Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2023

Physics

Unit 3 Practical Skills

Booklet B

Foundation Tier

[GPY32]

GPY32

TUESDAY 27 JUNE, MORNING

TIME

1 hour

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

13461

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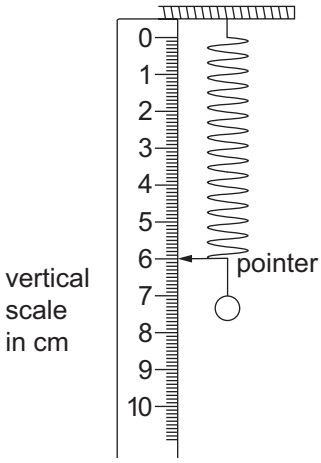
1 **(a)** A student investigates the stretching of a spring using the apparatus shown below.
The reading on the scale was recorded when slotted masses were added to stretch the spring.
The diagram shows the spring before slotted masses were added.



(i) What force is provided by a slotted mass of 100 g? _____ N [1]

(ii) Using the diagram, what is the unstretched length of the spring?

_____ cm [1]

(iii) What should the student do to make an accurate scale reading?

_____

_____ [1]

(iv) When masses are added, how is the extension of the spring calculated using the reading on the scale and the unstretched length of the spring?

_____

_____ [1]

[Turn over

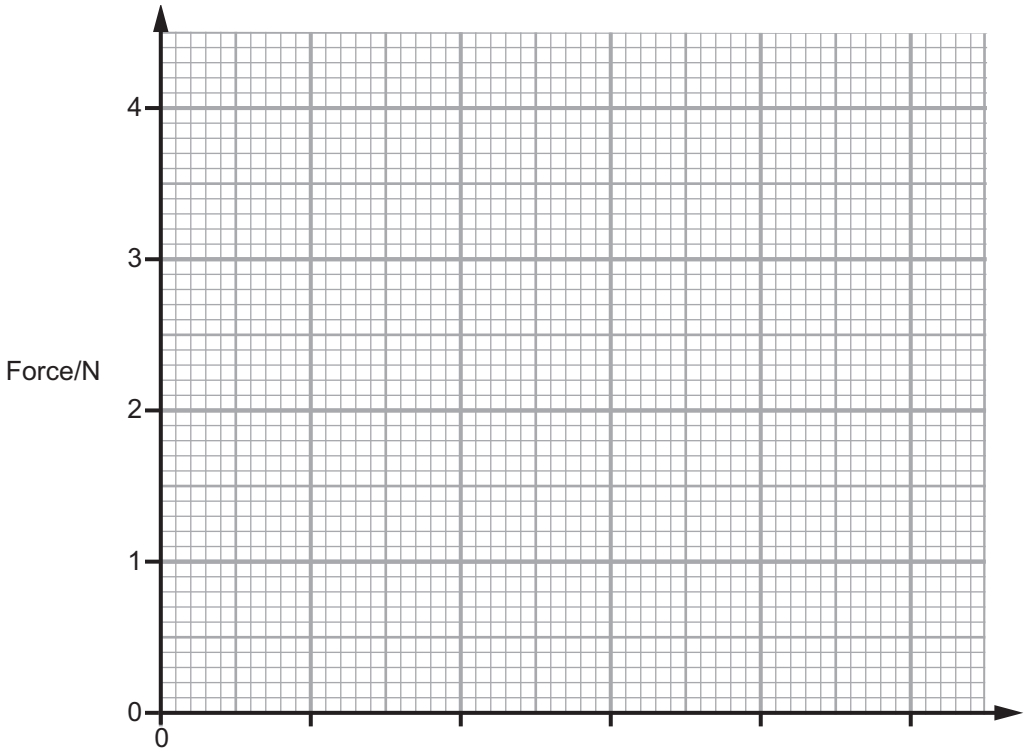
(b) In another experiment to investigate the stretching of a spring, the measurements of force and reading on the scale are shown in the table below.

Force/N	Reading on the scale/cm	
0	6.0	
1	8.0	
2	10.0	
3	12.0	
4	14.0	

Add a column heading with unit here

Using the measurements in the table above, calculate the extension of the spring for each of the various forces.
Give your answers to one **decimal** place.
Write your values in the blank column shown and add a **heading with unit**. [4]

(c) (i) Plot a graph of force (y-axis) against extension (x-axis).
Label the x-axis with the quantity and its unit.
Draw the best fit line through your points.
Use ⊙ or × to clearly mark your points. [5]



(ii) The relationship between the stretching force **F**, the spring constant **k** and the extension **e** is given by the equation

$$\mathbf{F = ke}$$

Using your graph, find the value of the spring constant **k**.
Show clearly how you get your answer.
State the unit of **k**.

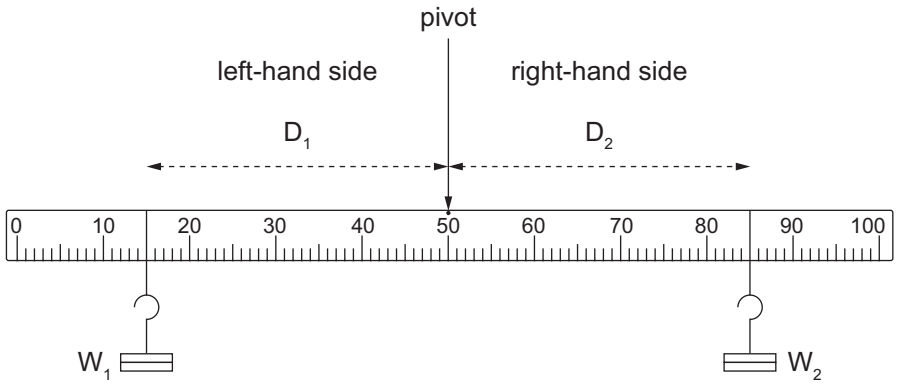
k = _____

Unit = _____ [4]

(iii) On the grid **above**, draw the graph that would be obtained if a spring had a spring constant **twice** the value of the one used. [3]

[Turn over

2 **(a)** The diagram below shows the equipment that can be used to verify the Principle of Moments.
Different weights were placed at various positions on both sides of the metre rule and their position adjusted until the metre rule was balanced.



(i) Using the Principle of Moments, complete the table by inserting the distance from the pivot, D_1 or D_2.
Write your answers in the appropriate blank space.

Left-hand side			**Right-hand side**	
W_1/N	**D_1/cm**		**W_2/N**	**D_2/cm**
2			3	10
1	25		2	
2			1	40

[3]

You may use the space below for your calculations.

(ii) A 4 N weight was placed 40 cm from the pivot on the left-hand side. Explain why it is not possible to position a 2 N weight on the right-hand side to balance the metre rule.

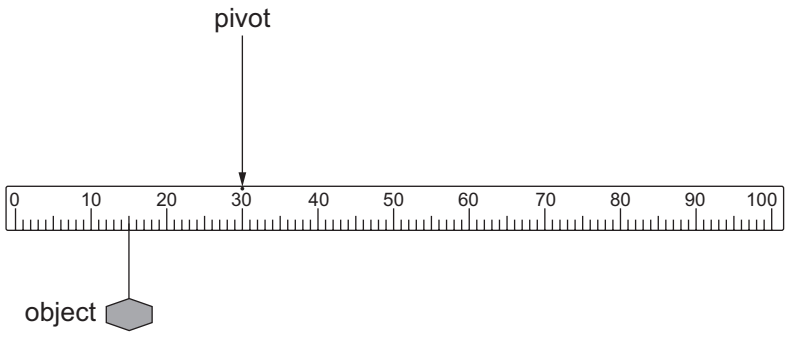
_____

_____

_____ [2]

[Turn over

(b) The weight of an object can be found using a metre rule and applying the Principle of Moments. The diagram below shows the arrangement that could be used.



(i) On the diagram, mark with an X the position of the centre of gravity of the metre rule. [1]

(ii) What is the direction of the moment produced by the weight of the metre rule?

_____ [1]

(iii) Using the information from the diagram above, calculate the weight of the object attached to the metre rule.
The weight of the metre rule is 1.5 N.
Show clearly how you get your answer, starting with the equation you plan to use.

Weight of the object = _____ N [4]

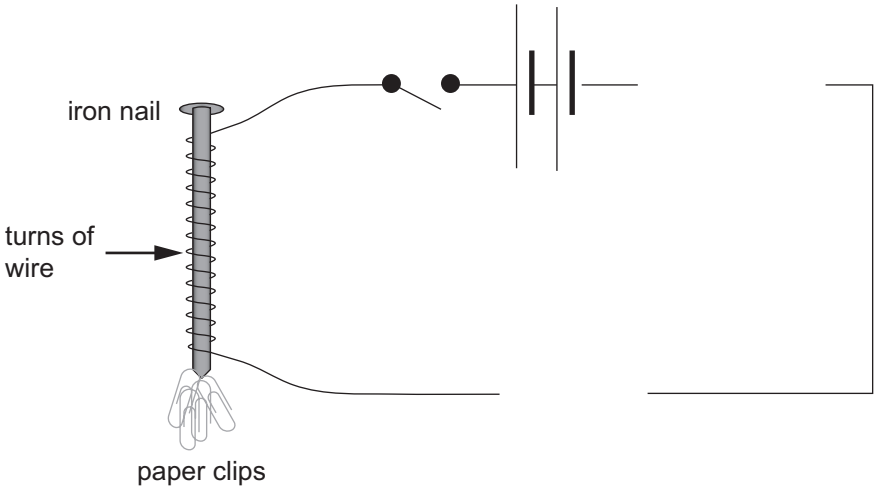
(iv) Describe what should be done to make your measured value for the weight of the object more reliable.

_____

_____ [2]

3 An electromagnet can be made by wrapping wire around an iron nail to form a coil as shown below.

To investigate how the number of turns on the coil affects the strength of the electromagnet the apparatus shown below was used.



The electromagnet was used to pick up paper clips.

A coil of 10 turns was first used. The number of turns was increased in steps of 5 turns until finally a coil of 30 turns was used.
For each coil with different numbers of turns the number of paper clips that were picked up by the electromagnet was counted.

(a) (i) It is important that the current is the same for each coil.
Add **two** components to the circuit, in the gaps provided, that would allow this to be done.
Use the correct symbols for the components. [2]

(ii) Describe how the components are used to achieve this constant current.

_____

_____

_____

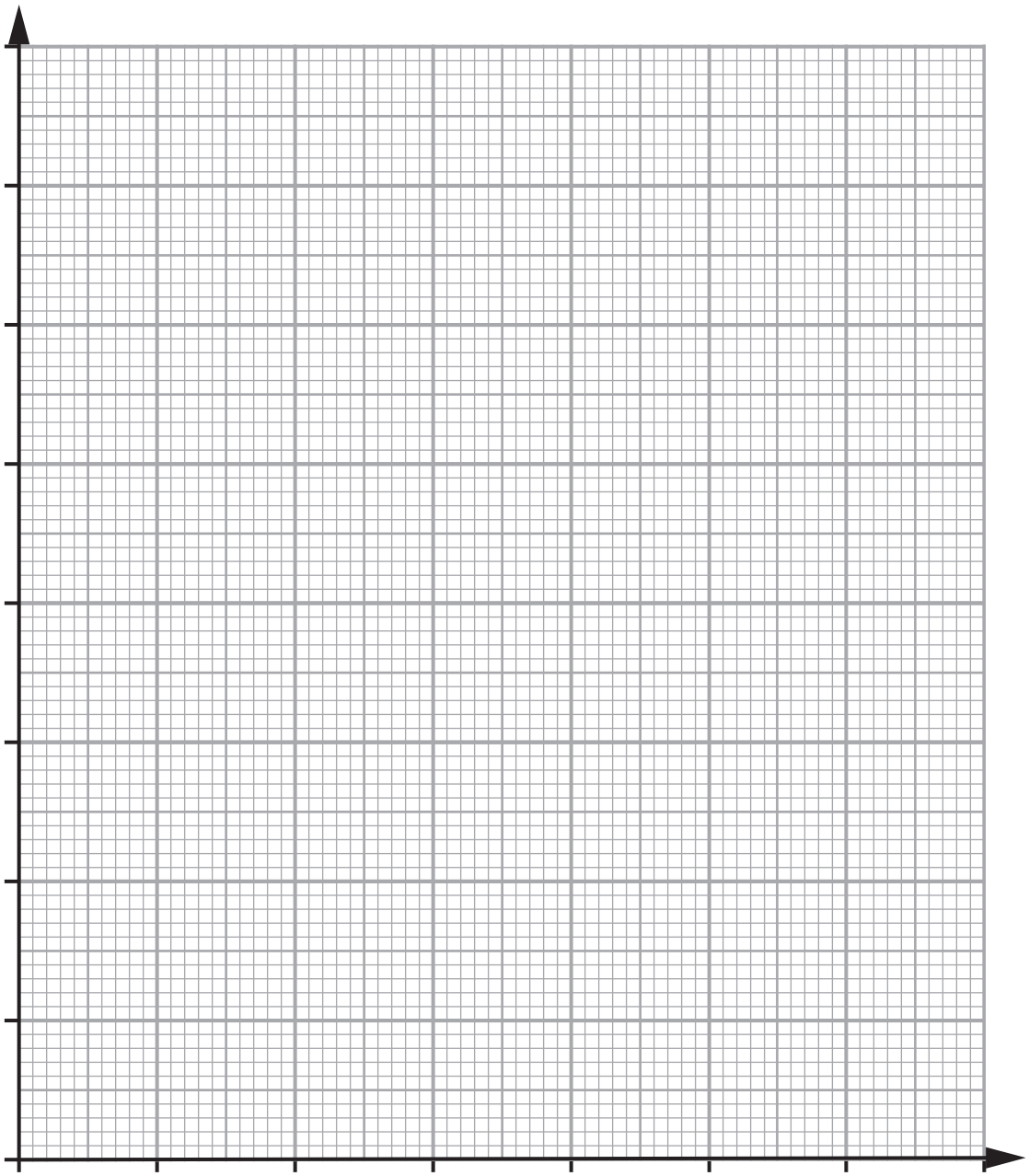
_____ [2]

[Turn over

(b) The table below shows the results of this experiment.

Number of turns on the coil	Number of paper clips picked up
10	4
15	6
20	8
25	10
30	12

(i) On the grid below, plot the graph of the number of paper clips picked up (y-axis) and the number of turns on the coil (x-axis).
Use ⊙ or × to clearly mark your points.
Label each axis with the quantity and unit, if appropriate.
Draw the best fit line through the points.



[6]

[Turn over

(ii) The relationship between the number of coils and the number of paper clips picked up is shown below.

number of paper clips = k × number of coils

Using the graph, find the value of **k**.
Show clearly how you get your answer.

k = _____ [3]

(c) In another investigation, the number of turns on the coil was kept constant and the current changed. The number of paper clips picked up for each value of the current in the electromagnet was counted.

(i) For this investigation, name the **dependent** variable.
Explain your answer.

_____

_____

_____ [2]

(ii) For this investigation, name the **independent** variable.
Explain your answer.

_____

_____

_____ [2]

(iii) For this investigation, name a **controlled** variable.
Explain your answer.

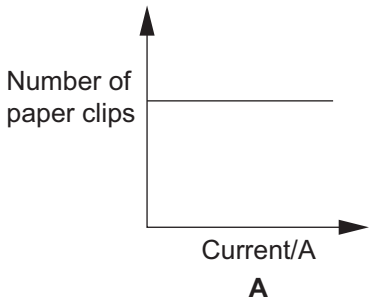
_____

_____

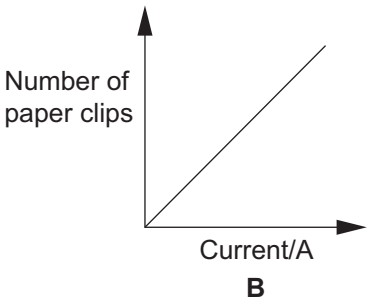
_____ [2]

The results of the investigation are shown in the table below.

Current/A	Number of paper clips picked up
0.5	2
1.0	4
1.5	6
2.0	8
2.5	10



A



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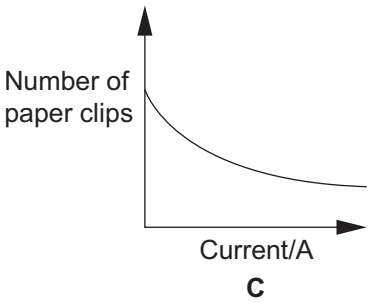

C

(iv) If a graph was plotted using these values, which one of the graphs shown above would be obtained? Explain your answer.

Graph _____

Explanation _____

_____ [2]

[Turn over

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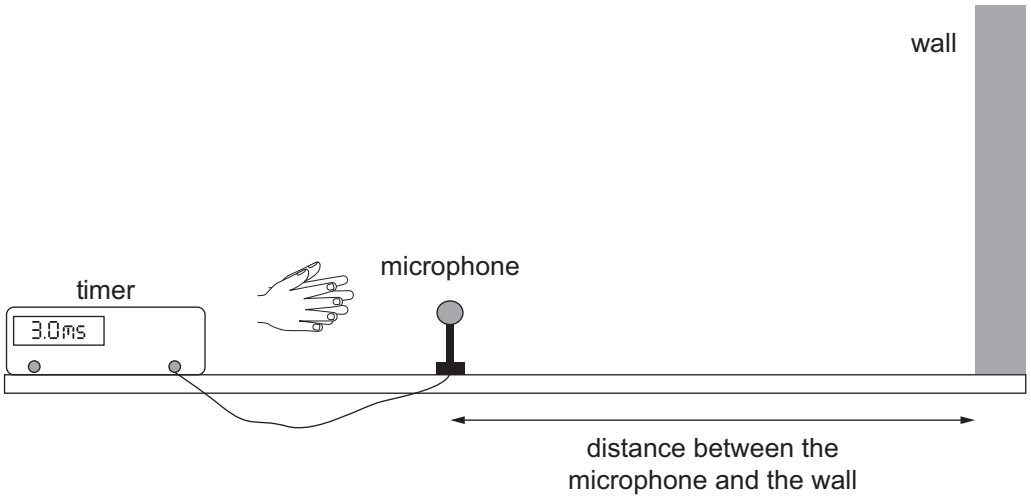
4 **(a)** The reflection of sound from a wall is known as an echo.
Echoes can be used to measure the speed of sound using the apparatus shown below.
A loud sound is made by clapping hands.
The sound travels to a microphone which starts the timer.
When the sound has been reflected by the wall it reaches the microphone for a second time and the timer is stopped.



The experiment is repeated as the distance between the microphone and the wall is changed.

[Turn over

The results are shown in the table below.

Distance between the microphone and the wall/m	Time shown on the timer/milliseconds	Time to travel the distance between the microphone and the wall/milliseconds
0.25	1.5	
0.50	3.0	1.5
0.75	4.6	2.3
1.00	4.0	2.0
1.25	7.6	3.8
1.50	9.0	

Complete these values

Note 1 millisecond (ms) = 0.001 s

(i) Some of the results are shown in the table above, but two have been left blank.
Complete the table by calculating the time taken for the sound to travel the distance between the microphone and the wall for those values left blank.
Give your values to **1 decimal place**.
Remember, the timer shows the time it takes the sound to travel to the wall and return to the microphone. [3]

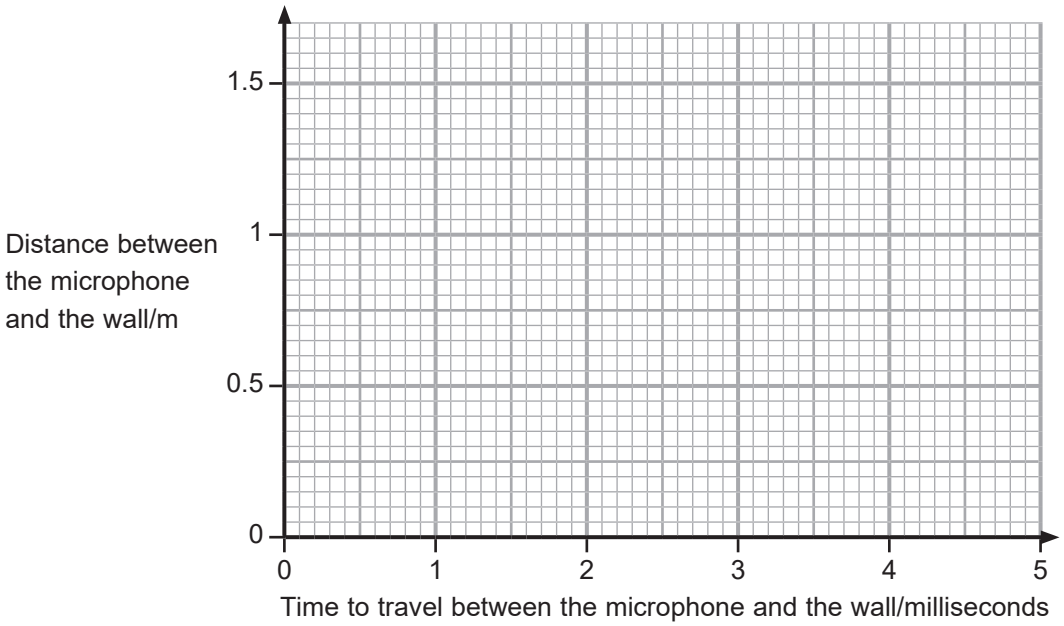
(ii) One of the time measurements is clearly anomalous.
Circle the anomalous time value. [1]

(iii) What is best experimental practice when an anomalous result is noticed?

_____ [1]

(b) (i) On the grid below, plot a graph of distance between the microphone and the wall (y-axis) against the time to travel between the microphone and the wall (x-axis).

Plot the results, using ⊙ or × to clearly show the points.
Draw the line of best fit through your points. [4]



(ii) Calculate the gradient of your best fit line.
Show clearly how you get your answer.

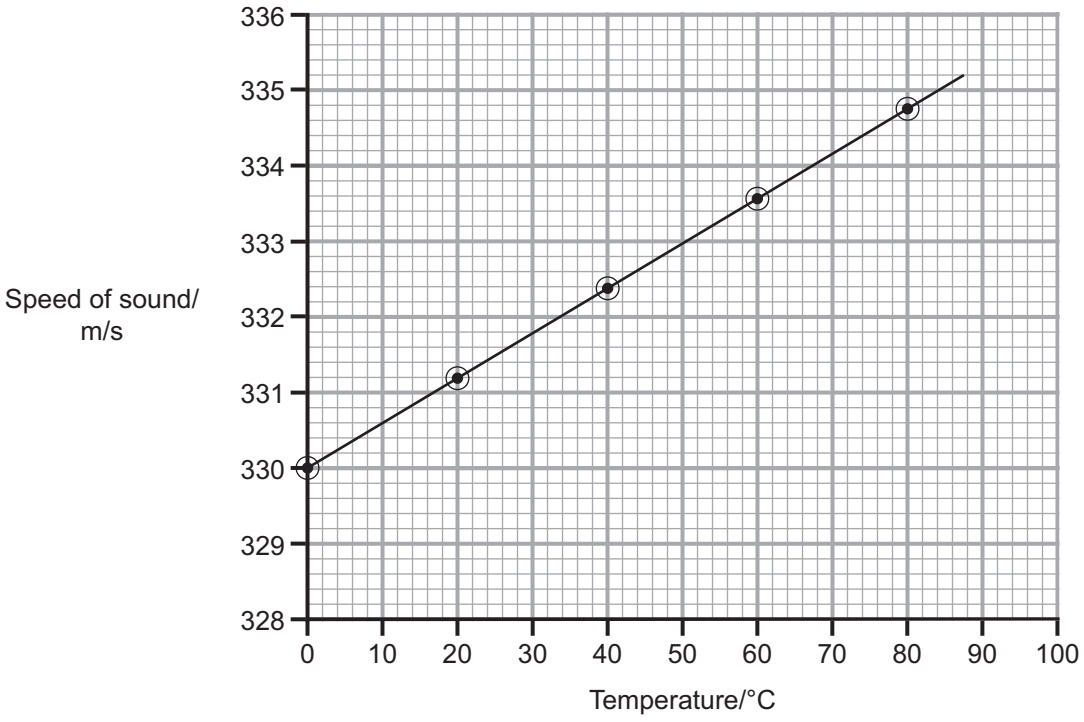
Gradient = _____ m/ms [2]

(iii) What does the value of the gradient of the distance–time graph represent?

_____ [1]

[Turn over

(c) The speed of sound depends on the temperature of the air.
The graph below shows how the speed of sound changes as the air temperature changes.



(i) Using the graph, calculate the difference between the speed of sound at 20°C and its speed at 40°C.
Show clearly how you get your answer.

Difference = _____ m/s [3]

(ii) Explain why the graph shows that the speed of sound is **not** proportional to the temperature of the air.

_____

_____ [1]

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
Total Marks	

Examiner Number