AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.1.3

Energy changes in systems

Past-paper questions

Tier	**Foundation**
Question groups	**17**
Available paper years	**2012–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.1.3 Energy changes in systems

Question 01

June 2012 | PH1FP | Original Q7 | Legacy

7 A wood burning stove is used to heat a room.



The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

7 (a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

.....

.....

.....

.....

(2 marks)

4.1.1.3 Energy changes in systems

Question 01 · continued

7 (b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(2 marks)

7 (c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

(1 mark)

7 (d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

(2 marks)

Question 7 continues on the next page

4.1.1.3 Energy changes in systems

Question 01 · continued

7 (e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Energy required = ...

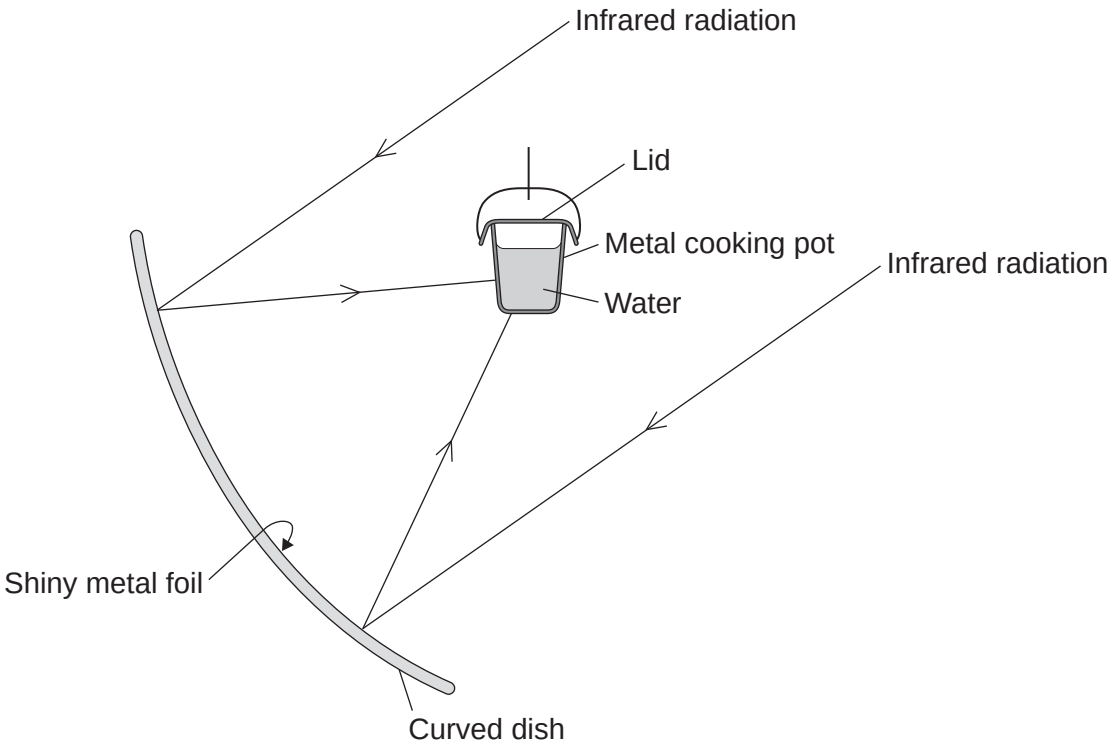
(3 marks)

10

4.1.1.3 Energy changes in systems

Question 02

5 The diagram shows the design of a solar cooker. The cooker heats water using infrared radiation from the Sun.



5 (a) Why is the inside of the large curved dish covered with shiny metal foil?

.....

.....

(1 mark)

5 (b) Which would be the best colour to paint the outside of the metal cooking pot?

Draw a ring around the correct answer.

black **silver** **white**

Give a reason for your answer.

.....

.....

.....

(2 marks)

4.1.1.3 Energy changes in systems

Question 02 · continued

5 (c) Why does the cooking pot have a lid?

.....

.....

(1 mark)

5 (d) Calculate how much energy is needed to increase the temperature of 2 kg of water by 80 °C.

The specific heat capacity of water = 4200 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy = ... J

(2 marks)

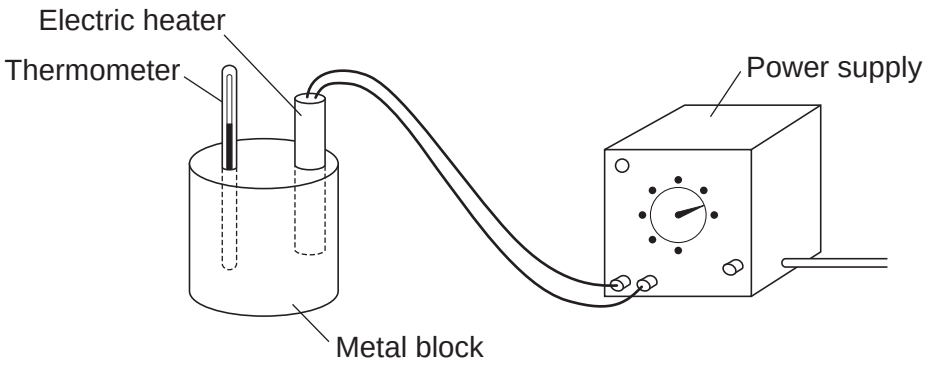
6

4.1.1.3 Energy changes in systems

Question 03

June 2013 | PH1FP | Original Q6 | Legacy

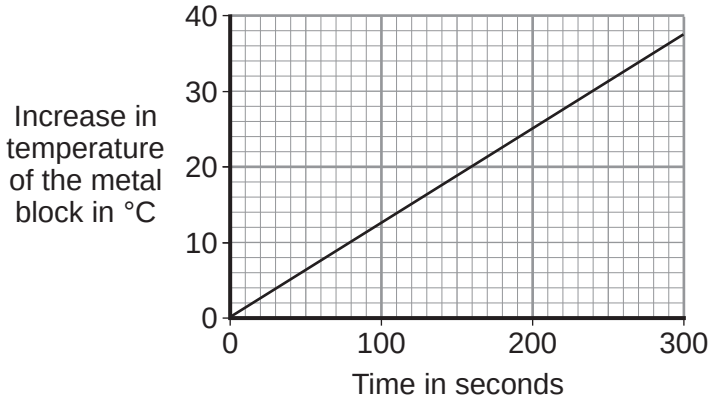
6 (a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.



6 (a) (i) Before starting the experiment, the student drew **Graph A**.

Graph A shows how the student expected the temperature of the metal block to change after the heater was switched on.

Graph A



Describe the pattern shown in **Graph A**.

.....

.....

.....

.....

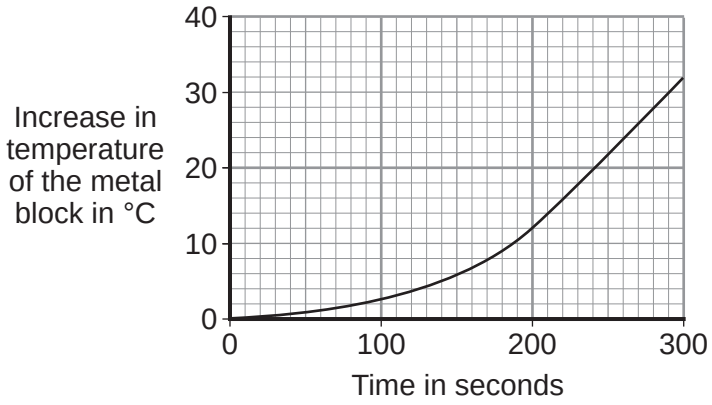
(2 marks)

Question 03 · continued

6 (a) (ii) The student measured the room temperature. He then switched the heater on and measured the temperature of the metal block every 50 seconds.

The student calculated the increase in temperature of the metal block and plotted **Graph B**.

Graph B



After 300 seconds, **Graph B** shows the increase in temperature of the metal block is lower than the increase in temperature expected from **Graph A**.

Suggest **one** reason why.

.....

.....

(1 mark)

6 (a) (iii) The power of the electric heater is 50 watts.

Calculate the energy transferred to the heater from the electricity supply in 300 seconds.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy transferred = ... J

(2 marks)

Question 6 continues on the next page

6 (b) The student uses the same heater to heat blocks of different metals. Each time the heater is switched on for 300 seconds.

Each block of metal has the same mass but a different specific heat capacity.

Metal	Specific heat capacity in J/kg°C
Aluminium	900
Iron	450
Lead	130

Which **one** of the metals will heat up the most?

Draw a ring around the correct answer.

aluminium **iron** **lead**

Give, in terms of the amount of energy needed to heat the metal blocks, a reason for your answer.

.....

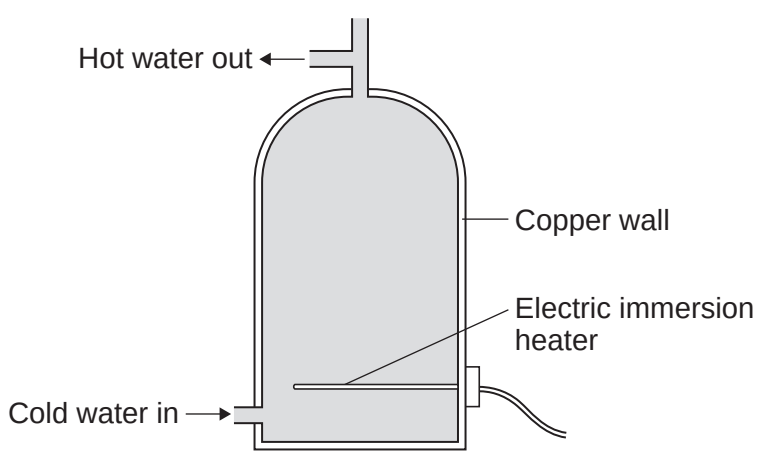
.....

.....

.....

(2 marks)

6 (c) A homeowner uses an electric immersion heater to heat the water in his hot water tank. The hot water tank has no insulation.



4.1.1.3 Energy changes in systems

Question 03 · continued June 2013 | PH1FP | Original Q6 | Legacy

6 (c) (i) Draw a ring around the correct answer to complete each sentence.

Energy is transferred through the water by

conduction.
convection.
evaporation.

Energy is transferred through the copper wall of the hot water tank by

conduction.
convection.
evaporation.

(2 marks)

6 (c) (ii) To keep the water in the tank hot for longer, the homeowner fits an insulating jacket around the tank. The insulating jacket costs £12 to buy.

The homeowner expects to save £16 each year from reduced energy bills.

Calculate the pay-back time for the insulating jacket.

.....

.....

Pay-back time = ... years
(2 marks)

11

4.1.1.3 Energy changes in systems

Question 04

June 2014 | PH1FP | Original Q5 | Legacy

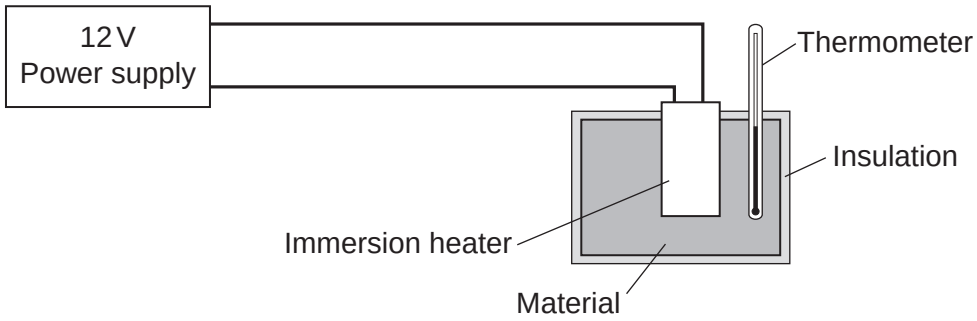
5 A student used the apparatus in **Figure 5** to compare the energy needed to heat blocks of different materials.

Each block had the same mass.

Each block had holes for the thermometer and the immersion heater.

Each block had a starting temperature of 20 °C.

Figure 5



The student measured the time taken to increase the temperature of each material by 5 °C.

5 (a) (i) State **two** variables the student controlled.

[2 marks]

1 .....

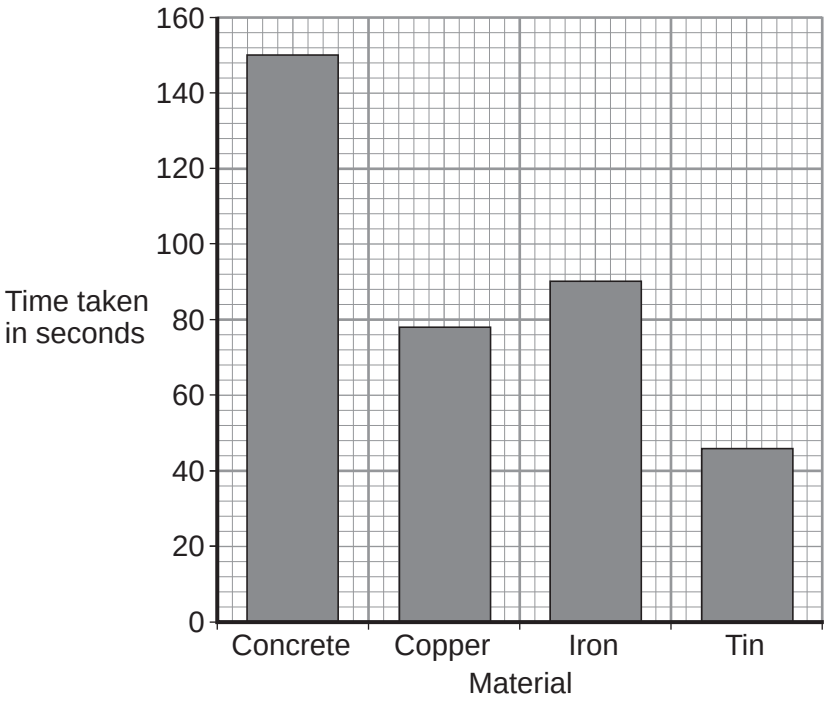
2 .....

4.1.1.3 Energy changes in systems

Question 04 · continued

Figure 6 shows the student's results.

Figure 6



5 (a) (ii) Why was a bar chart drawn rather than a line graph?

[1 mark]

.....

.....

5 (a) (iii) Which material was supplied with the most energy?

.....

Give the reason for your answer.

[2 marks]

.....

.....

Question 5 continues on the next page

4.1.1.3 Energy changes in systems

Question 04 · continued

5 (a) (iv) The iron block had a mass of 2 kg.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 5 °C.

Use the correct equation from the Physics Equations Sheet.

The specific heat capacity of iron is 450 J/kg °C.

[2 marks]

.....

.....

.....

Energy transferred = ... J

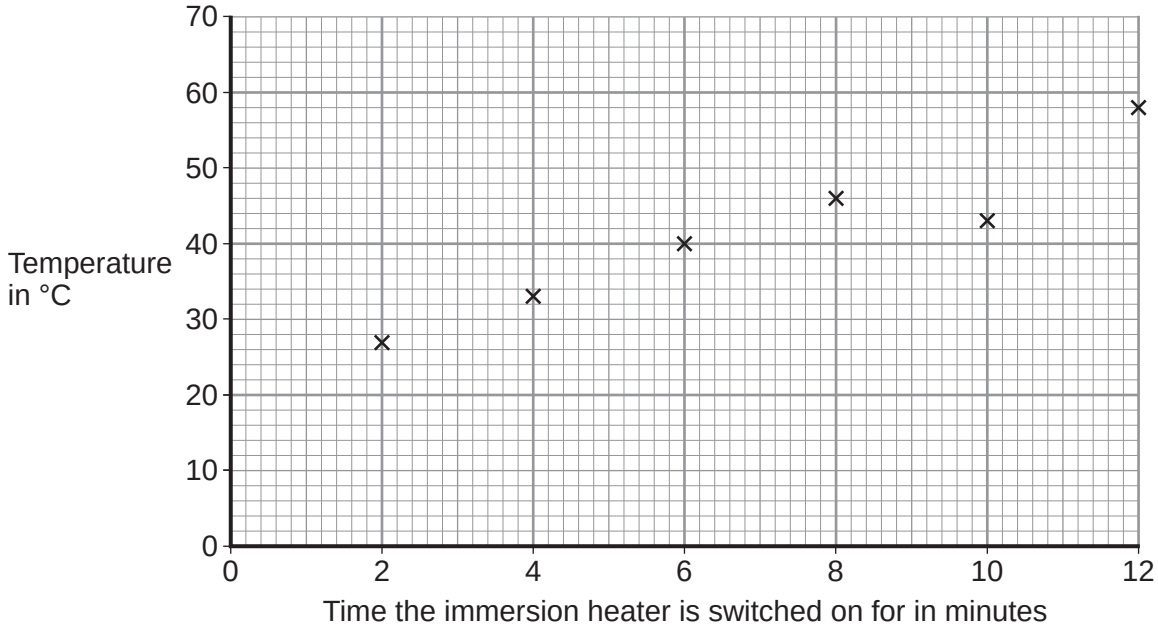
Question 04 · continued

5 (b) The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 7.**

Figure 7



5 (b) (i) One of the student's results is anomalous.

Draw a ring around the anomalous result.

[1 mark]

5 (b) (ii) Draw the line of best fit for the points plotted in **Figure 7**.

[1 mark]

5 (b) (iii) What was the temperature of the room?

[1 mark]

Temperature = ... °C

5 (b) (iv) What was the interval of the time values used by the student?

[1 mark]

Interval = ... minutes

11

4.1.1.3 Energy changes in systems

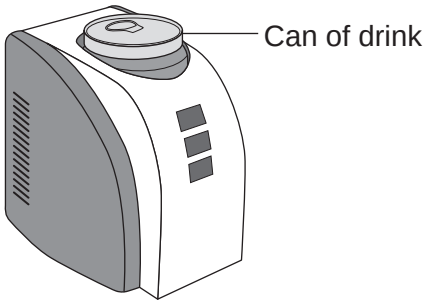
Question 05

June 2015 | PH1FP | Original Q4 | Legacy

4 A 'can-chiller' is used to make a can of drink colder.

Figure 6 shows a can-chiller.

Figure 6



4 (a) The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J/kg °C.

Calculate the energy transferred from the liquid as it cools.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy = ... J

4 (b) Complete the following sentence.

[1 mark]

The specific heat capacity of a substance is the amount of energy required to change the ..... of one kilogram of the substance by one degree Celsius.

4.1.1.3 Energy changes in systems

Question 05 · continued

4 (c) To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

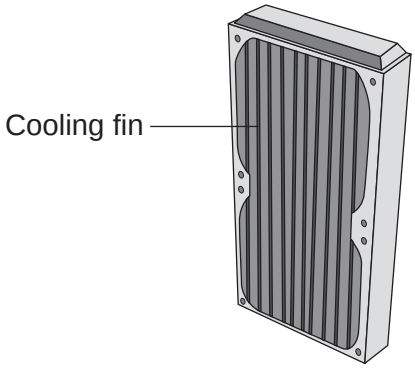
State the name of a measuring instrument used to measure mass.

[1 mark]

.....

4 (d) The back of the can-chiller has cooling fins, as shown in **Figure 7**.

Figure 7



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

[2 marks]

The cooling fins are a ..... colour because that makes them good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller to gain energy quickly and rise, transferring energy by ..... .

Question 4 continues on the next page

4.1.1.3 Energy changes in systems

Question 05 · continued

4 (e) (i) The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

[1 mark]

Energy can be transferred usefully, stored or dissipated, but cannot be

..... or destroyed.

4 (e) (ii) The temperature of the can of drink decreases while it is in the can-chiller.

What happens to the temperature of the air around the cooling fins?

[1 mark]

.....

8

4.1.1.3 Energy changes in systems

Question 06

2 The electric kettle shown in **Figure 2** is used to boil water.

Figure 2



2 (a) After the water has boiled, the temperature of the water decreases by 22 °C.
The mass of water in the kettle is 0.50 kg.
The specific heat capacity of water is 4200 J/kg °C.

Calculate the energy transferred to the surroundings from the water.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Energy = _____ joules

2 (b) Why is the total energy input to the kettle higher than the energy used to heat the water?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
Energy is absorbed from the surroundings.	
Energy is used to heat the kettle.	
The kettle is more than 100% efficient.	

4.1.1.3 Energy changes in systems

Question 06 · continued

2 (c) In one day, 0.6 kWh of energy is transferred from the mains electricity supply to the kettle.

The energy costs 15 pence per kWh.

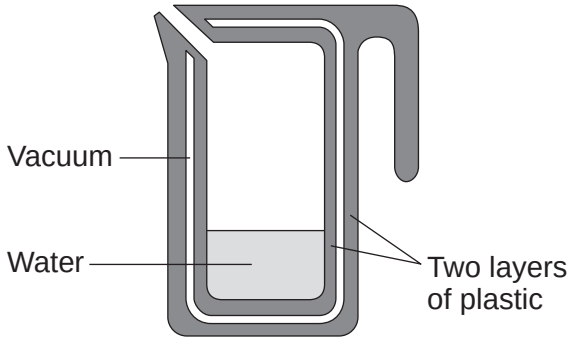
Calculate the cost of using the kettle for one day.

[2 marks]

Cost = _____ pence

2 (d) A new type of electric kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours. The new kettle is shown in **Figure 3**.

Figure 3



2 (d) (i) Which energy transfers does a vacuum reduce?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
conduction and radiation	
conduction and convection	
convection and radiation	

2 (d) (ii) Using the new kettle may reduce the householder's energy bill. Suggest **one** reason why.

[1 mark]

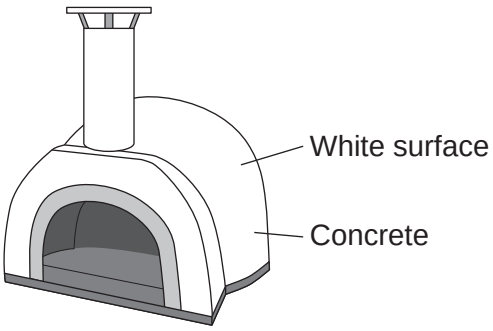
7

4.1.1.3 Energy changes in systems

Question 07

1 **Figure 1** shows an outdoor pizza oven.

Figure 1



1 (a) The pizza oven is designed to stay hot for a long time.

Use the correct answer from the box to complete each sentence. Each answer may be used once, more than once or not at all.

[2 marks]

conduction	**convection**	**radiation**

The white surface reduces energy transfer by _____ .

The concrete has a low U-value which means energy is transferred

slowly by _____ .

1 (b) The pizza oven is heated by burning wood.

What type of fuel is wood?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
biofuel	
fossil fuel	
non-renewable fuel	

4.1.1.3 Energy changes in systems

Question 07 · continued

1 (c) The concrete used to make the pizza oven has a specific heat capacity of 880 J/kg °C
The mass of the concrete is 250 kg

Calculate the energy transferred to the concrete to increase its temperature by 380 °C

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Energy transferred = _____ J

5

Turn over for the next question

4.1.1.3 Energy changes in systems

Question 08

June 2018 | 8463/1F | Original Q1

0 1 **Figure 1** shows a cyclist riding along a flat road.

Figure 1



0 1 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

_____

_____

_____

_____

Kinetic energy = _____ J

4.1.1.3 Energy changes in systems

Question 08 · continued

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

[1 mark]

- Decreased ☐
- Increased ☐
- Not affected ☐

7

4.1.1.3 Energy changes in systems

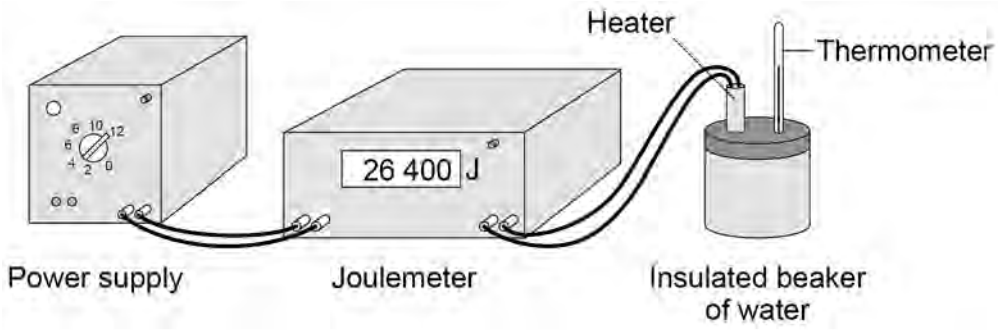
Question 09

June 2019 | 8463/1F | Original Q8

0 8 A student carried out an experiment to determine the specific heat capacity of water.

Figure 12 shows the equipment the student used to heat the water.

Figure 12



0 8 . 1 Why did the student insulate the beaker of water?

[1 mark]

Tick (✓) **one** box.

To increase energy transfer to the surroundings. ☐

To reduce energy transfer to the surroundings. ☐

To stop energy transfer to the surroundings. ☐

0 8 . 2 One hazard in this experiment is the hot water.

Give **one** risk to the student caused by this hazard.

[1 mark]

_____

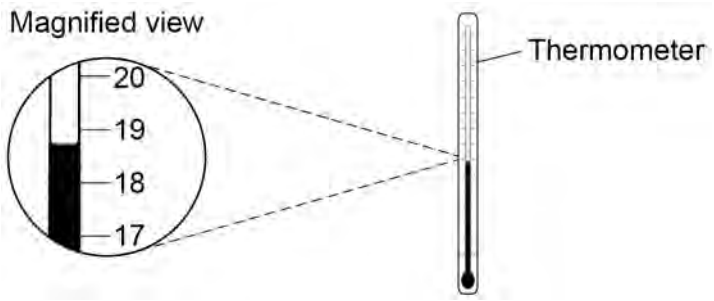
_____

4.1.1.3 Energy changes in systems

Question 09 · continued

0 8 . 3 **Figure 13** shows the thermometer that the student used.

Figure 13



What is the resolution of the thermometer?

[1 mark]

Tick (✓) **one** box.

1 °C ☐

3 °C ☐

19 °C ☐

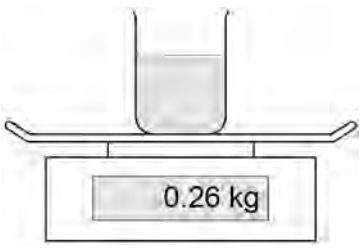
Question 8 continues on the next page

4.1.1.3 Energy changes in systems

Question 09 · continued

0 8 . 4 **Figure 14** shows the beaker of water on a balance.

Figure 14



The mass of the water was 0.20 kg

What was the mass of the beaker?

[1 mark]

Tick (✓) **one** box.

0.06 kg ☐

0.20 kg ☐

0.26 kg ☐

0.46 kg ☐

4.1.1.3 Energy changes in systems

Question 09 · continued

0 8 . 5 The energy transferred to the water was 26 400 J

The mass of water was 0.20 kg

The temperature increase of the water was 30 °C

Calculate the specific heat capacity of water using the data from this experiment.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J/kg	J/kg°C	J/°C

Specific heat capacity = _____ Unit _____

8

4.1.1.3 Energy changes in systems

Question 10

November 2020 | 8463/1F | Original Q7

0 7 A student heated water in an electric kettle.

0 7 . 1 Water has a high specific heat capacity.

Complete the sentence.

Choose answers from the box.

[2 marks]

°C	**J**	**kg**	**s**	**W**

The specific heat capacity of a substance is the energy needed to raise the

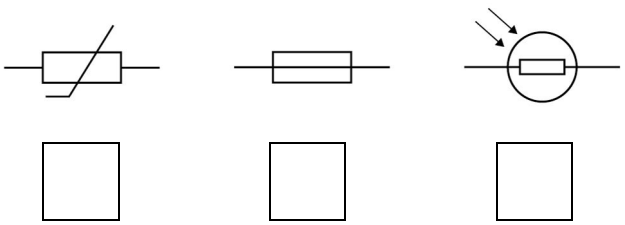
temperature of 1 _____ of the substance by 1 _____.

0 7 . 2 The kettle circuit contains a thermistor which is used to switch the kettle off when the water reaches 100 °C.

What is the correct symbol for a thermistor?

[1 mark]

Tick (✓) **one** box.



4.1.1.3 Energy changes in systems

Question 10 · continued

0 7 . 3 The resistance of the heating element in the kettle is 15 Ω.

The current in the heating element is 12 A.

Calculate the power of the heating element.

Use the equation:

$$\text{power} = (\text{current})^2 \times \text{resistance}$$

[2 marks]

Power = _____ W

Question 7 continues on the next page

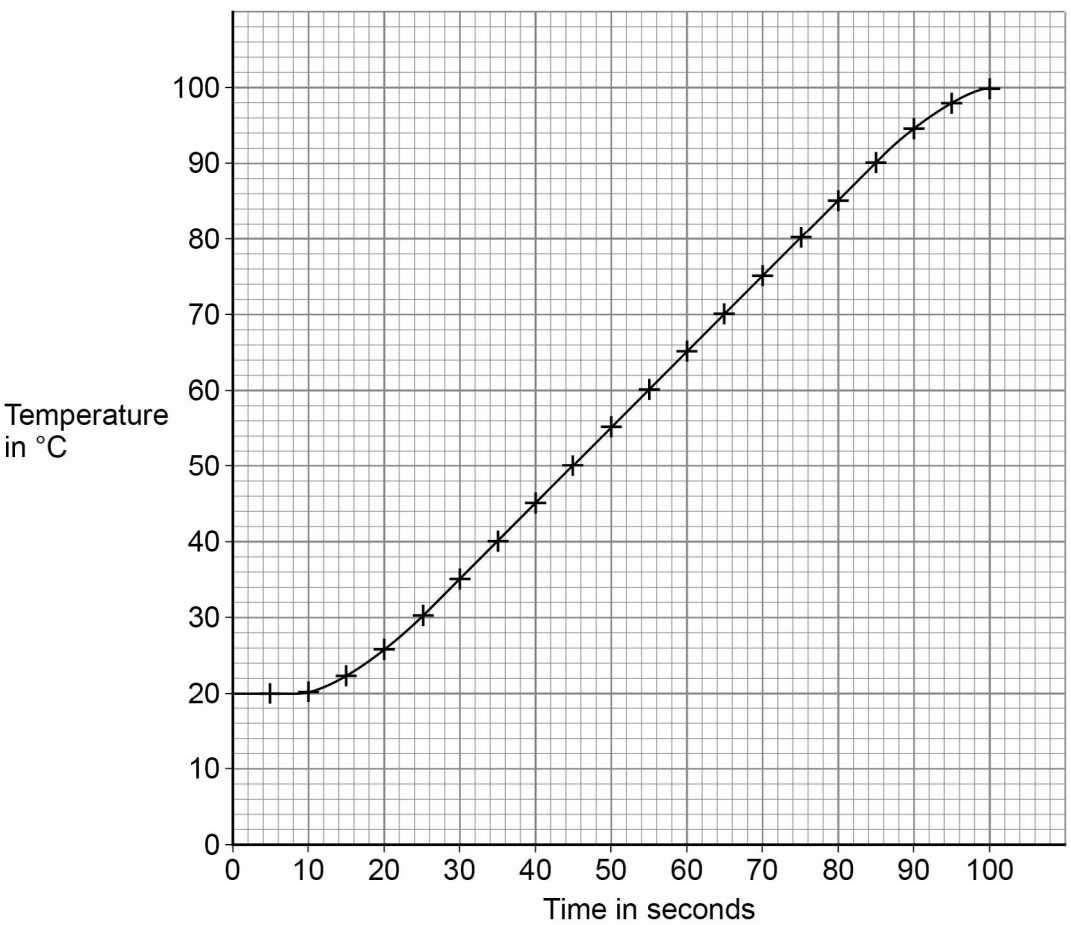
4.1.1.3 Energy changes in systems

Question 10 · continued

The student investigated how quickly the kettle could increase the temperature of 0.50 kg of water.

Figure 10 shows the results of the investigation.

Figure 10



4.1.1.3 Energy changes in systems

Question 10 · continued

0 7 . 4 The temperature of the water did **not** start to increase until 10 seconds after the kettle was switched on.

What is the reason for this?

[1 mark]

Tick (✓) **one** box.

- Energy is transferred from the surroundings to the kettle. ☐
- The charge flows slowly through the kettle circuit. ☐
- The heating element in the kettle takes time to heat up. ☐
- The power output of the kettle increases slowly. ☐

0 7 . 5 Describe a method the student could have used to obtain the results shown in **Figure 10**.

[6 marks]

Question 7 continues on the next page

4.1.1.3 Energy changes in systems

Question 10 · continued

0 7 . 6 The mass of water in the kettle was 0.50 kg.

The temperature of the water increased from 20 °C to 100 °C.

specific heat capacity of water = 4200 J/kg °C

Calculate the energy transferred to the water.

Use the Physics Equations Sheet.

[3 marks]

Energy = _____ J

0 7 . 7 The water in the kettle boiled for a short time before the kettle switched off.

During this time 5.0 g of water changed to steam.

specific latent heat of vaporisation of water = 2 260 000 J/kg

Calculate the energy transferred to change the water to steam.

Use the Physics Equations Sheet.

[3 marks]

Energy = _____ J

18

4.1.1.3 Energy changes in systems

Question 11

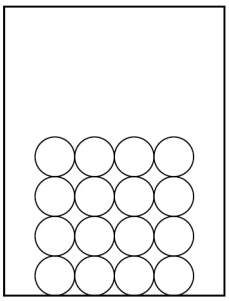
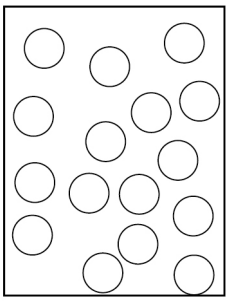
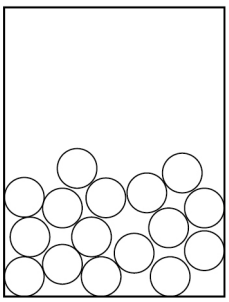
November 2021 | 8463/1F | Original Q1

0 1 . 1 A student investigated the three states of matter.

The arrangement of particles in the three states of matter are different.

Draw **one** line from each particle arrangement to the state of matter.

[2 marks]

Particle arrangement	State of matter
	Solid
	Liquid
	Gas

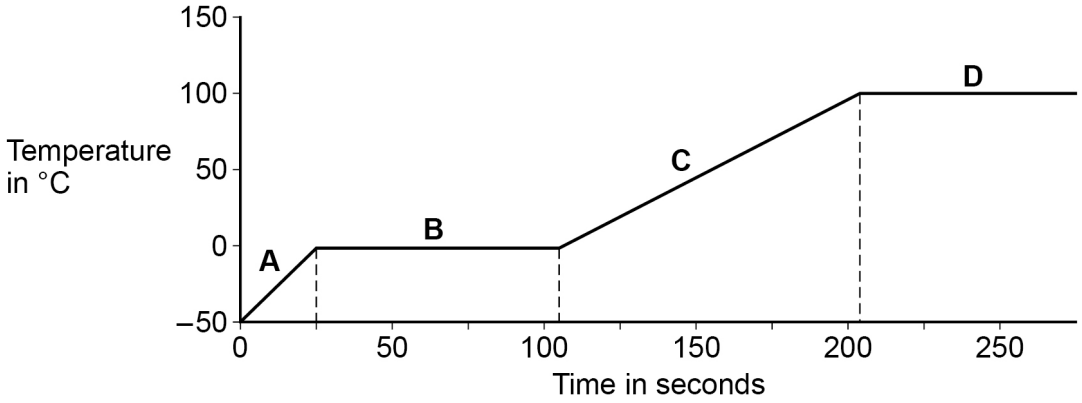
4.1.1.3 Energy changes in systems

Question 11 · continued

A large lump of ice was heated and changed state.

Figure 1 shows how the temperature varied with time.

Figure 1



0 1 . 2 Which part of **Figure 1** shows when the ice was melting?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Which part of **Figure 1** shows when the water was boiling?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 1 continues on the next page

4.1.1.3 Energy changes in systems

Question 11 · continued

0 1 . 4 Which property of the water particles changes as the temperature of the water increases?

[1 mark]

Tick (✓) **one** box.

The kinetic energy of the particles ☐

The mass of each particle ☐

The number of particles ☐

0 1 . 5 Calculate the thermal energy needed to melt 0.250 kg of ice at 0 °C.

specific latent heat of fusion of water = 334 000 J/kg

Use the equation:

thermal energy = mass × specific latent heat

[2 marks]

Thermal energy = _____ J

4.1.1.3 Energy changes in systems

Question 11 · continued

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

condenses	**evaporates**	**ionises**	**sublimates**

A substance is heated and changes directly from a solid to a gas.

The substance _____ .

8

Turn over for the next question

4.1.1.3 Energy changes in systems

Question 12

November 2021 | 8463/1F | Original Q10

1 0 Energy from the Sun is released by nuclear fusion.

1 0 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

1 0 . 2 Nuclear fusion of deuterium is difficult to achieve on Earth because of the high temperature needed.

Electricity is used to increase the temperature of 4.0 g of deuterium by 50 000 000 °C.

specific heat capacity of deuterium = 5200 J/kg °C

Calculate the energy needed to increase the temperature of the deuterium by 50 000 000 °C.

Use the Physics Equations Sheet.

[3 marks]

Energy = _____ J

4.1.1.3 Energy changes in systems

Question 12 · continued

10.3 The idea of obtaining power from nuclear fusion was investigated using models.

The models were tested before starting to build the first commercial nuclear fusion power station.

Suggest **two** reasons why models were tested.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

10.4 Generating electricity using nuclear fusion will have fewer environmental effects than generating electricity using fossil fuels.

Explain **one** environmental effect of generating electricity using fossil fuels.

[2 marks]

_____

_____

_____

_____

_____

9

4.1.1.3 Energy changes in systems

Question 13

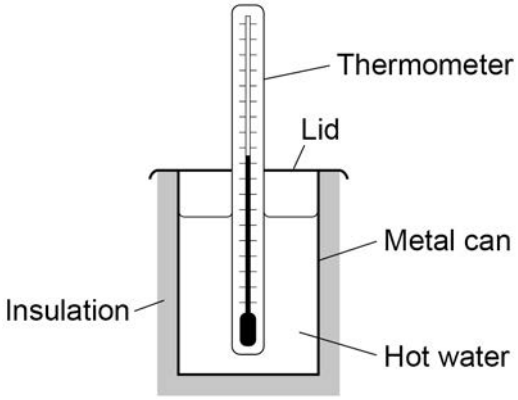
June 2022 | 8463/1F | Original Q8

0 8 A student investigated the insulating properties of two different materials.

The same thickness of each material was used.

Figure 9 shows some of the equipment used by the student.

Figure 9



The student used two different types of thermometer to measure the temperature changes.

Figure 10 shows a reading on each thermometer.

Figure 10



0 8 . 1 What is the resolution of thermometer **B**?

[1 mark]

Tick (✓) **one** box.

- 0.1 °C ☐
- 0.4 °C ☐
- 67.0 °C ☐
- 67.4 °C ☐

4.1.1.3 Energy changes in systems

Question 13 · continued

0 8 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a smaller	**the same**	**a bigger**

Thermometer **A** has _____ chance of being misread than thermometer **B**.

Question 8 continues on the next page

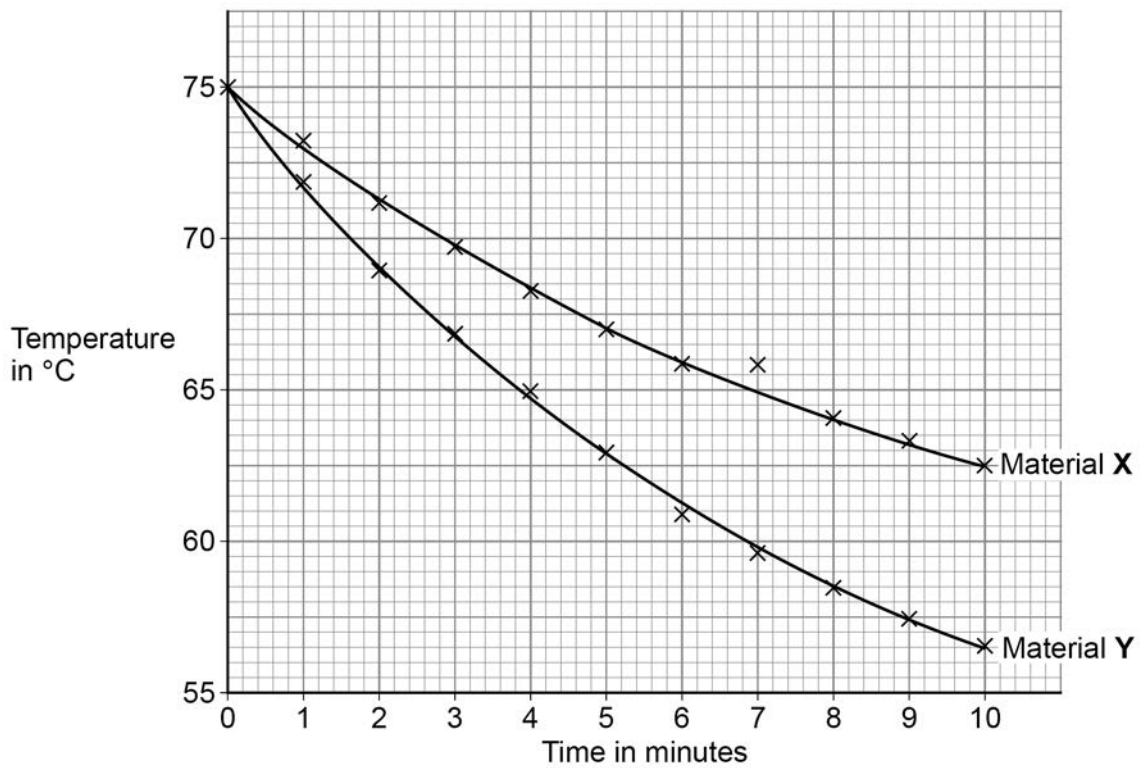
4.1.1.3 Energy changes in systems

Question 13 · continued

June 2022 | 8463/1F | Original Q8

Figure 11 shows the results.

Figure 11



0 8 . 3 The mass of water used was 0.12 kg.

specific heat capacity of water = 4200 J/kg °C

Determine the total change in thermal energy of the water when Material **X** was used.

Use values from **Figure 11**.

Use the Physics Equations Sheet.

[4 marks]

Total change in thermal energy = _____ J

4.1.1.3 Energy changes in systems

Question 13 · continued

0 8 . 4 There is an anomalous result on **Figure 11**.

Draw a ring around the anomalous result.

[1 mark]

0 8 . 5 Give **two** conclusions that can be made from **Figure 11**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

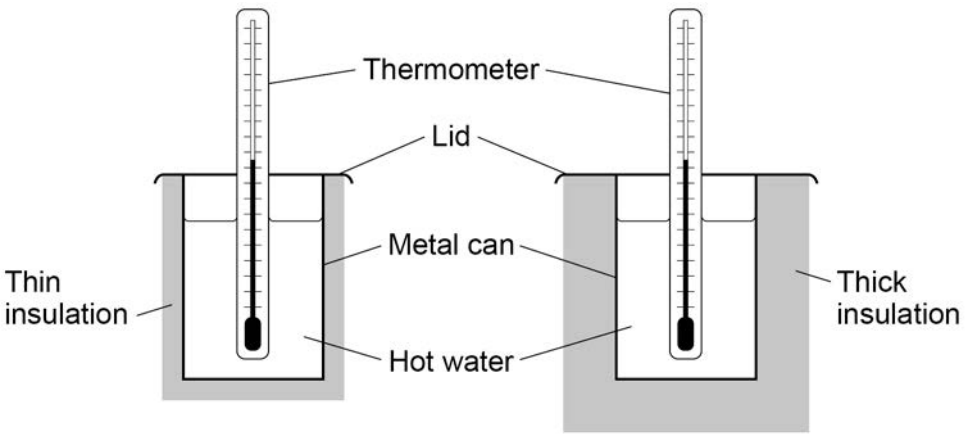
Question 8 continues on the next page

Question 13 · continued

Another student investigated how the thickness of the insulation affected the rate of cooling of hot water.

Figure 12 shows some of the equipment used.

Figure 12



0 8 . 6 How would using thick insulation affect the rate of cooling of hot water compared with using thin insulation?

[1 mark]

Tick (✓) **one** box.

The rate of cooling would be higher. ☐

The rate of cooling would be lower. ☐

The rate of cooling would not change. ☐

0 8 . 7 Predict how using thick insulation would affect the temperature of the water after 10 minutes compared with using thin insulation.

[1 mark]

Tick (✓) **one** box.

The temperature would be higher. ☐

The temperature would be lower. ☐

The temperature would be the same. ☐

11

4.1.1.3 Energy changes in systems

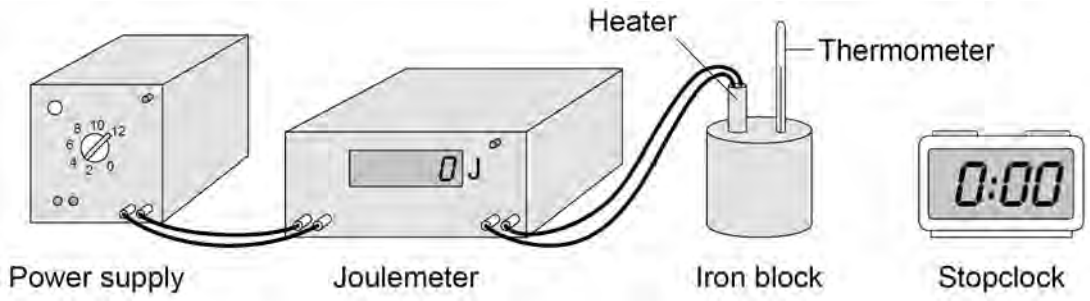
Question 14

June 2023 | 8463/1F | Original Q9

0 9 **Figure 12** shows the equipment a student used to determine the specific heat capacity of iron.

The iron block the student used has two holes, one for the heater and one for the thermometer.

Figure 12



0 9 . 1 Before the power supply was switched on, the thermometer was used to measure the temperature of the iron block.

The student left the thermometer in the iron block for a few minutes before recording the initial temperature.

Suggest why.

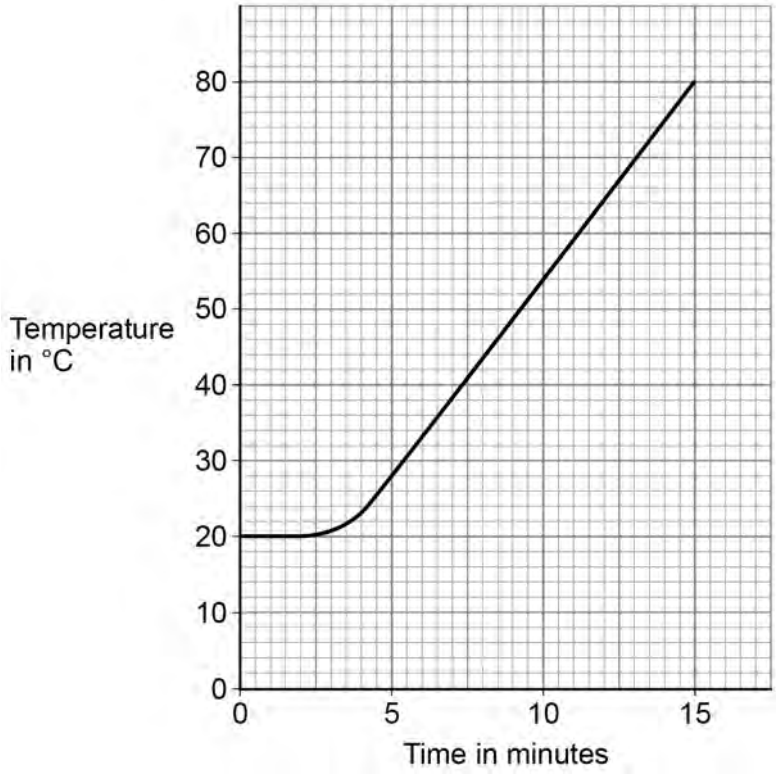
[1 mark]

4.1.1.3 Energy changes in systems

Question 14 · continued

0 9 . 2 **Figure 13** shows how the temperature changed after the power supply was switched on.

Figure 13



The energy transferred to the iron block between 5 and 10 minutes was 26 000 J.

The mass of the iron block was 2.0 kg.

Calculate the specific heat capacity of iron.

Use information from **Figure 13** and the Physics Equations Sheet.

[4 marks]

Specific heat capacity = _____ J/kg °C

4.1.1.3 Energy changes in systems

Question 14 · continued

0 9 . 3 The student repeated the investigation but wrapped insulation around the iron block.

What effect will adding insulation have had on the investigation?

[2 marks]

Tick (✓) **two** boxes.

- The calculated specific heat capacity will be more accurate. ☐
- The iron block will transfer thermal energy to the surroundings at a lower rate. ☐
- The power output of the heater will be lower than expected. ☐
- The temperature of the iron block will increase more slowly than expected. ☐
- The uncertainty in the temperature measurement will be greater. ☐

7

4.1.1.3 Energy changes in systems

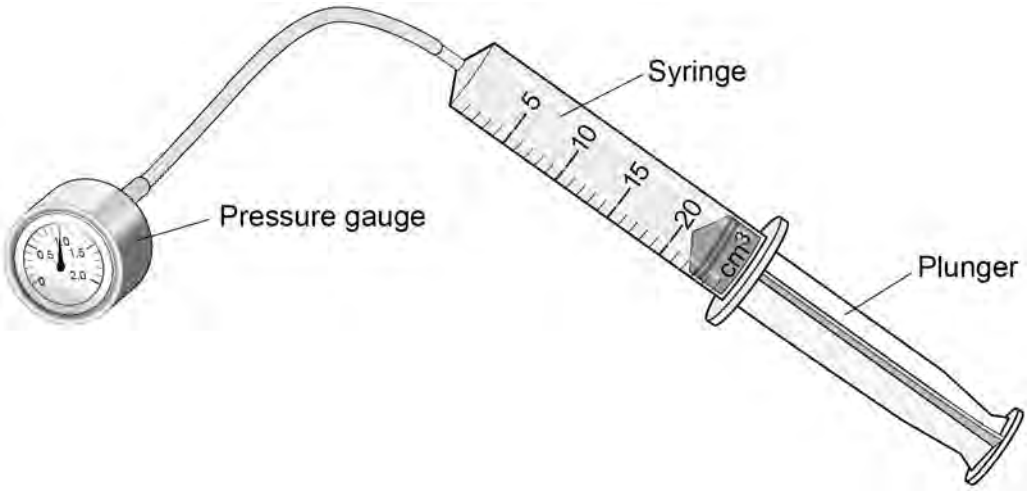
Question 15

June 2024 | 8463/1F | Original Q5

0 5 A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 10 shows the equipment used.

Figure 10



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

0 5 . 1 How did pushing the plunger in affect the volume of air in the syringe?

[1 mark]

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

4.1.1.3 Energy changes in systems

Question 15 · continued

June 2024 | 8463/1F | Original Q5

0 5 . 2 How did pushing the plunger in affect the distance between the air particles in the syringe?

[1 mark]

Tick (✓) **one** box.

The distance decreased. ☐

The distance stayed the same. ☐

The distance increased. ☐

0 5 . 3 How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

[1 mark]

Tick (✓) **one** box.

The frequency of collisions decreased. ☐

The frequency of collisions stayed the same. ☐

The frequency of collisions increased. ☐

0 5 . 4 How did pushing the plunger in affect the air pressure in the syringe?

[1 mark]

Tick (✓) **one** box.

The air pressure decreased. ☐

The air pressure stayed the same. ☐

The air pressure increased. ☐

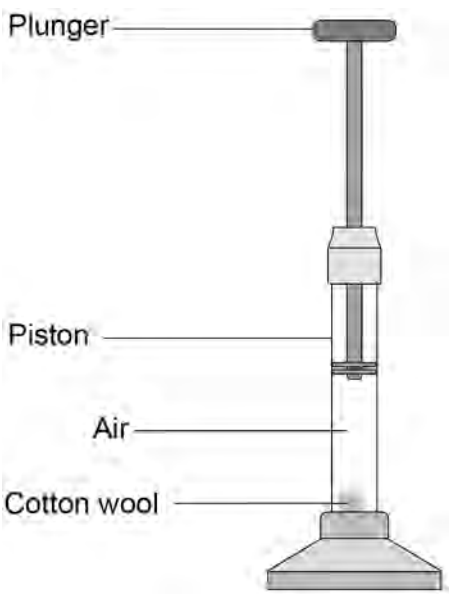
4.1.1.3 Energy changes in systems

Question 15 · continued

A fire piston is a special type of syringe that can be used to start fires.

Figure 11 shows a fire piston.

Figure 11



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

0 5 . 5 How does an increase in temperature affect the mean speed of the air particles inside the syringe?

[1 mark]

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

4.1.1.3 Energy changes in systems

Question 15 · continued

0 5 . 6 When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

8

4.1.1.3 Energy changes in systems

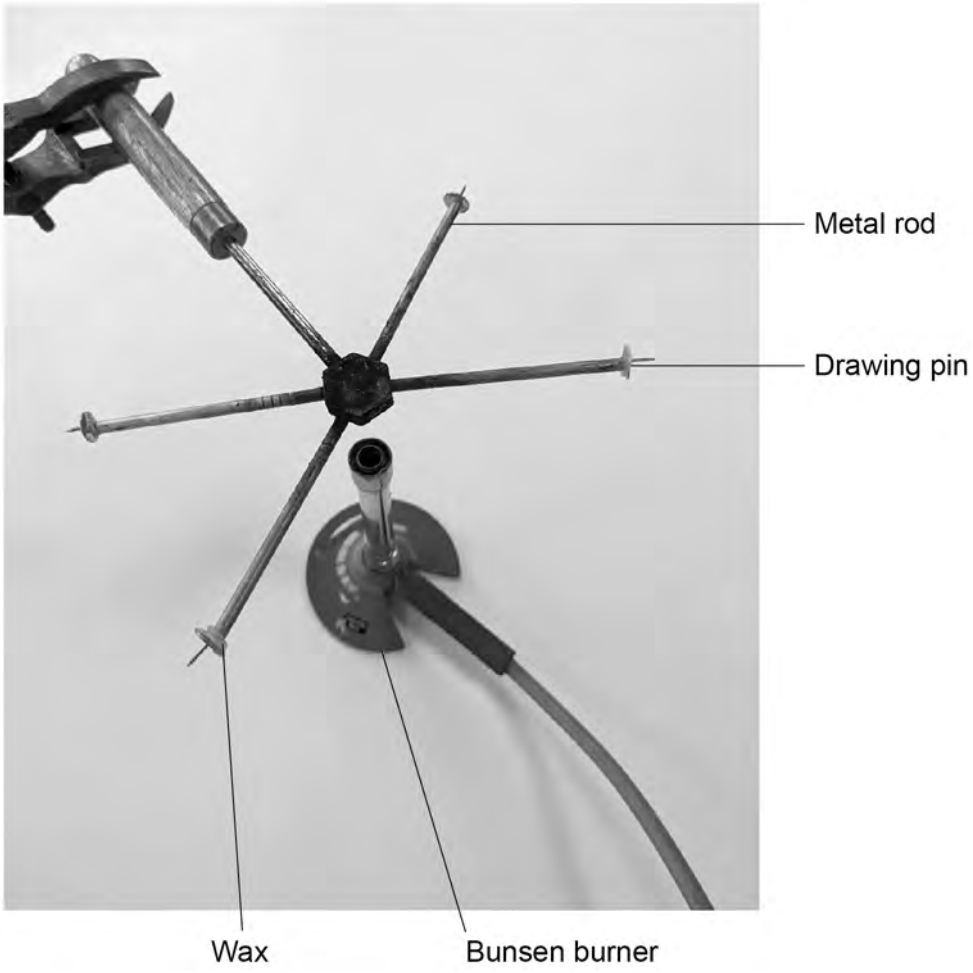
Question 16

June 2025 | 8463/1F | Original Q2

0 2 A student investigated the thermal conductivity of different metals.

Figure 2 shows some of the apparatus used.

Figure 2



Each rod was made from a different metal.

The metal rods are joined at the centre.

The size of each metal rod was the same.

This is the method used.

1. Attach a drawing pin to the end of each metal rod using wax.
2. Light the Bunsen burner.
3. Start a stopclock.
4. Record the time taken for the wax to melt and for the drawing pin to fall off each metal rod.

Question 16 · continued

Table 1 shows the results.

Table 1

Type of metal	Time taken for drawing pin to fall off in seconds
Copper	10
Iron	22
Nickel	18
Steel	24

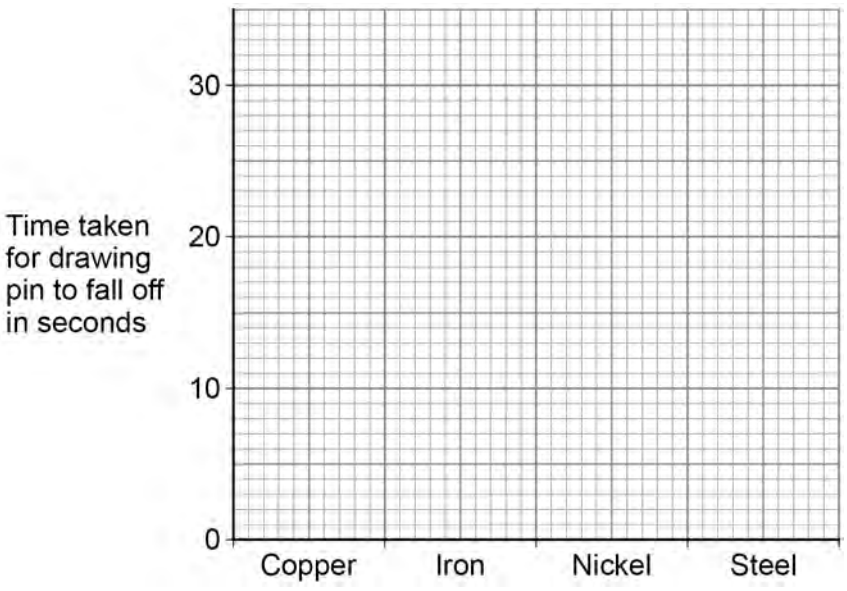
0 2 . 1 Complete **Figure 3**.

You should:

- label the *x*-axis
- plot the data from **Table 1** as a bar chart.

[3 marks]

Figure 3



Question 16 · continued

0 2 . 2 Which type of metal in **Table 1** had the greatest thermal conductivity?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Copper ☐ Iron ☐ Nickel ☐ Steel ☐

Reason _____

_____

_____

0 2 . 3 The thermal energy transferred to the nickel rod was 132 J.

The temperature change of the rod was 20 °C.

mass of the nickel rod = 0.015 kg

Calculate the specific heat capacity of nickel.

Use the equation:

$$\text{specific heat capacity} = \frac{\text{thermal energy}}{(\text{mass} \times \text{temperature change})}$$

[2 marks]

_____

_____

_____

_____

Specific heat capacity = _____ J/kg °C

4.1.1.3 Energy changes in systems

Question 16 · continued

Use the Physics Equations Sheet to answer questions **02.4** and **02.5**.

0 2 . 4 Write down the equation which links energy transferred (*E*), power (*P*) and time (*t*).

[1 mark]

0 2 . 5 At the end of the investigation, the Bunsen burner was turned off.

As the nickel rod cooled to room temperature, the rod transferred 132 J of energy to the room.

The mean power transfer was 0.33 W.

Calculate the time taken for the energy transfer.

[3 marks]

Time taken = _____ s

11

4.1.1.3 Energy changes in systems

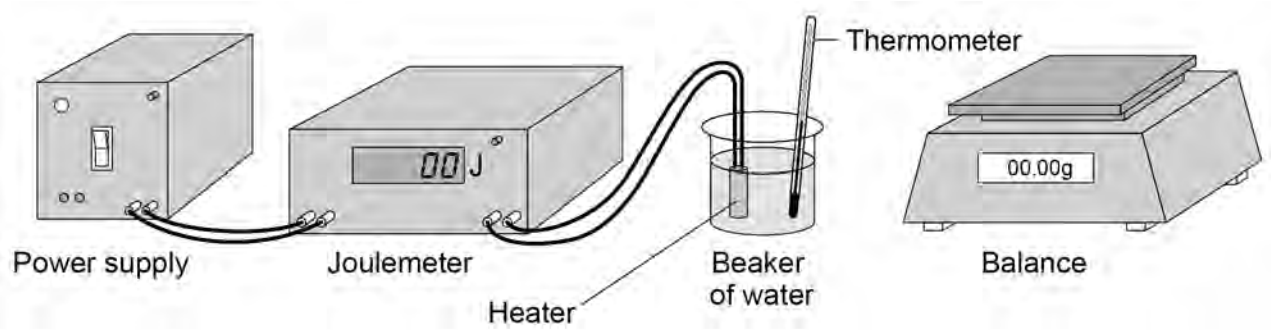
Question 17

June 2025 | 8463/1F | Original Q9

0 9 A student determined the specific heat capacity of water.

Figure 17 shows the apparatus used.

Figure 17



The joulemeter measures energy transfer.

0 9 . 1 Give **one** hazard in the investigation.

[1 mark]

0 9 . 2 Describe how the student could determine the specific heat capacity of water using the apparatus in **Figure 17**.

[6 marks]

4.1.1.3 Energy changes in systems

Question 17 · continued

Extra space

0 9 . 3 One source of error in the experiment was energy loss to the surroundings.

Suggest **one** change to the apparatus to reduce energy loss to the surroundings.

[1 mark]

0 9 . 4 The student's value for the specific heat capacity of water was 4410 J/kg °C.

The actual value for the specific heat capacity of water is 4200 J/kg °C.

Calculate the percentage difference between the student's value and the actual value.

[2 marks]

Percentage difference = _____ %

10