

# Thermal Properties and Temperature

## Question Paper 3

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 3

**Time Allowed:** 58 minutes

**Score:** /48

**Percentage:** /100



- (b) Use your symbols from (a) to complete the formula used to determine the specific heat capacity  $c$ .

specific heat capacity  $c =$

.....[2]

- (c) Another student performs the experiment without using insulation. He obtains a higher value for  $c$ .

Explain why this student's measurements lead to this higher value.

.....

..... [1]

[Total: 7]

2 A technician is designing a liquid-in-glass thermometer. The following is a list of properties of the thermometer that she is considering.

sensitivity                      range                      speed of response                      linearity

(a) (i) 1. Which one of these properties is affected by the length of the stem of the thermometer?

.....

2. Explain your answer.

.....

.....

[2]

(ii) 1. Which property is affected by the diameter of the capillary?

.....

2. Explain your answer.

.....

.....

[2]

(b) The thermometer is to be used to measure temperatures between  $-10^{\circ}\text{C}$  and  $50^{\circ}\text{C}$ . The technician considers using water or red-coloured alcohol as the liquid in the thermometer.

(i) Write down which liquid would be suitable.

.....

(ii) Give **two** reasons for your answer.

1. ....

.....

2. ....

.....

[2]

[Total: 6]

- 3 A student uses a 2400W electric kettle to obtain a value for the specific heat capacity of sunflower oil.

Fig. 6.1 shows the apparatus.

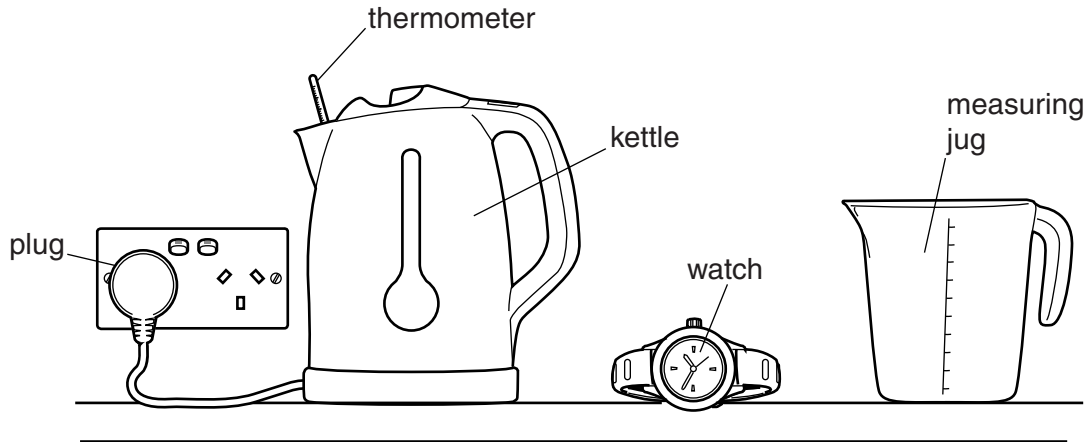


Fig. 6.1

The student uses a measuring jug and pours 1.5 kg of sunflower oil into the empty kettle. He uses a thermometer to measure the temperature of the oil.

The kettle is switched on and left on for 50s. The temperature of the oil increases by 32 °C.

The student assumes that all the electrical energy is transferred as thermal energy to the oil.

- (a) Calculate the value for the specific heat capacity of sunflower oil obtained by the student.

specific heat capacity = ..... [4]

- (b) State and explain whether the value for the specific heat capacity obtained by the student is too large or too small.

.....  
..... [1]

4 (a) Suggest

- (i) an example of a change of state resulting from the removal of thermal energy from a quantity of material,

..... [1]

- (ii) the effect of this change of state on the temperature of the material.

..... [1]

- (b) Define the *thermal capacity* of a body.

.....  
.....  
..... [2]

- (c) A polystyrene cup holds 250 g of water at 20 °C. In order to cool the water to make a cold drink, small pieces of ice at 0 °C are added until the water reaches 0 °C and no unmelted ice is present.

[specific heat capacity of water = 4.2 J/(g °C), specific latent heat of fusion of ice = 330 J/g]

Assume no thermal energy is lost or gained by the cup.

- (i) Calculate the thermal energy lost by the water in cooling to 0 °C.

thermal energy lost = ..... [2]

**(ii)** State the thermal energy gained by the ice in melting.

thermal energy gained = ..... [1]

**(iii)** Calculate the mass of ice added.

mass of ice = ..... [2]

[Total: 9]

- 5 Fig. 6.1 shows a glass flask full of water at 10°C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

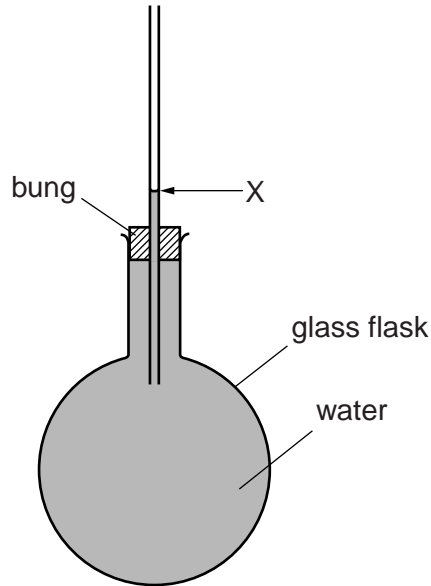


Fig. 6.1

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

(a) Suggest why

(i) the water level initially falls,

.....  
..... [2]

(ii) the water level then rises,

.....  
..... [2]

(iii) the rise is greater than the fall.

.....  
..... [1]



- (b) Suggest a change to the apparatus that would make the fall and rise of the water level greater.

.....

..... [1]

[Total: 6]

6 (a) Define *specific latent heat of fusion*.

.....  
.....  
..... [1]

(b) (i) A tray of area  $0.25\text{m}^2$ , filled with ice to a depth of 12mm, is removed from a refrigerator.

Calculate the mass of ice on the tray. The density of ice is  $920\text{kg/m}^3$ .

mass = ..... [2]

(ii) Thermal energy from the Sun is falling on the ice at a rate of  $250\text{W/m}^2$ . The ice absorbs 60% of this energy.

Calculate the energy absorbed in 1.0s by the  $0.25\text{m}^2$  area of ice on the tray.

energy = ..... [2]

(iii) The ice is at its melting temperature.

Calculate the time taken for all the ice to melt. The specific latent heat of fusion of ice is  $3.3 \times 10^5\text{J/kg}$ .

time = ..... [3]

[Total: 8]

7 (a) Explain why a liquid cools when evaporation takes place from its surface.

.....  
 .....  
 ..... [2]

(b) Fig. 7.1 shows five vessels each made of the same metal and containing water.

Vessels A, B, C and D are identical in size and shape. Vessel E is shallower and wider. The temperature of the air surrounding each vessel is 20 °C.

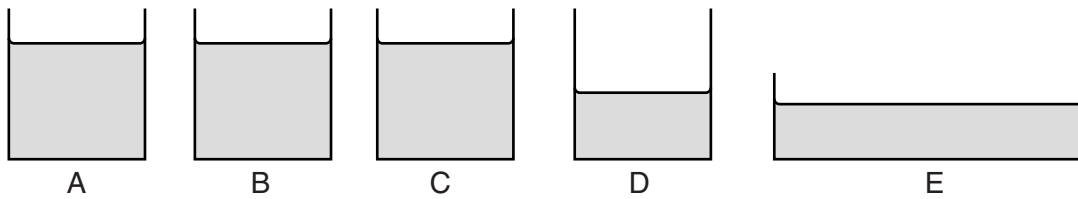


Fig. 7.1

The table shows details about each vessel and their contents.

vessel	outer surface	volume of water/cm <sup>3</sup>	initial temperature of water/°C
A	dull		80
B	shiny	200	80
C	dull		95
D	dull		80
E	dull		80

The following questions are about the time taken for the temperature of the water in the vessels to fall by 10 °C from the initial temperature.

(i) Explain why the water in B takes longer to cool than the water in A.

.....  
 ..... [1]

(ii) Explain why the water in C cools more quickly than the water in A.

.....  
..... [1]

(iii) Explain why the water in D cools more quickly than the water in A.

.....  
..... [1]

(iv) Suggest **two** reasons why the water in E cools more quickly than the water in A.

1. ....  
.....  
2. ....  
..... [2]

[Total: 7]