OCR
Oxford Cambridge and RSA

Thursday 22 May 2025 – Morning

GCSE (9–1) in Combined Science B (Twenty First Century Science)

J260/03 Physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

F

You must have:
- a ruler (cm/mm)
- the Equation Sheet for GCSE (9–1) Combined Science Physics B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

J260003

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk(*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

1 Alex uses scalar and vector quantities to describe a journey through their school.

(a) Which statement describes a vector quantity?

Tick (✓) **one** box.

It has both magnitude and direction ☐

It has direction only ☐

It has magnitude only ☐

[1]

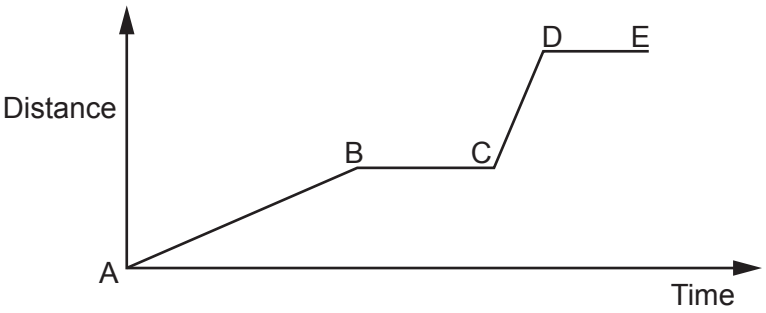
(b) Complete the table to show which quantities are scalar and which are vector.

Tick (✓) **one** box in each row.

Quantity	Scalar	Vector
Distance		
Speed		
Velocity		

[2]

(c) A distance–time graph of Alex's journey is shown.



Between points A and B Alex is walking at constant speed.

(i) Describe Alex's motion between points B and C.

.....

..... **[1]**

(ii) Describe how Alex's motion between points C and D is different to their motion between points A and B.

.....

..... **[1]**

2 A student is researching the structure of different atoms.

(a) Complete the sentences to describe the parts of an atom.

Put a (ring) around each correct option.

The nucleus of the atom has a **negative / neutral / positive** charge.

The nucleus is surrounded by negatively charged particles called **electrons / neutrons / protons**.

The diameter of the nucleus is about a **hundredth / hundred-thousandth / millionth** of the diameter of the atom.

[3]

(b) The table shows information about four different nuclei.

Nucleus	Number of protons	Number of neutrons
P	3	3
Q	2	2
R	3	4
S	4	3

A proton has a charge of +1.
A neutron has a charge of 0.

(i) Which nucleus has the largest charge?

..... **[1]**

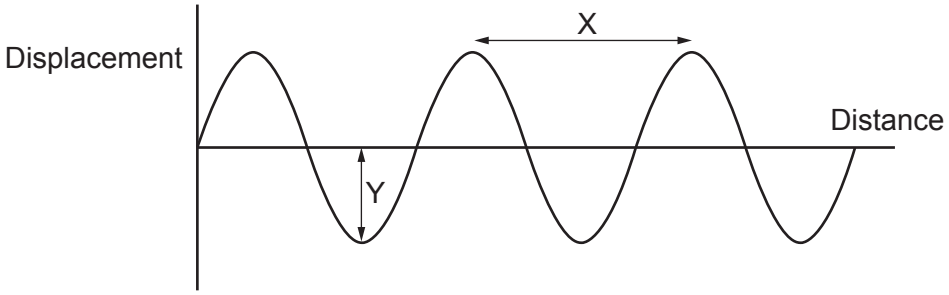
(ii) Which **two** nuclei are isotopes of the same element?

..... **and** ..... **[1]**

3 Riley and Sam are investigating the speeds of water waves and sound waves.

(a) **Fig. 3.1** represents a water wave.

Fig. 3.1



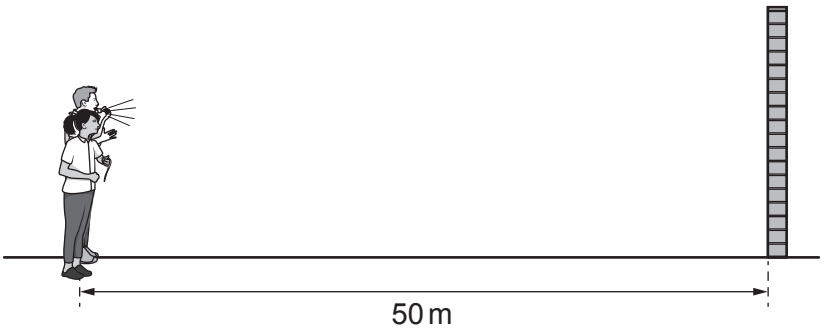
Draw lines to connect each **description** of the water wave with its correct **feature**.

Description	**Feature**
Arrow X on **Fig. 3.1**	Amplitude
Arrow Y on **Fig 3.1**	Frequency
The number of waves passing a point each second	Period
	Wavelength

[3]

(b) **Fig. 3.2** shows Riley and Sam standing 50 m from a tall, flat wall.
They are doing an experiment to measure the speed of sound in air.

Fig. 3.2



Sam blows a whistle and Riley starts a timer at the same time.
Riley stops the timer when she hears the echo from the wall.

(i) When Riley stops the timer, it shows a time of 0.40 seconds.

Calculate the speed of sound in air using this result.

Use the equation: speed = $\frac{(2 \times \text{distance to wall})}{\text{time}}$

Speed = ... m/s **[2]**

(ii) This calculated speed is **not** accurate.

The sound produced by the whistle has a frequency of 600 Hz and a wavelength of 0.55 m in air.

Calculate an accurate value of the speed of sound in air using this information.

Use the equation: wave speed = frequency × wavelength

Speed = ... m/s **[2]**

(iii) What step should Riley and Sam take to improve the accuracy of their value for the speed of sound in air?

Tick (✓) **one** box.

Increase the time between starting and stopping the timer by standing further away from the wall. ☐

Reduce the amplitude of the sound wave by using a quieter whistle. ☐

Use a timer that measures to the nearest 0.001 s. ☐

[1]

(c) The water waves are transverse waves and the sound waves are longitudinal waves.

Describe the difference between transverse waves and longitudinal waves.

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.....

..... **[2]**

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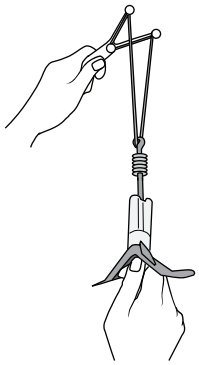
DO NOT WRITE ON THIS PAGE
Turn over for the next question

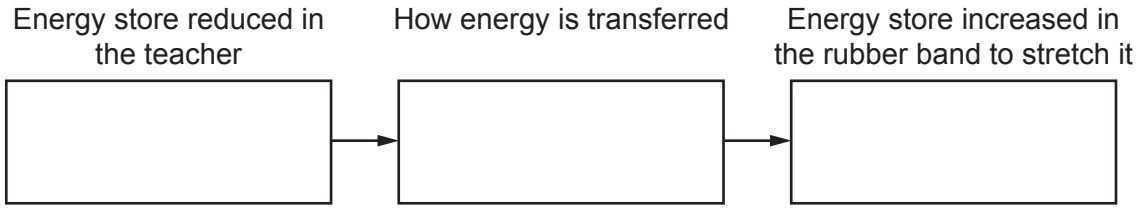
4 A teacher uses a rubber band to fire a toy rocket vertically upwards.



(a) The teacher pulls back the rocket and transfers energy to the rubber band to stretch it.

Complete **Fig. 4.1** to show the energy transfer from the teacher to the rubber band.

Fig. 4.1



[3]

(b) The rocket is released and it leaves the rubber band at a speed of 12.0 m/s.
The mass of the rocket is 0.125 kg.

(i) Calculate the kinetic energy of the rocket as it leaves the rubber band.

Use the equation: kinetic energy = $\frac{1}{2}$ × mass × speed^2

Kinetic energy = ... J **[2]**

(ii) Calculate the maximum height reached by the rocket after it leaves the rubber band.

Use the equation: maximum height = $\frac{\text{kinetic energy}}{\text{mass} \times \text{gravitational field strength}}$

Gravitational field strength = 10 N / kg.

Use your answer to **(b)(i)**.

Maximum height = ... m **[2]**

(iii) Suggest **one** reason why the measured maximum height of the rocket is less than your answer calculated in **(b)(ii)**.

.....

..... **[1]**

(c) When the rocket falls back to the ground it travels at constant speed for most of the journey.

(i) State the value of the resultant force when the rocket is travelling at a constant speed.

Resultant force = ... N **[1]**

(ii) Explain your answer.

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.....

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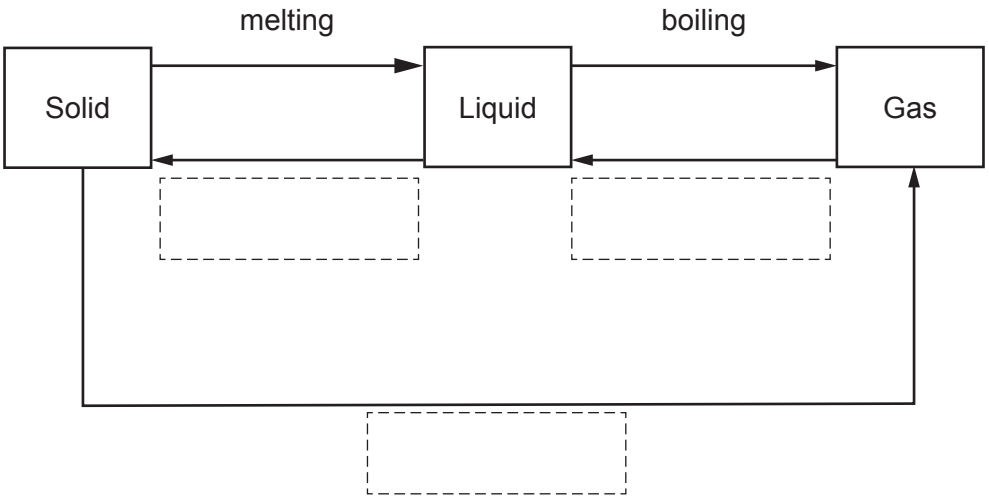
..... **[2]**

5 This question is about the three states of matter.

(a) Complete the diagram by writing in the names of the changes of state.



[3]

(b) Describe the differences in the arrangement and behaviour of the particles in a liquid and a gas.

You can include a diagram to support your answer.

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..... **[4]**

(c) Sasha does an experiment to find the specific latent heat of vaporisation of water.

This is Sasha's method:

- Put an electric heater inside a container.
- Put some water with a mass of 1.00 kg in the container.
- Switch on the electric heater.
- Start a timer when the water starts boiling.
- Stop the timer after 300 seconds.
- Measure the new mass of the water.

This is Sasha's results table:

Starting mass of water (kg)	1.00
New mass of water (kg)	0.80
Energy transferred by the heater (J)	540 000
Time (s)	300

(i) Calculate the power of the electric heater.

Use the equation: energy transferred = power × time

Power = ... W **[3]**

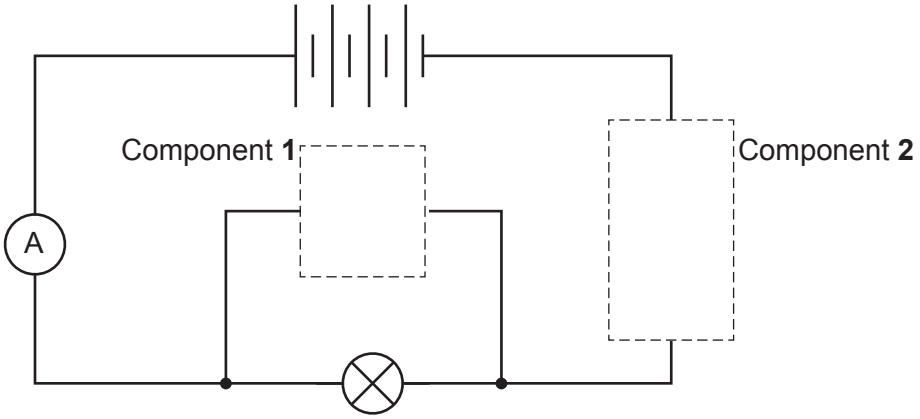
(ii) Calculate the specific latent heat of vaporisation of water.

Use the equation: specific latent heat of vaporisation = $\frac{\text{energy transferred to water}}{\text{mass of water that changed state}}$

Specific latent heat of vaporisation = ... J / kg **[3]**

6 Hiro is investigating how the current through a filament lamp varies with the potential difference across it.

The diagram shows the circuit used by Hiro.
The diagram is **not** complete.

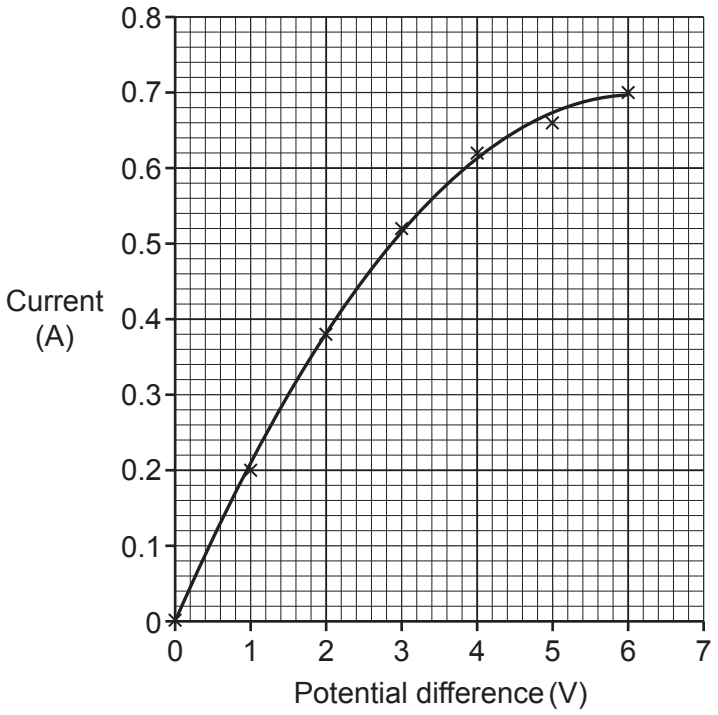


(a) Component **1** is used to measure the potential difference across the filament lamp.

Component **2** is used to change the potential difference across the filament lamp.

Complete the diagram by drawing in the symbols for component **1** and component **2**. **[2]**

(b) The graph shows Hiro's results.



(i) Use the graph to find the current in the filament lamp when the potential difference across it is **2.4 V**.

Current = ... A **[1]**

(ii) Calculate the resistance of the filament lamp when the potential difference across it is 2.4 V.

Use the equation: resistance = $\frac{\text{potential difference}}{\text{current}}$

Use your answer to **(b)(i)**.

Resistance = ... Ω **[2]**

(iii) Explain the relationship between current and potential difference shown on the graph.

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..... **[2]**

7 Ling wants to find out more about the electricity supply and electricity usage in their home.

(a) Complete the sentences about the UK domestic electricity supply.

The frequency of the supply is ..... Hz

The potential difference of the supply is V

[2]

(b) Domestic electricity supply in the UK provides alternating current.

State the difference between alternating current and direct current.

.....

..... **[1]**

(c) Ling wants to know how much they spend on boiling water in the kettle each week.
Ling estimates that the kettle is switched on for a total of **5** hours each week.

Calculate the cost of using the kettle each week.

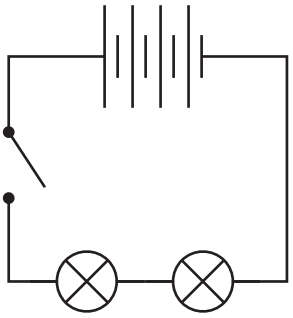
Power of the kettle = 2.6 kW.
Cost of 1 kWh = 35 p.

Use the Equation Sheet.

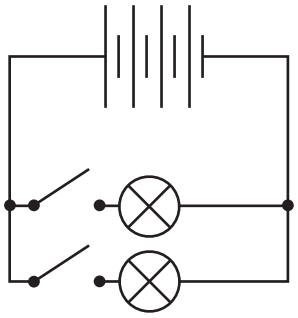
Cost = £ ..... **[4]**

(d)* Ling makes Circuits **A** and **B** to work out what kind of circuit is used in the home.

Circuit A



Circuit B



Explain why Circuit **B** is used in the home rather than Circuit **A**.

Include in your answer:

- a comparison of the potential difference across the lamps in each circuit
- why the current through the battery in Circuit **B** is larger.

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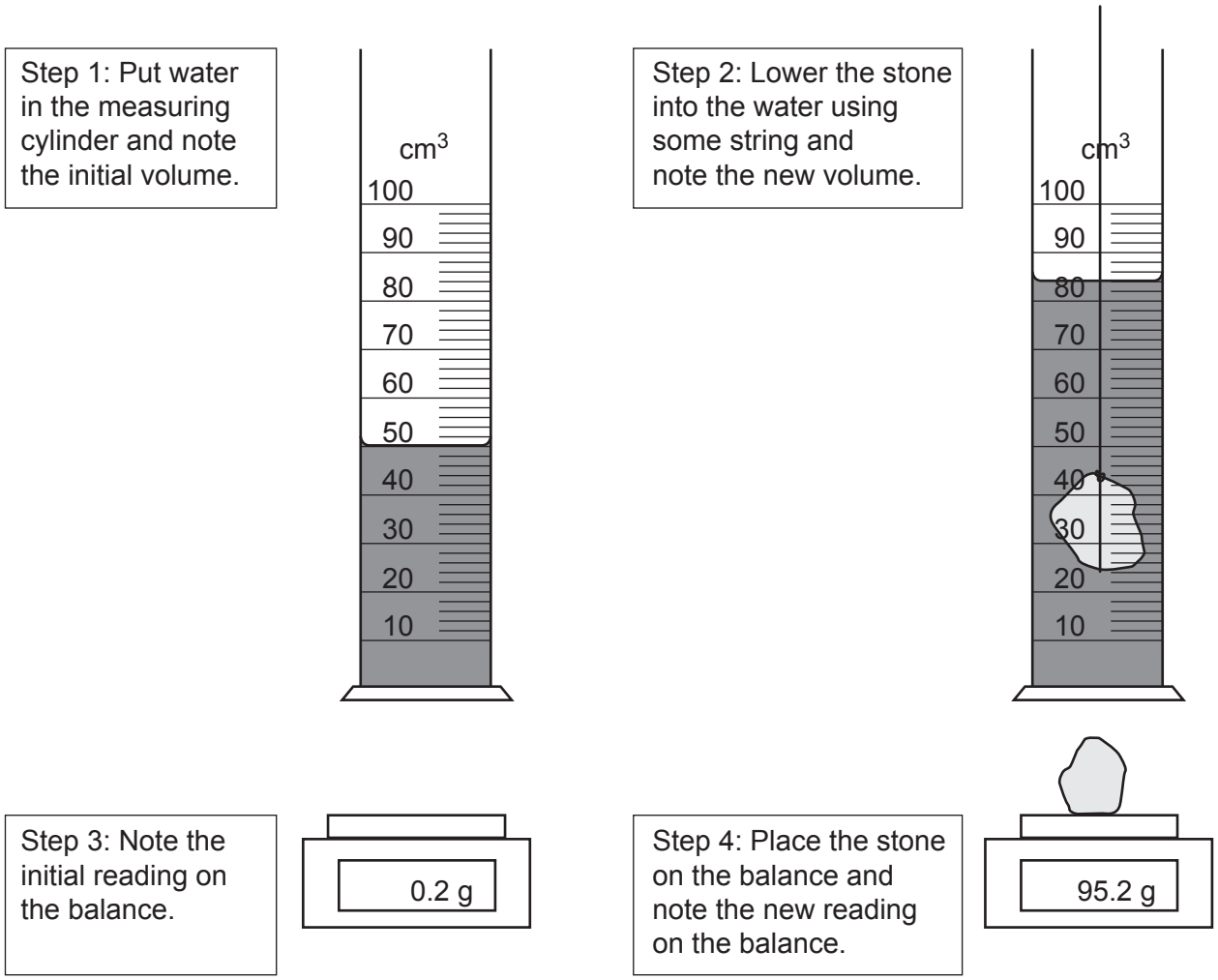
..... **[6]**

8 Ryan does an experiment to determine the density of a stone sample.
They use a 100 cm^3 measuring cylinder and a balance that can measure up to 100.0 g.

Fig. 8.1 shows the steps followed by Ryan.

Fig. 8.1



(a)
(i) Calculate the volume of the stone, using **Fig. 8.1**.

Volume = ... cm^3 **[2]**

(ii) What type of error does the balance show in **Fig. 8.1**?
Tick (✓) **one** box.

Random error ☐

Recording error ☐

Systematic error ☐

[1]

(iii) Calculate the mass of the stone.

Mass = ... g **[1]**

(iv) Calculate the density of the stone.

Use your answers from **(a)(i)** and **(a)(iii)** and the Equation Sheet.

Give your answer to **2** significant figures.

Density = ... g/cm^3 **[4]**

(b) Explain **two** changes that Ryan can make to improve their experiment.

1 .....

.....

.....

.....

2 .....

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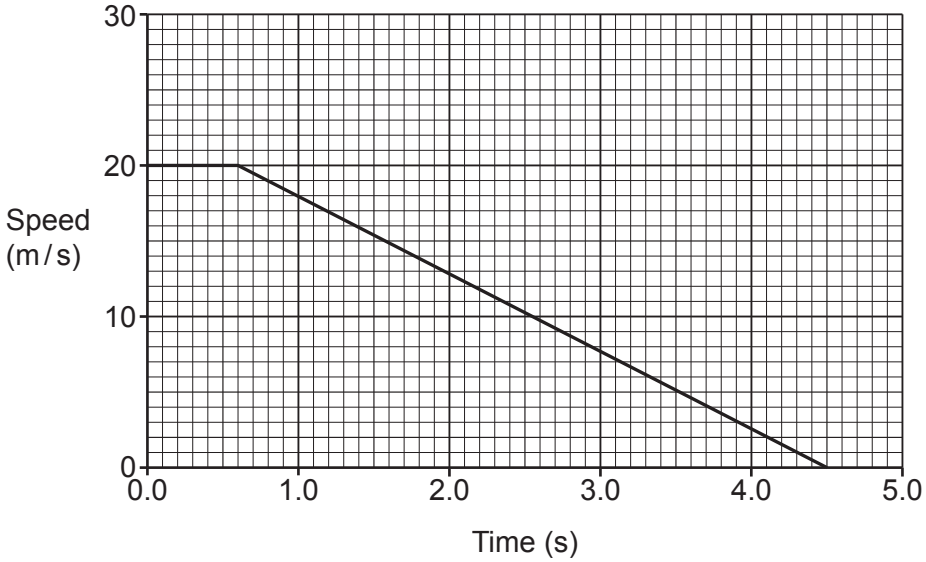
[4]

9 Casey is driving a car along a straight, level road when they see a road block ahead.

The graph shows how the speed of the car changes with time immediately after Casey sees the road block.



(a) While Casey is reacting to the obstruction the car continues to travel at constant speed.

Calculate the distance travelled by the car while Casey is **reacting**.

Use the Equation Sheet.

Distance = ... m **[4]**

(b) The initial kinetic energy of the car is 174 kJ.

When Casey presses the brakes, the braking force acting on the car is 4350 N.

The work done by the brakes to stop the car = the kinetic energy lost by the car.

Calculate the distance travelled while the car is braking.

Use the equation: work done = force × distance

Distance = ... m **[4]**

(c) In the village where Casey lives the speed limit has been reduced from 30 mph to 20 mph.

Explain how reducing the speed limit can improve road safety in the village.

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.....

.....

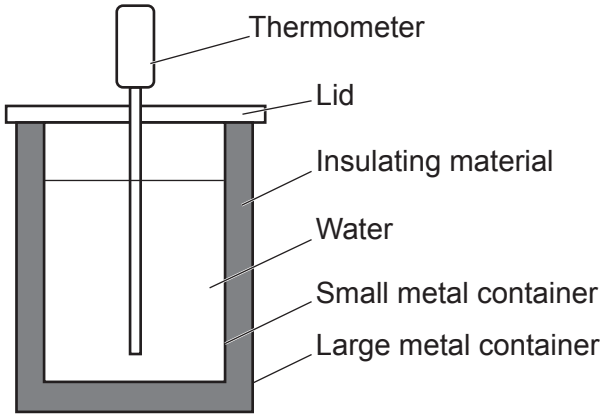
..... **[2]**

10 Amit does an experiment at room temperature to compare the thermal conductivity of different insulating materials.

(a) This is Amit's method:

- Place a small metal container inside a large metal container.
- Place some insulating material between them.
- Pour water at a temperature of 80 °C into the small container and place a lid on it.
- Measure the temperature of the water every minute for 30 minutes using a thermometer.
- Repeat the experiment using different insulating materials.

This is the apparatus used:



(i) State **two** variables that Amit should control in this experiment.

1 .....

2 .....

[2]

(ii) Explain why Amit uses metal containers rather than plastic containers.

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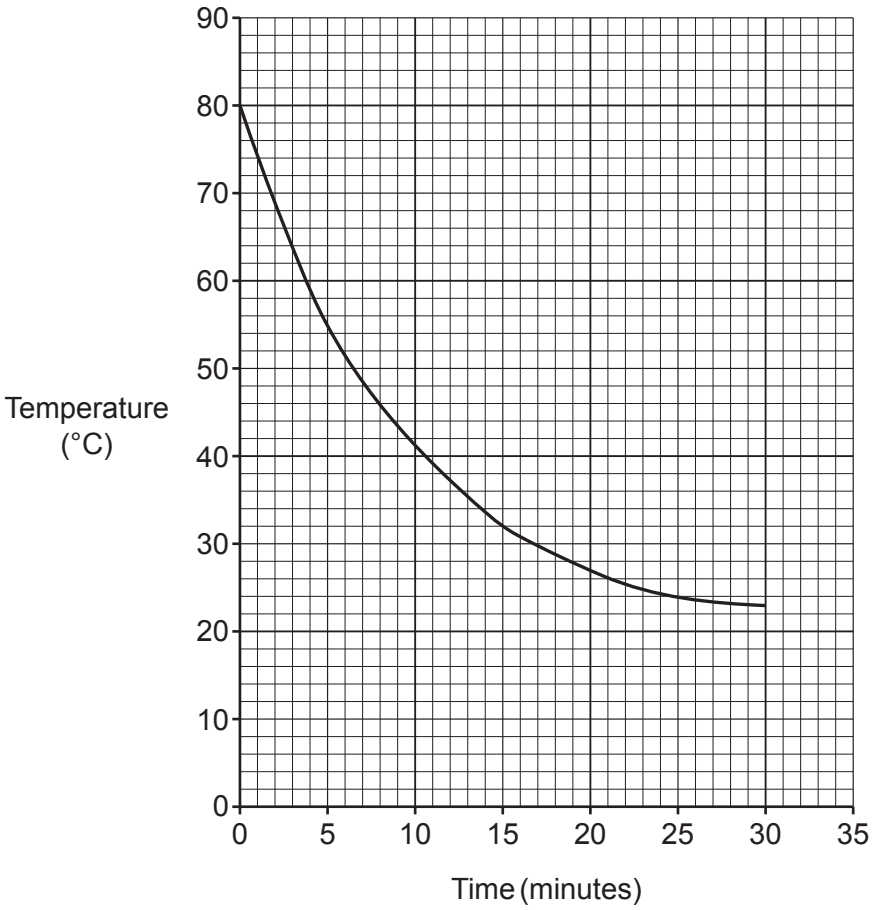
..... **[2]**

(b) The graph shows Amit's results for one insulating material.



(i) Draw a tangent to the curve at time of 15 minutes. **[1]**

(ii) Calculate the gradient of the tangent drawn in **(b)(i)**.

Gradient = ... °C / minute **[2]**

(iii) Sketch a curve on **the graph** to show the results of the experiment when a material of **higher** thermal conductivity is used. **[2]**

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.