

Calorimetry

Question paper

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|-------------------|----------------------------------|
| Level | International A Level |
| Subject | Physics |
| Exam Board | Edexcel |
| Topic | Physics from Creation to Collaps |
| Sub Topic | Calorimetry |
| Booklet | Question paper |

Time Allowed: 26 minutes

Score: /21

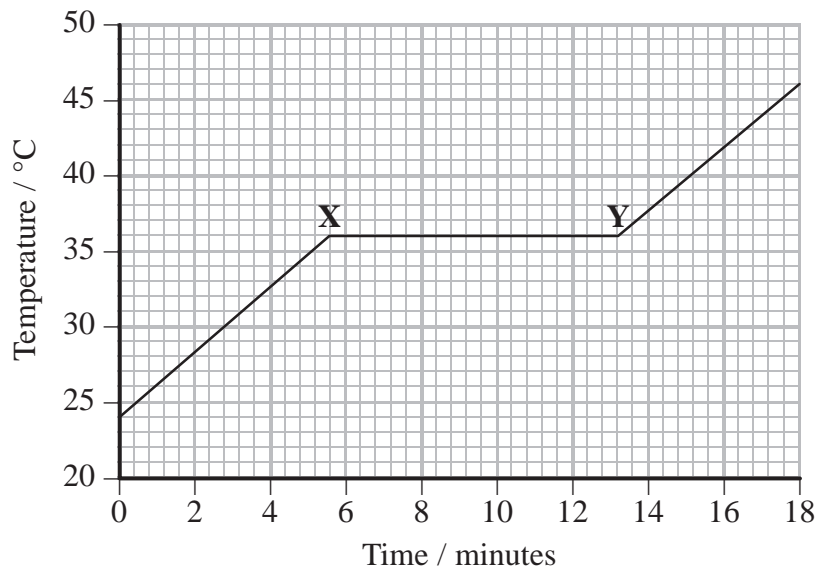
Percentage: /100

Grade Boundaries:

| A* | A | B | C | D | E | U |
|------|--------|-----|-------|-------|-----|------|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

- 1 A piece of chocolate is heated at a constant rate.

The graph shows how the temperature of the chocolate varies with time.



Select the correct statement for the time between X and Y.

- A The internal energy of the chocolate increases.
- B The internal energy of the chocolate stays constant.
- C The kinetic energy of the molecules in the chocolate increases.
- D The potential energy between the molecules in the chocolate stays constant.

(Total for Question 1 = 1 mark)

- 2 A student carries out an experiment to measure the specific heat capacity of a block of aluminium by heating the block with an electric heater. The value obtained by the student is less than the textbook value.

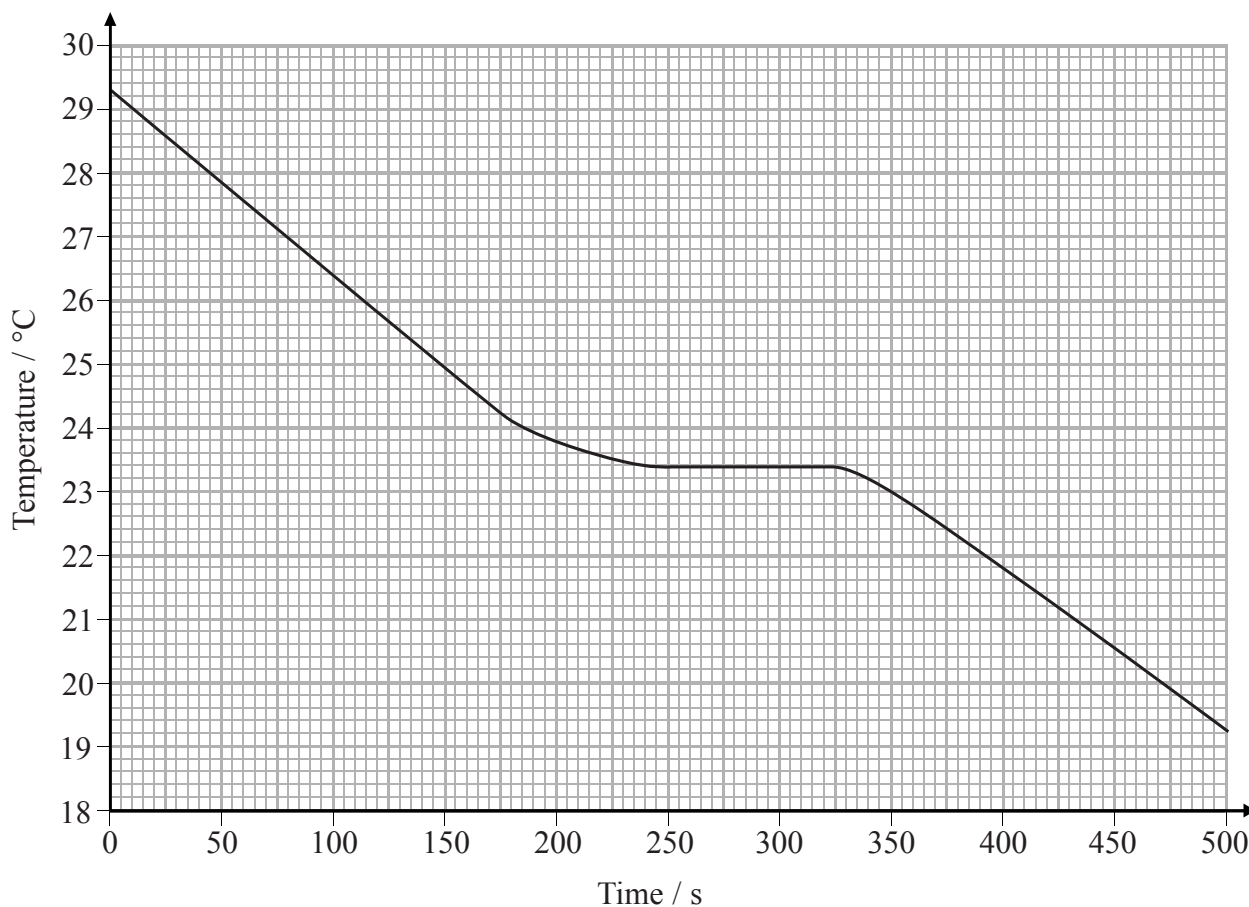
The most likely reason for this is that

- A the heater was inefficient.
- B the mass of the block was overestimated.
- C the thermometer scale didn't start from zero.
- D thermal energy was transferred to the surroundings.

(Total for Question 2 = 1 mark)

- 3 A student investigated the properties of chocolate. He heated 0.75 kg of chocolate until it was a few degrees above its melting point. He then used a temperature sensor connected to a datalogger to monitor the temperature of the chocolate as it cooled in cold surroundings.

The rate at which thermal energy was transferred from the chocolate to the surroundings was approximately constant over the temperature range shown in the graph below.



- (a) Use the graph to show that the rate at which thermal energy was transferred from the liquid chocolate was about 50 W.

specific heat capacity of liquid chocolate = $2500 \text{ J kg}^{-1} \text{ K}^{-1}$

(3)

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(b) Explain the shape of the graph between 250s and 330s.

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(c) During the last 100s of cooling the temperature fell at a lower rate than during the first 100s of cooling.

Suggest why this is the case.

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(Total for Question 3 = 7 marks)

- 4 The maximum recommended temperature at which meat should be maintained when it is being transported is 4°C .

275 kg of meat is being transported to a supermarket. The meat is cooled from 18.5°C to 1.5°C before it is loaded onto the van ready for transportation.

Specific heat capacity of the meat = $3.59 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$

- (a) Calculate the amount of thermal energy that has been removed from the meat.

(2)

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Thermal energy removed =

- (b) When the meat is unpacked at the supermarket it is initially left in a warm environment. The meat warms up uniformly from 1.5°C as energy is transferred to the meat from the surroundings at a rate of 720 W.

Show that there may be a risk in eating the meat if it is left out for longer than an hour.

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(Total for Question 4 = 5 marks)

- 5 The physicist James Joule married in 1847 and visited the Cascade de Sallanches whilst on his honeymoon. This is one of the tallest vertical waterfalls in France, with the largest drop falling for just over 270 m.



It is claimed that, whilst at the waterfall, Joule performed an experiment to measure the temperature of the water at the top and bottom.

- (a) (i) Consider 1.0 kg of water falling through a distance of 270 m.

Show that the temperature rise due to the gravitational potential energy change is about 0.6 K.

specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$

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- (ii) State an assumption that you made.

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(b) A physics student plans to repeat Joule’s experiment.

She intends to use a thermometer with a precision of 0.25 K.

Discuss the extent to which she will be able to draw a valid conclusion from her measurements with this thermometer.

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(Total for Question 5 = 7 marks)
