Thermal Properties and Temperature

Question Paper 9

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 9

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

1 A solar panel is mounted on the roof of a house. Fig. 4.1 shows a section through part of the solar panel.

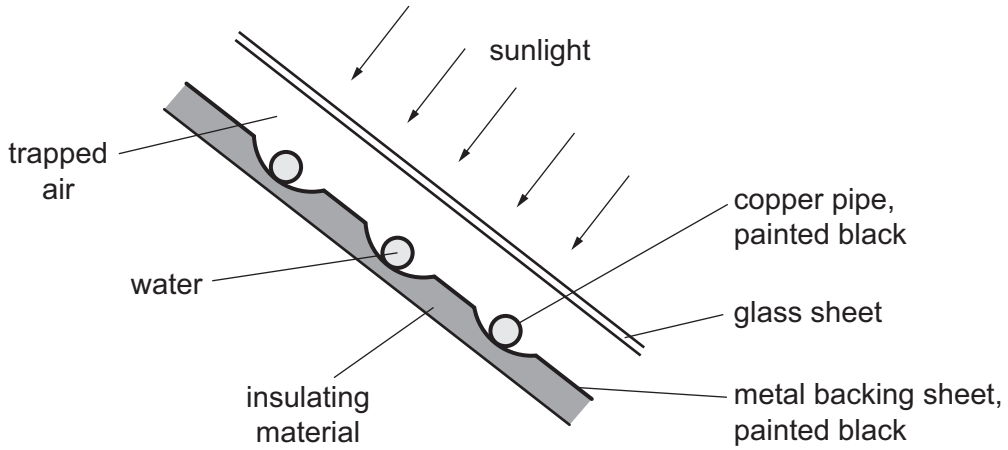

Fig. 4.1

A pump makes water flow through the copper pipes. The water is heated by passing through the solar panel.

(a) Select and explain **three** features of the solar panel that maximise the final temperature of the water.

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..... [4]

(b) During one day, 250 kg of water is pumped through the solar panel. The temperature of this water rises from 16 °C to 38 °C.

The water absorbs 25 % of the energy incident on the solar panel. The specific heat capacity of water is 4200 J / (kg °C).

Calculate the energy incident on the solar panel during that day.

energy = ... [4]

(c) The solar panel in Fig. 4.1 is designed to heat water.

A person is deciding whether to install solar panels on her house.

List and explain **three** pieces of information she needs to consider in order to make her decision.

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..... [4]

(d) The Sun releases energy as a result of nuclear fusion.

State the meaning of *nuclear fusion*.

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..... [2]

[Total: 14]

2 **(a)** **(i)** State two ways in which the molecular structure of a liquid is different from the molecular structure of a solid.

1. .....

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2. .....

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[2]

(ii) Explain, in terms of energy, the process which takes place as a solid at its melting point changes into a liquid at the same temperature.

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..... [1]

(b) During a severe snowstorm, a layer of snow (ice crystals) forms on the body of an animal in a field. The snow and the surrounding air are at 0 °C. The snow begins to melt.

(i) The mass of snow that falls on the animal is 1.65 kg. The specific latent heat of fusion of snow is 330 000 J / kg.

Calculate the thermal energy needed to melt this snow.

thermal energy = ... [2]

(ii) The animal derives energy from its food to maintain its body temperature.

State the energy change that takes place.

..... [1]

[Total: 6]

3 **(a)** State the type of electromagnetic radiation

(i) used in luggage security checks at airports,

.....

(ii) used by remote controls for TV sets.

.....
[2]

(b) **(i)** The electromagnetic waves used in a microwave oven have a frequency of 2.45×10^9 Hz. The speed of the waves is 3.00×10^8 m/s.

Calculate the wavelength of the waves.

wavelength = ... [2]

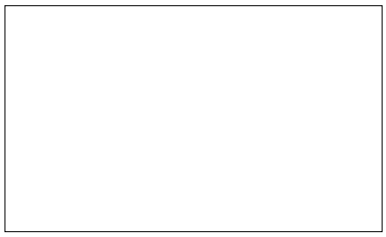
(ii) A 150 g block of ice at 0 °C is placed in the oven. The input power of the oven is 1100 W. The energy absorbed by the block is 65% of the input energy.

Calculate the time taken to melt the ice to water at 0 °C. The specific latent heat of fusion of ice is 330 J/g.

time = ... [4]

[Total: 8]

4 **(a)** In the box below, sketch a diagram to represent the molecular structure of a liquid. Show the molecules as small circles of equal size.



[2]

(b) A teacher in a school laboratory pours liquid ethanol from a bottle into a glass dish. The glass dish rests on an electronic balance. Although the temperature of the laboratory is below the boiling point of ethanol, the mass of ethanol in the dish quickly decreases as ethanol evaporates.

(i) State the effect of this evaporation on the temperature of the remaining ethanol.

..... [1]

(ii) Explain, in terms of the ethanol molecules, why this is happening.

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..... [1]

(iii) The specific latent heat of vaporisation of ethanol is 850 J/g.

Calculate the thermal energy required to evaporate 3.4 g of ethanol.

thermal energy = ... [2]

(iv) Suggest **two** ways in which the rate of evaporation of ethanol from the dish can be reduced.

1. .....

2. .....

[2]

[Total: 8]

5 Fig. 3.1 shows a long, plastic tube, sealed at both ends. The tube contains 0.15 kg of small metal spheres.

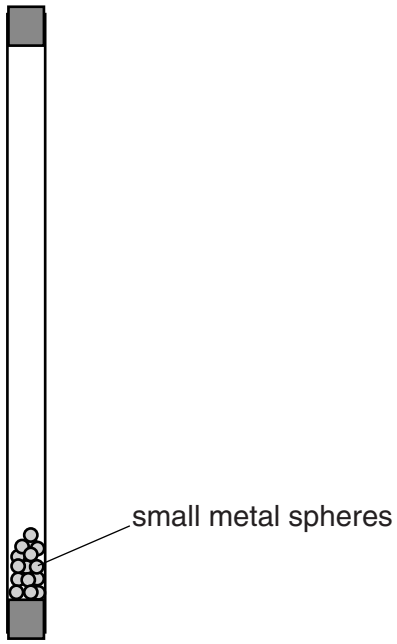

Fig. 3.1

A physics teacher turns the tube upside down very quickly and the small metal spheres then fall through 1.8 m and hit the bottom of the tube.

(a) Calculate

(i) the decrease in gravitational potential energy as the spheres fall 1.8 m,

decrease in gravitational potential energy = ... [2]

(ii) the speed of the spheres as they hit the bottom of the tube.

speed = ... [3]

(b) The gravitational potential energy of the spheres is eventually transformed to thermal energy in the metal spheres. The physics teacher explains that this procedure can be used to determine the specific heat capacity of the metal.

(i) State one other measurement that must be made in order for the specific heat capacity of the metal to be determined.

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.....[1]

(ii) Suggest a source of inaccuracy in determining the specific heat capacity using this experiment.

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.....[1]

(iii) The teacher turns the tube upside down and lets the spheres fall to the bottom 100 times within a short period of time.

Explain why turning the tube upside down 100 times, instead of just once, produces a more accurate value of the specific heat capacity.

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.....[2]

[Total: 9]

6 **(a)** On a hot day, sweat forms on the surface of a person's body and the sweat evaporates.

Explain, in terms of the behaviour of molecules,

(i) the process of evaporation,

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(ii) how this process helps the body to cool down.

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[3]

(b) The temperature of a person of mass 60 kg falls from 37.2 °C to 36.7 °C.

(i) Calculate the thermal energy lost from the body. The average specific heat capacity of the body is 4000 J/(kg °C).

thermal energy lost = ... [2]

(ii) The cooling of the body was entirely due to the evaporation of sweat.

Calculate the mass of sweat which evaporated. The specific latent heat of vaporisation of sweat is $2.4 \times 10^6 \, \text{J/kg}$.

mass = ...[2]

[Total: 7]