AP PHYSICS 2 • EXERCISE SHEET

# 9.5 Specific Heat and Thermal Conductivity

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

## 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 J kg$^{-1}$ 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: $Q = 2.0 \times 4200 \times 10 = 8.4 \times 10^4$ J.

## 2 Practice

**2.1** Find the heat needed to raise 0.50 kg of water by 20 K (take $c = 4200$ J kg$^{-1}$ 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]

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## 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

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**3.3** A 0.30 kg metal block ($c = 900$ J kg$^{-1}$ 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]

## 4 Go further

- work through the **9.5 Specific Heat and Thermal Conductivity** lesson on the **Learn** page;
- read the **Thermodynamics** section of the AP Physics 2 handout on the **Know** page.

## Solutions

**2.1** $Q = mc\Delta T = 0.50 \times 4200 \times 20 = 4.2 \times 10^4$ 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) $Q = 0.30 \times 900 \times 50 = 1.35 \times 10^4$ J. (b) $2.7 \times 10^4$ J (double).