AP PHYSICS 2 • EXERCISE SHEET

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 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]

3 Exam-style questions

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

- **A** power
- **B** heat transferred
- **C** temperature
- **D** conductivity

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 ($c = 900$ 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]

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) 2.7×10^4 J (double).