

- 1 a Name a good conductor of heat (a thermal conductor).
b Name a good thermal insulator.
- 2 What is needed for heat to flow through a conductor?
- 4 'A thermal (heat) energy transfer by means of the motion of a fluid.' Is this a description of conduction or convection?
- 5 When a gas is heated, its particles gain energy. Imagine that you could see the particles of a hot gas and of a cold gas (at the same pressure).
a What difference would you see in their movement?
b What difference would you see in their separation?
- 6 What part does convection play in the spreading of energy around a room from an electric heater?
- 7 Write a brief explanation of convection, using the terms **expansion**, **density** and **gravity**.
- 8 Why would it not be a good idea to fit an electric heater near the ceiling in a room?

9

A student is using a thermometer to measure temperatures in a laboratory. The thermometer contains mercury. As the temperature increases, the length of the mercury column in the thermometer increases.

a Explain why the mercury column becomes longer. [1]

b The thermometer measures temperatures on the Celsius scale. Table 10.2 gives details of the two fixed points of the scale. Copy and complete the table. [2]

	Definition	Value
lower fixed point	melting point of pure ice
upper fixed point	100 °C

A student heats an insulated steel block using an electrical heater. The temperature of the block rises.

- a The heater supplies energy to the block. In what form does the block store this energy?
- b The student then heats a second block, made of copper. The heater supplies energy at the same rate as before. The temperature of this block rises faster than that of the steel block. Which block has the greater thermal capacity? Explain your answer.

11

A student is investigating two thermometers. She notices that their scales are marked differently.

- Liquid-in-glass thermometer: scale from -10°C to $+110^{\circ}\text{C}$.
 - Thermocouple thermometer: scale from -200°C to $+450^{\circ}\text{C}$.
- a Which thermometer has the greater range?

The student places both thermometers in pure, melting ice. Each shows that the temperature is 0°C .

b State another temperature at which you would expect the two thermometers to give the same reading. Explain your answer.

She then places the two thermometers in a beaker of warm water. The liquid-in-glass thermometer shows that the temperature is 45.5°C . The thermocouple thermometer reads 43°C .

- c Which thermometer is more sensitive? Explain how you know.
- d Suggest why the two thermometers do not indicate the same temperature when they are placed in the beaker of water.

12

Willem has to measure the specific heat capacity of copper. He has a copper block, which he heats with an electrical heater. The heater supplies energy to the block at a rate of 50 J each second.

Willem records the temperature of the block. Then he switches on the heater for exactly 10 minutes.

- a What two other measurements will he require in order to calculate the specific heat capacity of steel?
- b Explain why the block must be well insulated if he is to obtain an accurate result.
- c If the block is poorly insulated, will Willem's result be too high or too low?

13

In cold climates, it is important to keep a house well insulated. Listed below are three ways of insulating a house. For each, explain how it reduces heat loss. In your answers, refer to conduction, convection or radiation, as appropriate.

- a Heavy curtains, when closed, trap air next to a window.
- b Shiny metal foil is fitted in the loft, covering the inside of the roof.
- c Glass wool is used to fill the gap in the cavity walls.

14

- a One end of a plastic rod is immersed in boiling water. The temperature of the other end gradually increases. Use ideas from the kinetic model of matter to explain how energy travels from one end of the rod to the other.
- b If the experiment was repeated using a metal rod of the same dimensions as the plastic rod, what difference would you expect to notice?

- c What particles in a metal are involved in transferring energy from hotter regions to colder ones?

15

A beaker contains 1 kg of water at 20°C. A student heats a 1 kg block of aluminium to 100°C and then drops it into the water. After a short while, the water and the block have both reached a temperature of 38°C. The student said that this showed that water has a greater specific heat capacity than aluminium. Was he correct? Explain your answer.

16

Suppose that you have a matt black surface and a shiny black surface.

- a Which is a better absorber of infrared radiation?
- b Which is a better emitter of infrared radiation?
- c Which is a better reflector of infrared radiation?

17

List as many features as you can that contribute to the insulation of a house in a cold climate. For each, state whether it reduces heat loss by conduction, by convection or by radiation.

18

Why is it important to wear a hat on a very cold day?