

9.5 Specific Heat and Thermal Conductivity

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS thermal conductivity 热导率 • specific heat 比热容 • temperature 温度 • heat 热量

Objective

Build the skills to answer exam questions on **specific heat and thermal conductivity**.

You must be able to:

- use $Q = mc\Delta T$ with **specific heat** 比热容 to find the heat needed for a temperature change
- explain how **thermal conductivity** 热导率 governs the rate of heat transfer
- compare how different materials store and conduct thermal energy

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Specific heat

$Q = mc\Delta T$, where c is in $\text{J kg}^{-1} \text{K}^{-1}$. Water's large $c \approx 4200$ means it takes a lot of heat to warm up.

■ Thermal conductivity

A **high** conductivity (metals) transfers heat quickly; a **low** conductivity (wood, air, foam) makes a good insulator.

■ Example

To warm 2.0 kg of water by 10 K: $Q = 2.0 \times 4200 \times 10 = 8.4 \times 10^4 \text{ J}$.

2 Practice

2.1 Find the heat needed to raise 0.50 kg of water by 20 K (take $c = 4200 \text{ J kg}^{-1} \text{ K}^{-1}$). [2]

2.2 State what a high thermal conductivity means for the rate of heat transfer. [1]

2.3 Two blocks receive the same heat. State which has the greater temperature rise — the one with the larger or smaller specific heat. [1]

3 Exam-style questions

3.1 The equation $Q = mc\Delta T$ gives the [1]

- **A** power
 - **B** heat transferred
 - **C** temperature
 - **D** conductivity
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3.2 A good thermal insulator has a [1]

- **A** high thermal conductivity
 - **B** low thermal conductivity
 - **C** high specific heat only
 - **D** zero mass
-

3.3 A 0.30 kg metal block ($c = 900 \text{ J kg}^{-1} \text{ K}^{-1}$) is heated from 20 °C to 70 °C.

(a) Find the heat needed. [3]

(b) State the heat needed if the mass were doubled.

[1]

Solutions

2.1 $Q = mc\Delta T = 0.50 \times 4200 \times 20 = 4.2 \times 10^4 \text{ J}.$

2.2 heat is transferred quickly (a fast rate).

2.3 the one with the smaller specific heat.

3.1 B.

3.2 B.

3.3 (a) $Q = 0.30 \times 900 \times 50 = 1.35 \times 10^4 \text{ J}.$ (b) $2.7 \times 10^4 \text{ J}$ (double).