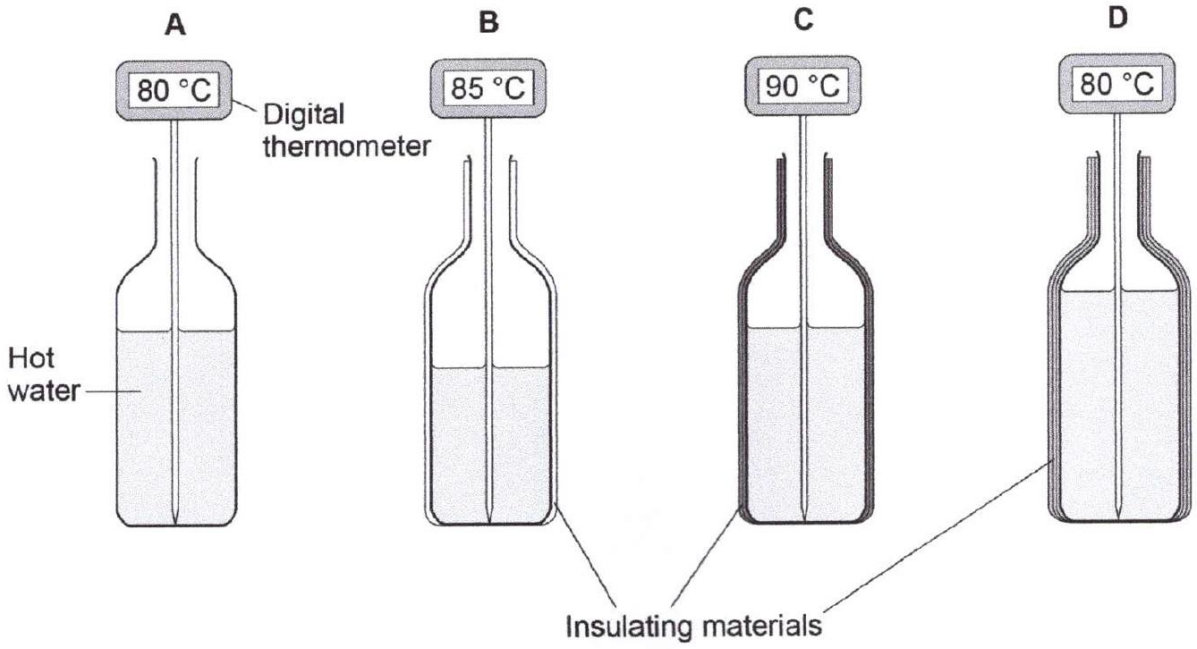
Internal energy and energy transfer – GCSE Physics Paper 1

1. No.5

0 5 A student investigated how different insulating materials affect the energy transfer from bottles of very hot water.

Figure 6 shows some of the equipment used.

Figure 6



0 5 . 1 To prevent spillages the student used a funnel to pour very hot water into each bottle.

Why did the student use the funnel?

[1 mark]

Tick (✓) **one** box.

Preventing spillages was a control variable. ☐

To make the investigation valid. ☐

Using the funnel was a safety precaution. ☑

0 5 . 2 Why did the student **not** use insulation for bottle **A**?

[1 mark]

Tick (✓) **one** box.

Bottle **A** was the control. ✓

Bottle **A** was the fair test.

Bottle **A** was the independent variable.

The student recorded how much the temperature of the water in each bottle changed in five minutes.

0 5 . 3 What equipment could the student use to measure time?

[1 mark]

Stopwatch

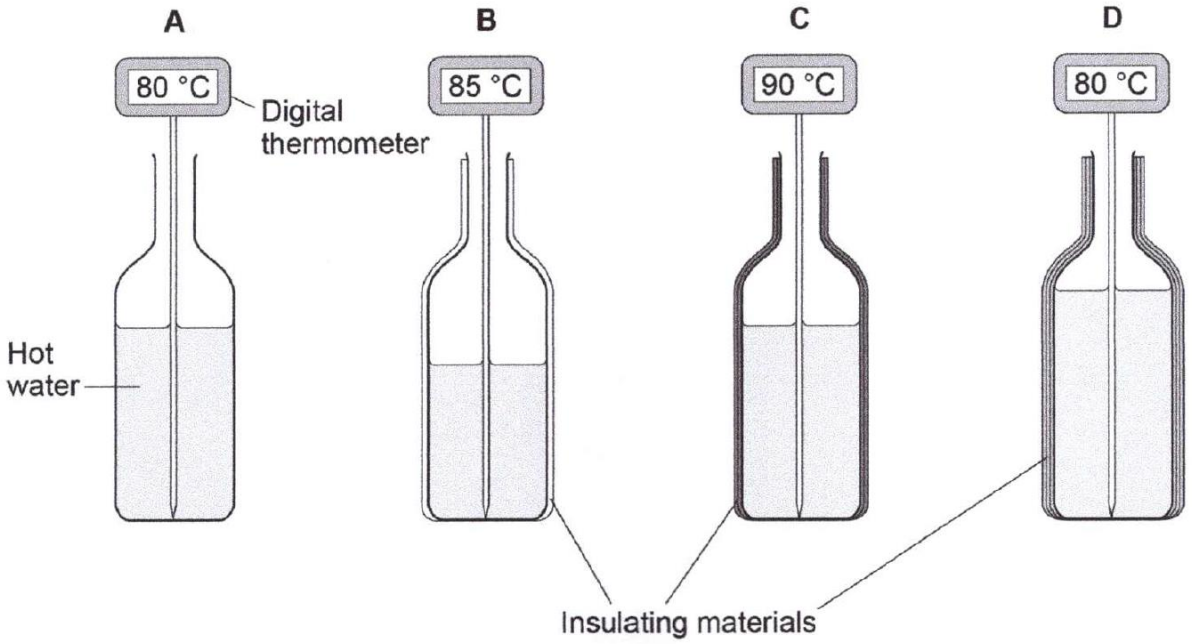
0 5 . 4 **Table 4** shows the results.

Table 4

Bottle	Insulation	Start temperature in °C	Final temperature in °C	Temperature change in °C
A	None	80	60	20
B	1 layer of paper	85	70	15
C	2 layers of card	90	75	15
D	3 layers of bubble wrap	80	70	10

Figure 6 is repeated below.

Figure 6



The student could **not** make a valid conclusion from the results about how different insulating materials affect the energy transfer.

Explain **two** ways that the student could improve the investigation to be able to make a valid conclusion.

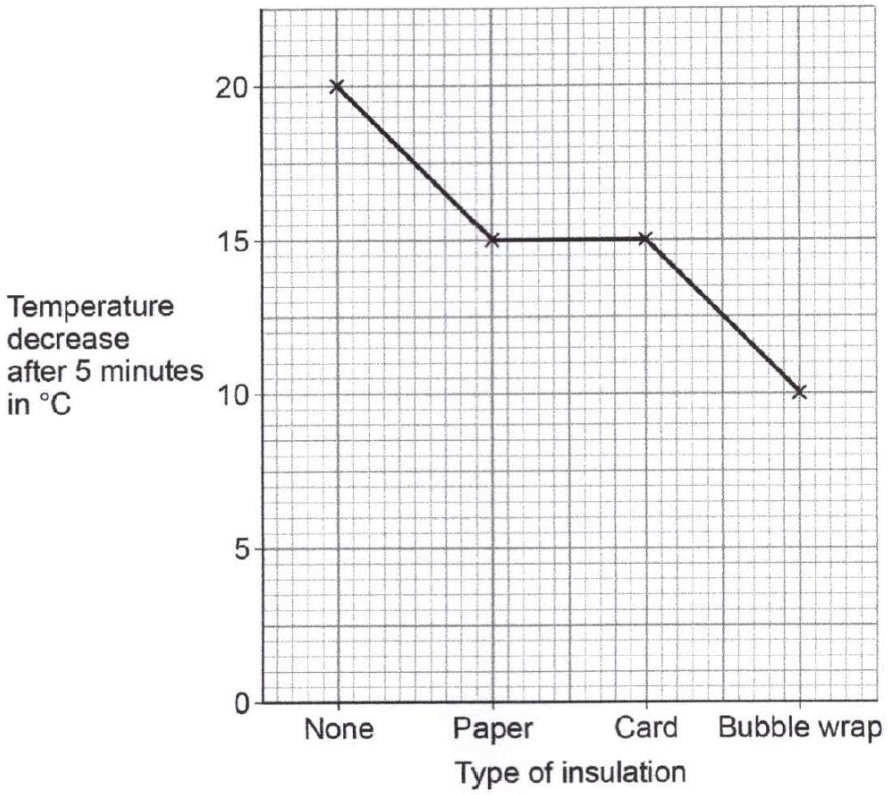
Use **Figure 6** and **Table 4**.

[4 marks]

- Use the same start temperature for all
- Use equal volumes of water for all bottles
- Use same thickness of insulation for all bottles
- Use a lid for each bottle to reduce evaporation

0 5 . 5 **Figure 7** shows the graph plotted by the student.

Figure 7



The student should **not** have plotted a line graph.

What type of graph should the student have plotted?

Give a reason for your answer.

[2 marks]

Type of graph Bar graph

Reason

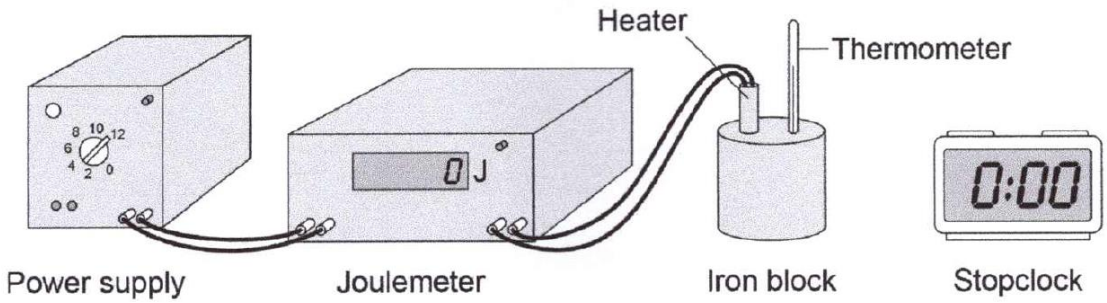
Insulation is a category and not a numerical value.

2. No.9

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.

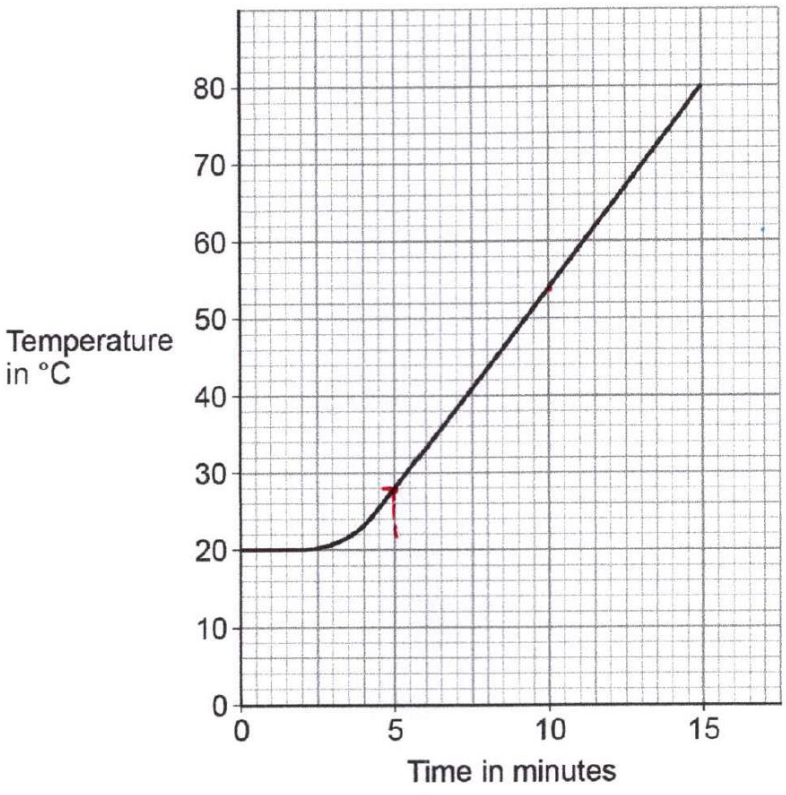
Suggest why.

[1 mark]

So that the thermometer temperature is at the same as the temperature of the iron block.

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]

$\Delta\theta = 54 - 28 = 26\,^{\circ}C$

$E = mc\Delta T$

$c = \frac{E}{m \times \Delta T}$

$c = \frac{26\,000}{2 \times 26}$

$c = 500\ J/kg\,^{\circ}C$

Specific heat capacity = 500 J/kg °C

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.

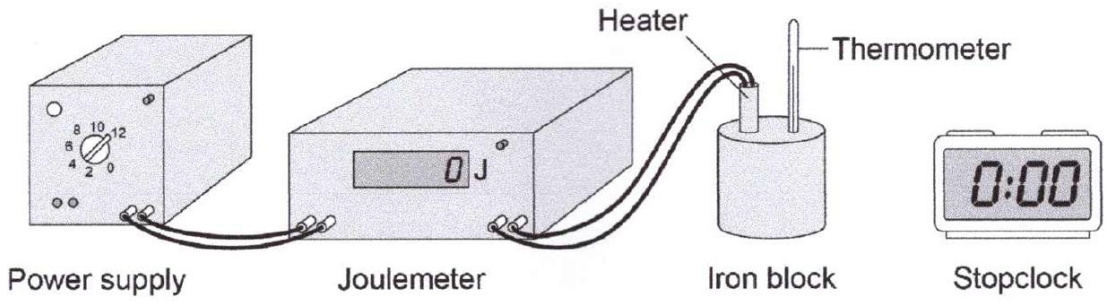
The calculated specific heat capacity will be more accurate.	✓
The iron block will transfer thermal energy to the surroundings at a lower rate.	✓
The power output of the heater will be lower than expected.	
The temperature of the iron block will increase more slowly than expected.	
The uncertainty in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

3. No.2

0 2 **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



0 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.

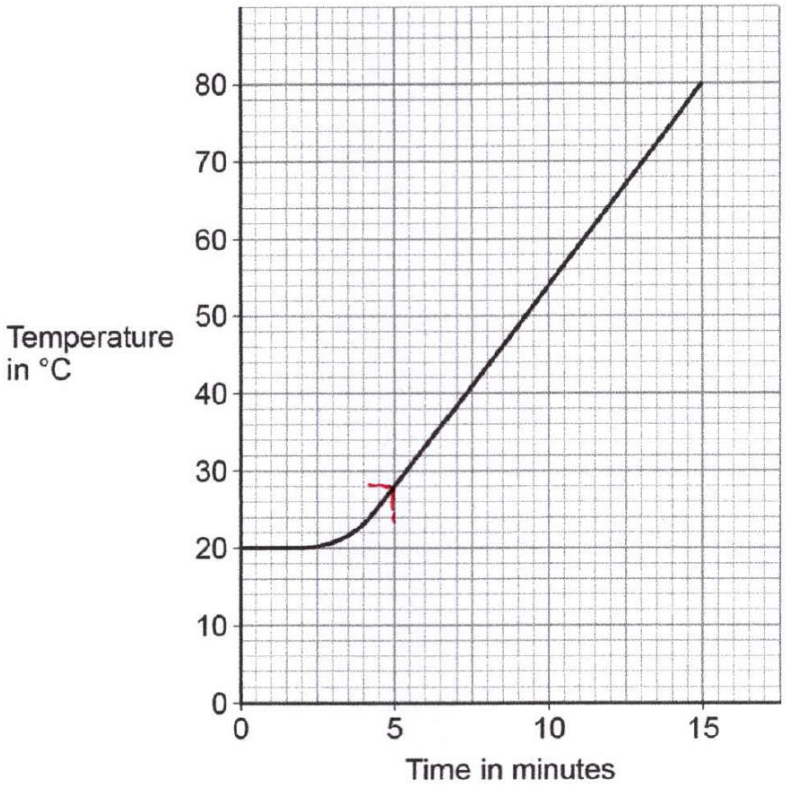
Suggest why.

[1 mark]

So that the thermometer temperature is at the same as the temperature of the iron block.

0 2 . 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]

$\Delta\theta = 54 - 28 = 26\ ^\circ C$

$E = mc\Delta T$

$\Delta T = 26^\circ C$

$m = 2$

$E = 26000$

$c = \frac{E}{m \times \Delta T}$

$c = \frac{26000}{2 \times 26}$

$c = 500$

Specific heat capacity = 500 J/kg °C

0 2 . 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.	