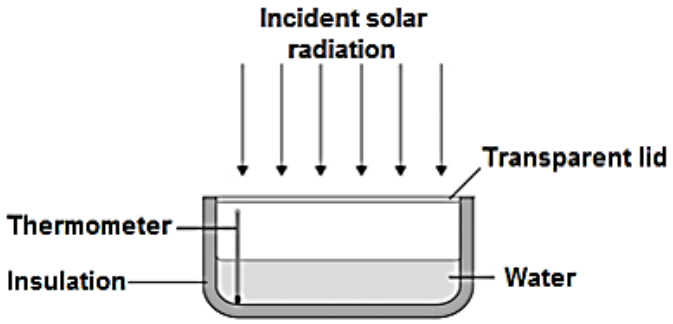
Thermal Physics GCSE AQA Higher Physics Past Papers Questions

01. A student investigated how much energy from the Sun was incident on the Earth's surface at her location.

She put an insulated pan of water in direct sunlight and measured the time it took for the temperature of the water to increase by 0.6 °C.

The apparatus she used is shown in **Figure 3**.

Figure 3



1 Choose the most appropriate resolution for the thermometer used by the student.

[1 mark]

Tick **one** box.

- 0.1 °C ☐
- 0.5 °C ☐
- 1.0 °C ☐

The energy transferred to the water was 1050 J.

The time taken for the water temperature to increase by 0.6 °C was 5 minutes.

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

2 Write down the equation which links energy transferred, power and time.

[1 mark]

3 Calculate the mean power supplied by the Sun to the water in the pan.

[2 marks]

Average power = _____ W

4 Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Mass = _____ kg

5 The student's results can only be used as an estimate of the mean power at her location.

Give **one** reason why.

[1 mark]

02. **Figure 15** shows a coffee machine. The coffee machine uses an electric element to heat water.

Figure 15

1 The coffee machine has a metal case.

Why would it be dangerous for the live wire of the electric cable to touch the metal case?

[1 mark]

_____

_____

2 The power output of the coffee machine is 2.53 kW.

The mains potential difference is 230 V.

Calculate the current in the coffee machine.

[3 marks]

_____

_____

_____

_____

Current = _____ A

. 3 The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

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

Calculate the mass of water that the coffee machine can heat in 14 seconds.

[5 marks]

Mass = _____ kg

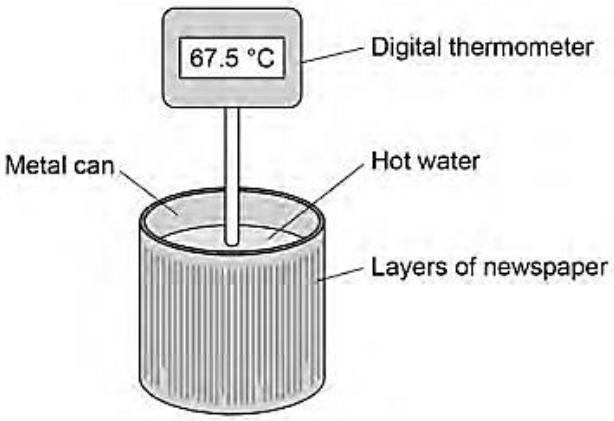
9

03.

A student investigated the insulating properties of newspaper.

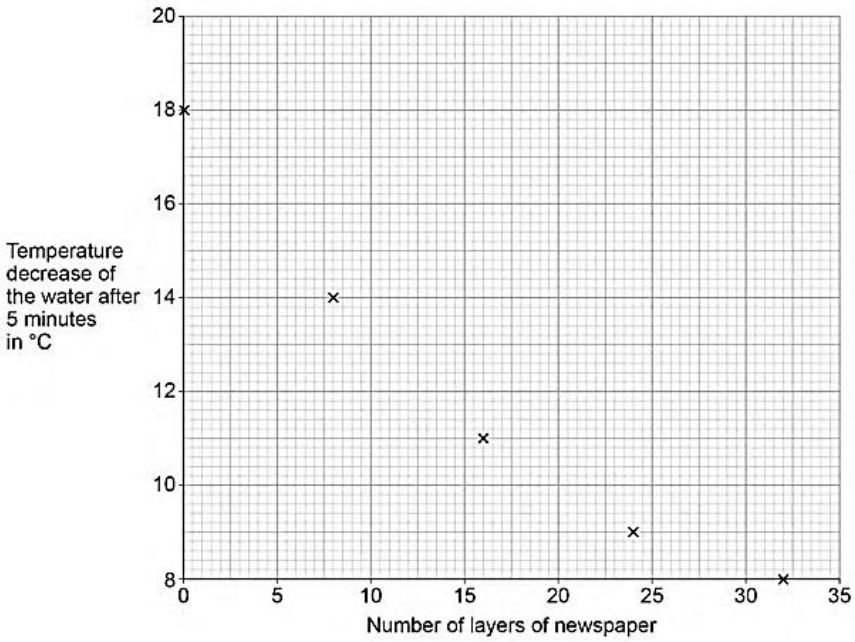
Figure 1 shows the apparatus the student used.

Figure 1



The student's results are shown in **Figure 2**.

Figure 2



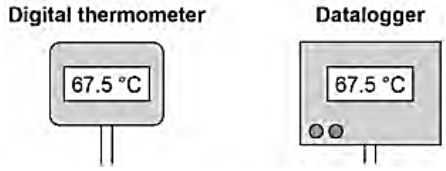
. 1 Describe a method the student could have used to obtain the results shown in **Figure 2**.

[6 marks]

. 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 3 shows the readings on the digital thermometer and the datalogger.

Figure 3



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

[2 marks]

8

04.

A student investigated the thermal conductivity of different metals.

This is the method used:

1. Measure the mass of an ice cube.
2. Put the ice cube on a metal block which is at room temperature.
3. Measure the mass of the ice cube after one minute.
4. Repeat with other blocks of the same mass made from different metals.

Figure 10

Table 3 shows the student's results.

Table 3

Metal	Initial mass of ice cube in grams	Final mass of ice cube in grams	Change in mass of ice cube in grams
Aluminium	25.85	21.14	4.71
Copper	26.20	20.27	5.93
Lead	25.53	21.97	3.56
Steel	24.95	19.45	5.50

. 1 The initial temperature of each ice cube was –15 °C

Why was it important that the initial temperature of each ice cube was the same?

[1 mark]

Tick (✓) **one** box.

Initial temperature was a continuous variable. ☐

Initial temperature was a control variable. ☐

Initial temperature was the dependent variable. ☐

Initial temperature was the independent variable. ☐

. 2 Which metal had the highest thermal conductivity?

Give a reason for your answer.

[2 marks]

Metal: _____

Reason: _____

_____

_____

. 3 Suggest **one** source of random error in the student's investigation.

[1 mark]

_____

4 An ice cube has a temperature of –15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

[5 marks]

Mass of ice cube = _____ kg

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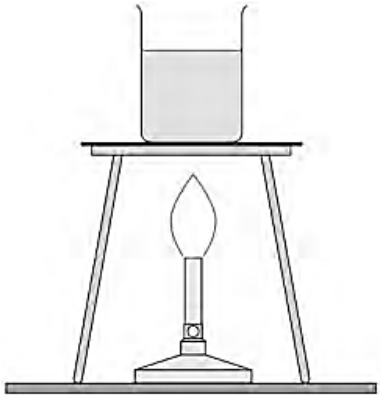
9

05.

Figure 14 shows a Bunsen burner heating some water in a beaker.
Eventually the water changes into steam.

Figure 14



. 1 Explain how the internal energy of the water changes as it is heated from 20 °C to 25 °C

[2 marks]

. 2 How is the particle model used to explain the difference in density between a liquid and a gas?

[1 mark]

Tick (✓) **one** box.

Particles in a gas have less kinetic energy than particles in a liquid. ☐

Particles in a gas have more potential energy than particles in a liquid. ☐

Particles in a liquid are further apart than particles in a gas. ☐

Particles in a liquid are larger than particles in a gas. ☐

. 3 A student measured the mass of boiling water that was turned into steam in five minutes.

Explain how the student could use this information to estimate the power output of the Bunsen burner in watts.

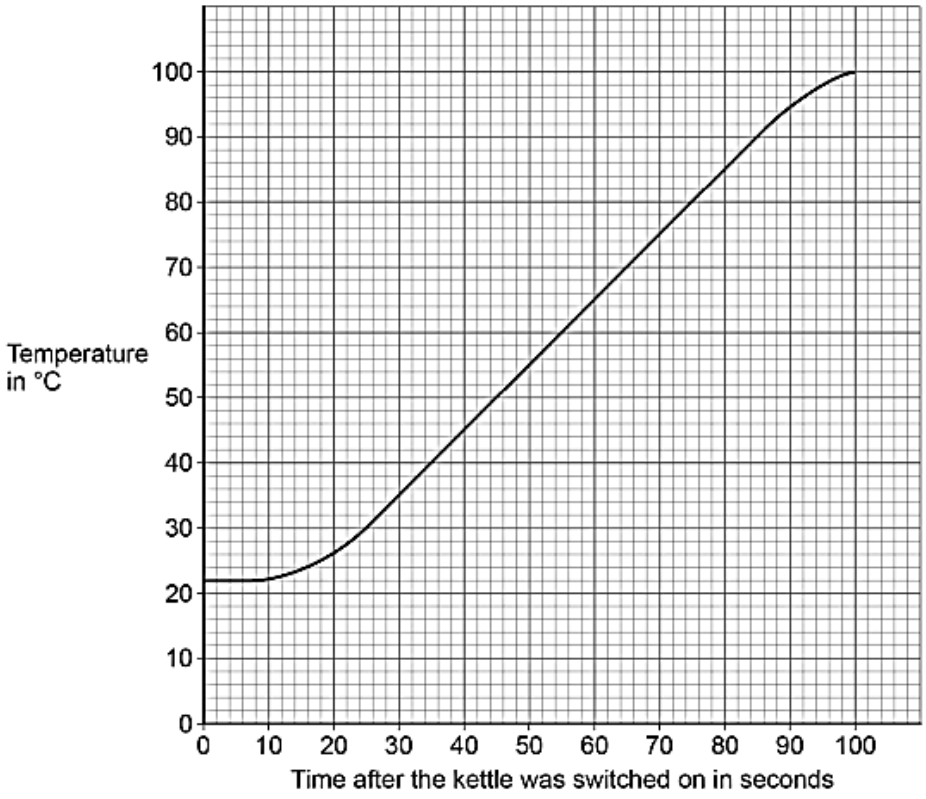
[4 marks]

06.

An electric kettle was switched on.

Figure 10 shows how the temperature of the water inside the kettle changed.

Figure 10



. 1 When the kettle was switched on the temperature of the water did **not** immediately start to increase.

Suggest **one** reason why.

[1 mark]

_____

_____

. 2 The energy transferred to the water in 100 seconds was 155 000 J.

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

Determine the mass of water in the kettle.

Use **Figure 10**.

Give your answer to 2 significant figures.

[5 marks]

Mass of water (2 significant figures) = _____ kg

. 3 The straight section of the line in **Figure 10** can be used to calculate the useful power output of the kettle.

Explain how.

[3 marks]

9

07.

Energy from the Sun is released by nuclear fusion.

1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

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 Equation Sheet.

[3 marks]

_____

_____

_____

_____

_____

Energy = _____ J

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 _____

_____

_____

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]

_____

_____

_____

_____

_____

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9

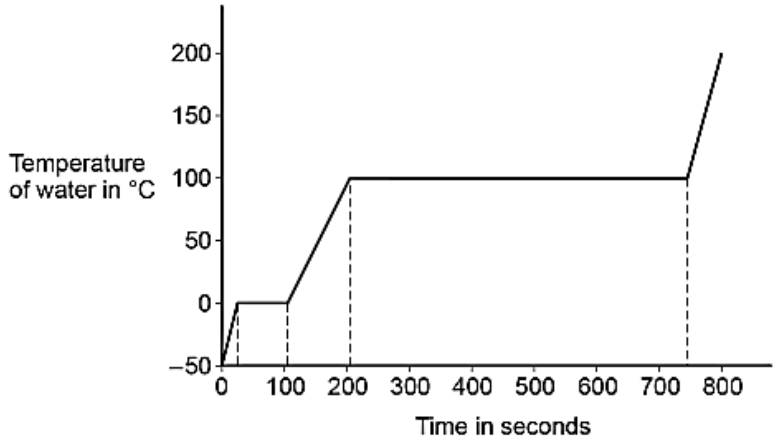
08. A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

Figure 17 shows the student's results.

The power output of the heater was constant.

Figure 17



. 1 The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how **Figure 17** shows this.

[2 marks]

. 2 The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how **Figure 17** shows this.

[2 marks]

. 3 A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in **Figure 17** would have been different.

[2 marks]

1

2

. 4 When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

[5 marks]

Specific latent heat of vaporisation = _____

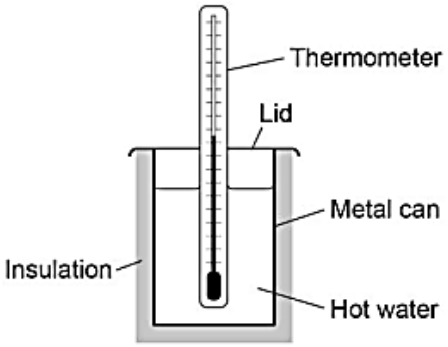
Unit _____

___
11

09. A student investigated the insulating properties of different materials.

Figure 4 shows some of the equipment used by the student.

Figure 4



This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1–4 using the same thickness of different insulating materials.

. 1 Identify the independent variable and the dependent variable in this investigation.

[2 marks]

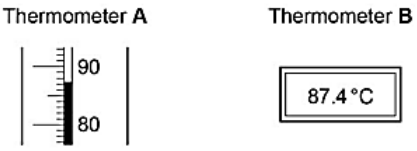
Independent variable _____

Dependent variable _____

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

Figure 5 shows a reading on each thermometer.

Figure 5



2 What is the resolution of thermometer **B**?

[1 mark]

Resolution = _____ °C

3 Thermometer **A** is more likely to be misread.

Give **one** reason why.

[1 mark]

_____

_____

_____

4 For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

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

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

[3 marks]

_____

_____

_____

_____

_____

Mass = _____ kg

. 5 **Table 2** shows the results for two insulating materials.

Table 2

Material	Time for temperature to decrease by 20 °C in seconds
X	450
Y	745

Explain how the results in **Table 2** can be used to compare the thermal conductivity of the two materials.

[2 marks]

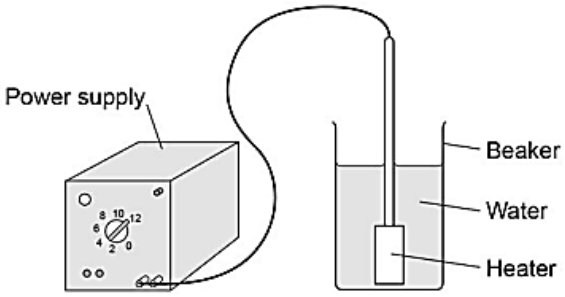
9

10.

A student determined the specific latent heat of vaporisation of water.

Figure 9 shows some of the equipment used.

Figure 9



This is the method used:

1. Put 50 cm^3 of water in a beaker.
2. Measure the mass of the beaker and water.
3. Use a heater to boil the water and keep it boiling for 600 seconds.
4. Measure the mass of the beaker and water after 600 seconds.

. 1 What measuring instrument should be used to measure the volume of water?

[1 mark]

. 2 What is a hazard in the student's investigation?

[1 mark]

Tick (✓) **one** box.

- burns ☐
- boiling water ☐
- heatproof gloves ☐
- safety goggles ☐

. 3 The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

Calculate the specific latent heat of vaporisation of water given by the student's data.

Give the unit.

Use the Physics Equations Sheet.

[5 marks]

Specific latent heat of vaporisation = _____ Unit _____

. 4 Some thermal energy was transferred to the surroundings while the water was being heated.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

. 5 Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

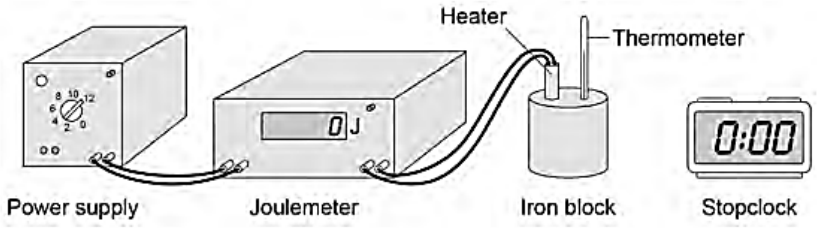
11

11.

Figure 2 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 2



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

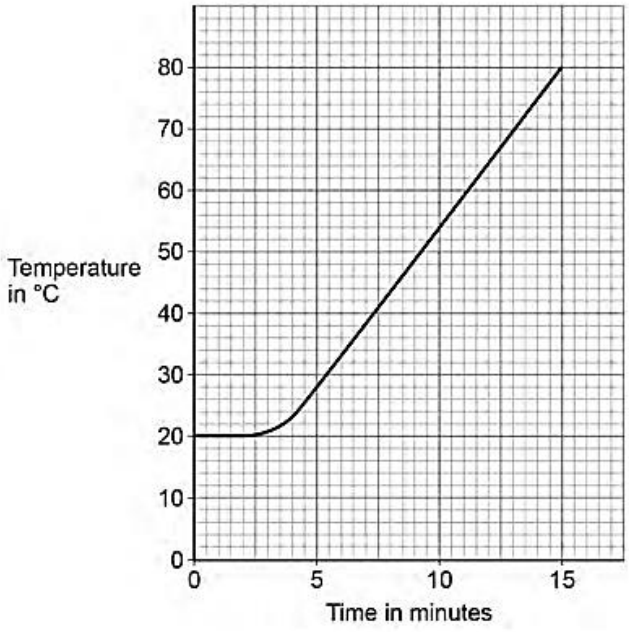
The student left the thermometer in the iron block for a few minutes before recording the initial temperature.

Suggest why.

[1 mark]

. 2 **Figure 3** shows how the temperature changed after the power supply was switched on.

Figure 3



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 3** and the Physics Equations Sheet.

[4 marks]

Specific heat capacity = _____ J/kg °C

. 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. ☐

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