

Enthalpy Changes and Calorimetry

Time: 30 min. 6 questions.

Instructions

Answer all six questions using your knowledge of enthalpy, calorimetry, and the equation $Q = mc\Delta T$. Show all calculation steps for the numeric and short-answer questions, including units at each stage. A periodic table and the specific heat capacity of water ($c = 4.19 \text{ J/(g}\cdot^{\circ}\text{C)}$) may be used where needed.

Questions

1. A calorimetry trial burns a sample of fuel beneath a container of water. Which quantity must be measured directly in order to calculate the heat absorbed by the water using $Q = mc\Delta T$?

A) The molar mass of the fuel
B) The change in temperature of the water
C) The pressure inside the calorimeter
D) The number of moles of fuel burned

([Outcome](#))

2. Define enthalpy, and explain what molar enthalpy represents for a chemical reaction. ([Outcome](#))
3. True or false: In a calorimetry experiment, the heat released by a combustion reaction is assumed to equal the heat absorbed by the surrounding water, provided heat loss to the environment is negligible. ([Outcome](#))
4. A student mixes 50.0 g of water at 22.0°C with a dissolving salt sample in a polystyrene-cup calorimeter. The final temperature of the solution is 18.5°C . Using $c = 4.19 \text{ J/(g}\cdot^{\circ}\text{C)}$ for the solution, calculate the heat change, Q , of the water in joules. State whether the process is exothermic or endothermic. ([Outcome](#))
5. A reaction releases 45.6 kJ of energy when 0.250 mol of reactant is consumed. Calculate the molar enthalpy of the reaction, in kJ/mol, and write the value with the correct sign. ([Outcome](#))
6. Explain why a calorimeter constructed from polystyrene cups, rather than an open beaker, improves the accuracy of an experimentally determined enthalpy change. ([Outcome](#))

Curriculum coverage

Question	Outcome alias
1	Outcome
2	Outcome
3	Outcome
4	Outcome
5	Outcome
6	Outcome

Answer key

1. **B) The change in temperature of the water.** $Q = mc\Delta T$ where m is the mass, c is the specific heat capacity of the water along with its measured temperature change, ΔT , to calculate heat transfer.
2. **Enthalpy (H) is the heat content of a system at constant pressure, and a change in enthalpy (ΔH) is the enthalpy change per mole of a specified substance in the reaction, expressed in kJ/mol.** This distinguishes the total energy change of a reaction from the energy change per mole of reactant or product.
3. **True.** Calorimetry assumes conservation of energy between the reacting system and the water (or solution) surrounding it, so heat lost by the reaction equals heat gained by the water when the calorimeter is well insulated.
4. $Q = mc\Delta T$ where m is the mass, c is the specific heat capacity of the water along with its measured temperature change, ΔT , to calculate heat transfer. The negative sign shows the water's temperature dropped, meaning the water lost heat to the dissolving process, so the dissolving is endothermic.
5. **Molar enthalpy = $-45.6 \text{ kJ} \div 0.250 \text{ mol} = -182 \text{ kJ/mol}$** The negative sign indicates the reaction is exothermic, releasing 182 kJ of energy for every mole of reactant consumed.
6. **A polystyrene-cup calorimeter reduces heat exchange with the surroundings because polystyrene is a poor conductor of heat, unlike an open beaker, which allows significant heat loss to the air.** Minimizing heat loss keeps the assumption that heat released by the reaction equals heat absorbed by the water valid, improving the accuracy of the calculated enthalpy change.