfer
2	Outcome	Use and interpret ΔH , ΔG , ΔS to communicate and calculate energy changes
3	Outcome	Classify chemical reactions as endothermic or exothermic
4	Outcome, Outcome	Use ΔH , ΔG , ΔS to determine if a reaction is spontaneous as endothermic or exothermic

5	Outcome, Outcome	Apply $Q = mc\Delta T$ and use calorimetry data to determine enthalpy changes
6	Outcome	Analyze and label energy diagrams of a chemical reaction

Answer Key

- Answer: B) 34.2 kJ**
Using $Q = mc\Delta T$ $Q = 1000 \text{ g} \times 4.18 \text{ J/g}^\circ\text{C} \times 8.2^\circ\text{C} = 34,276 \text{ J}$ "H 34.2 kJ, which is the heat released by the combustion of 2.5 g of ethanol.
- Answer: 9D, 0 3CR ´ . The positive sign indicates the reaction is endothermic because energy is absorbed from the surroundings. (Outcome)**
- Answer: False.** In an exothermic reaction, the enthalpy of the products is lower than the enthalpy of the reactants, which is why energy is released (Outcome).
- Answer: The negative sign indicates the reaction is exothermic and releases 890 kJ of energy per mole of methane burned.** This reaction is important because combustion of methane (natural gas) is a major energy source for heating, electricity generation, and industrial processes in society (Outcome, Outcome).
- Answer: 9.41 kJ**
 $Q = mc\Delta T$ 0 S r r Bã , 0ö{ 2 r f#BãR !" # ã > 0 S r Bã , r BãR 0 "C R ¢ \$, 'ãC (Outcome, Outcome).
- Answer: The reaction is exothermic. 9D, 0 !#s ´ .**
The products (80 kJ) are lower in energy than the reactants (150 kJ), so the reaction releases energy; 9D, 0 f !" S 0 !#s (Outcome).