AP CHEMISTRY • EXERCISE SHEET

6.4 Heat Capacity and Calorimetry

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

Objective

Build the skills to answer exam questions on **heat capacity and calorimetry**.

You must be able to:

- use $q = mc\Delta T$
- carry out a **calorimetry** 量热法 calculation
- find a specific heat or a heat of reaction from data

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

The heat equation

$$q = mc\Delta T,$$

where q is heat (J), m mass (g), c **specific heat** 比热容 (J $g^{-1}°C^{-1}$), and $\Delta T = T_{\text{final}} - T_{\text{initial}}$.

A worked heat

Heat 50 g of water ($c = 4.18$) from 20 to 30°C:

$$q = (50)(4.18)(10) = 2090 \text{ J}.$$

Calorimetry

In a calorimeter, the heat released by a reaction is absorbed by the water: $q_{\text{reaction}} = -q_{\text{water}} = -mc\Delta T$. Measure the water's temperature change to find the reaction's heat.

Heat of reaction per mole

Divide the total heat by the moles reacted to get ΔH **per mole**: $\Delta H = \dfrac{q}{n}$ (with the right sign —negative if the water warmed).

2 Practice

Now apply the methods above.

2.1 Write the equation $q = mc\Delta T$ and name each symbol. [2]

2.2 Find the heat to warm 100 g of water ($c = 4.18$) by 5.0°C. [2]

2.3 In a calorimeter the water warms. Was the reaction exo- or endothermic? [1]

3 Exam-style questions

3.1 In $q = mc\Delta T$, ΔT is [1]

- **A** $T_{\text{initial}} - T_{\text{final}}$
- **B** $T_{\text{final}} - T_{\text{initial}}$
- **C** the average temperature
- **D** always positive

3.2 A reaction in a calorimeter warms 200 g of water ($c = 4.18$) by 6.0°C.

(a) Find the heat absorbed by the water. [2]

(b) State q for the reaction (sign and value). [2]

3.3 Burning 0.50 g of a fuel raises 100 g of water ($c = 4.18$) by 10.0°C. Find the heat

released per gram of fuel. [4]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **6.4 Heat Capacity and Calorimetry** lesson on the **Learn** page;
- read the **Heat Capacity and Calorimetry** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 q heat, m mass, c specific heat, ΔT temperature change.

2.2 $q = (100)(4.18)(5.0) = 2090$ J.

2.3 Exothermic (it released heat to the water).

3.1 B —$T_{\text{final}} - T_{\text{initial}}$.

3.2 (a) $q = (200)(4.18)(6.0) = 5016$ J ≈ 5.0 kJ. (b) $q_{\text{reaction}} = -5.0$ kJ (exothermic).

3.3 $q_{\text{water}} = (100)(4.18)(10.0) = 4180$ J; heat released $= 4180$ J for 0.50 g; per gram $= 4180/0.50 = 8360$ J/g.