

Thermochemistry & Calorimetry

INSTRUCTOR / SELF-STUDY ANSWER KEY

Answers and reasoning appear in red. Use these to discuss why incorrect choices are incorrect.

Part A — Concept checks

1. An exothermic reaction has...

Answer: B. negative ΔH — Heat leaves the reaction system so $\Delta H < 0$ at constant pressure.

2. What is ΔT when $T_{\text{initial}} = 22\text{ }^{\circ}\text{C}$ and $T_{\text{final}} = 31\text{ }^{\circ}\text{C}$?

Answer: B. $9\text{ }^{\circ}\text{C}$ — $\Delta T = T_{\text{final}} - T_{\text{initial}} = 9\text{ }^{\circ}\text{C}$.

3. Heat capacity is used to connect heat with...

Answer: C. temperature change — $q = C\Delta T$ for the relevant object or system.

4. A 10.0 g sample with $c = 2.0\text{ J/(g }^{\circ}\text{C)}$ warms by $5.0\text{ }^{\circ}\text{C}$. $q = \dots$

Answer: C. 100 J — $10.0 \times 2.0 \times 5.0 = 100\text{ J}$.

5. The surroundings gain $+200\text{ J}$ in an insulated idealization. The system loses...

Answer: B. -200 J — Conservation of energy gives $q_{\text{system}} = -q_{\text{surroundings}}$.

6. Which quantity is a state function?

Answer: C. enthalpy H — Enthalpy depends on system state rather than process path.

Part B — Application and explanation

7. How much heat warms 75.0 g of water from $20.0\text{ }^{\circ}\text{C}$ to $28.0\text{ }^{\circ}\text{C}$?

Model solution: $q = (75.0\text{ g})(4.184\text{ J g}^{-1}\text{ }^{\circ}\text{C}^{-1})(8.0\text{ }^{\circ}\text{C}) = 2.5104 \times 10^3\text{ J}$, reported as $2.5 \times 10^3\text{ J}$ given $\Delta T = 8.0\text{ }^{\circ}\text{C}$. Sign is positive for the warming water. Final answer: $+2.5\text{ kJ}$ (absorbed by water)

8. Explain why this guideline matters, with an example of what could go wrong if you ignore it: The heat gained by water is not automatically the reaction enthalpy. In an insulated calorimeter, $q_{\text{reaction}} \approx -q_{\text{surroundings}}$ after considering all relevant heat capacities.

Model explanation: The heat gained by water is not automatically the reaction enthalpy. In an insulated calorimeter, $q_{\text{reaction}} \approx -q_{\text{surroundings}}$ after considering all relevant heat capacities. Example/check: Specify what is reacting and what counts as surroundings. Heat absorbed by one part is released by another in an insulated model.

REFERENCE RELATIONSHIP

$q = mc\Delta T$; at constant pressure with only PV work, $\Delta H = q_p$