Rewarding Learning

Centre Number

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2022

Physics

Assessment Unit AS 3B
(Theory)
assessing
Practical Techniques and Data Analysis

[SPH32]

SPH32

MONDAY 9 MAY, AFTERNOON

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 five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You may use an electronic calculator.

1 An elastic band was loaded and then unloaded. **Table 1.1** shows the extension e of the elastic band as the load F was changed.

Table 1.1

F / N	0	1.96	3.38	5.91	7.85
Loading e/cm	0	4.2	9.4	15.0	16.0
Unloading e/cm	0	2.0	6.2	12.6	16.0

(a) On **Fig. 1.1**, plot a graph of e against F and draw two smooth curves through the points, one for loading and the other for unloading.

Mark your points clearly using a ⊙ or a +.

(b) The energy converted to heat in the process of loading and unloading the elastic band is given by the area enclosed between the two curves. Estimate the energy converted to heat.

Energy = _____ J [3]

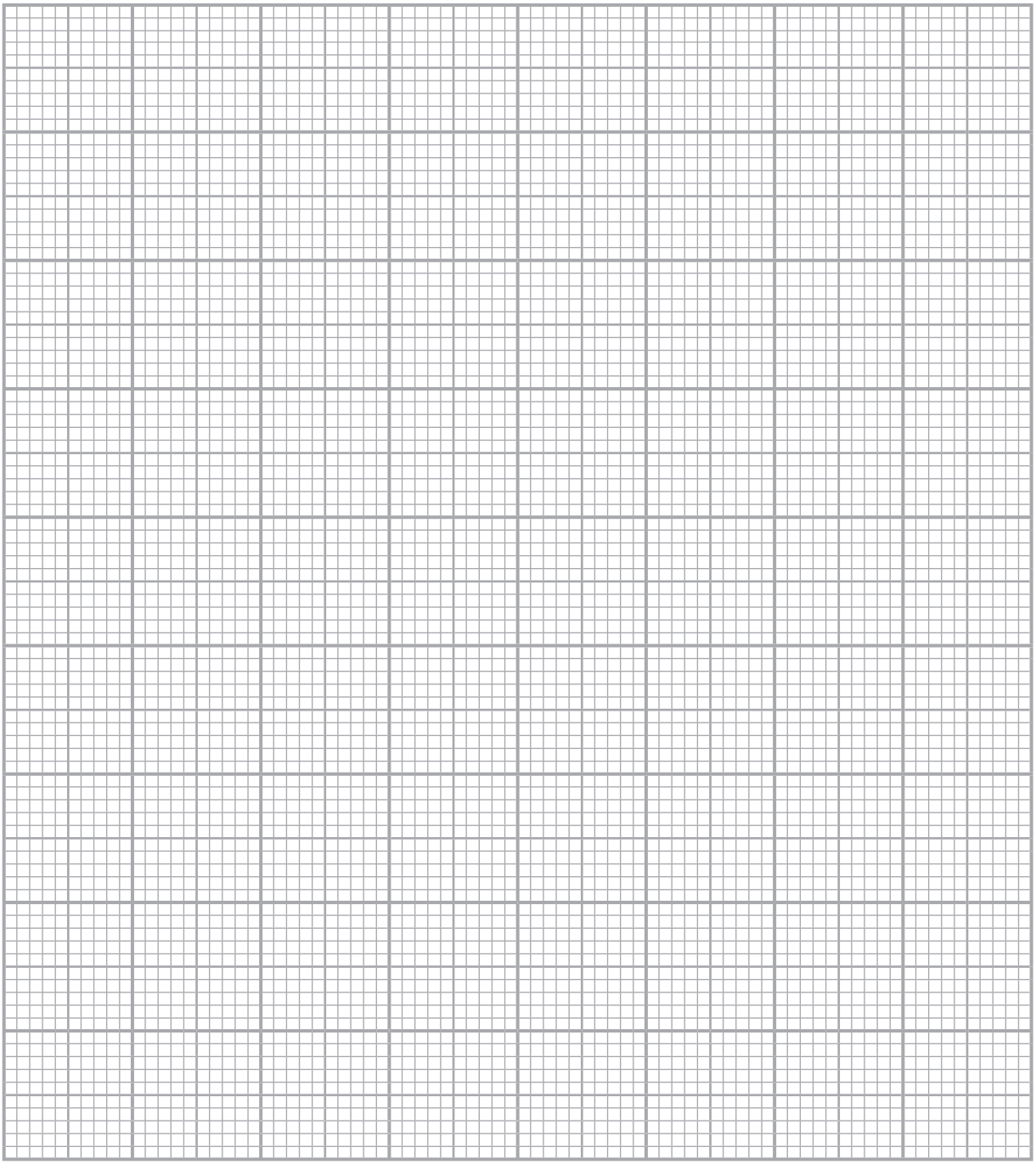

Fig. 1.1

[8]

[Turn over

2 When an object moves through a fluid it is acted on by a drag force F_D given by **Equation 2.1**.

$$F_D = \frac{1}{2}\rho A C_D v^2 \qquad \textbf{Equation 2.1}$$

ρ is the density of the fluid, A is the area of the front face of the object that is moving through the fluid, v is the velocity of the object and C_D is a constant called the drag coefficient.

In testing, the drag force F_D on a cyclist is measured as the velocity v of the cyclist changes. A graph of F_D against v^2 has been plotted on the grid of **Fig. 2.1**.

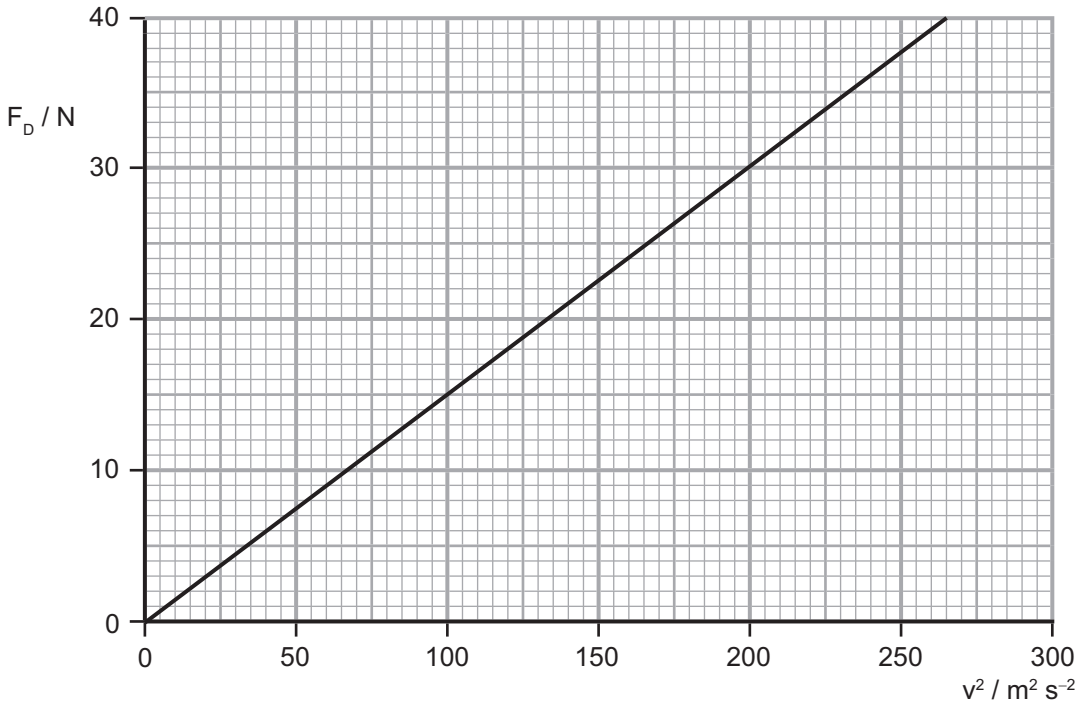

Fig. 2.1

(a) Determine a value for the gradient of the graph and give the unit of the gradient. If there is no unit write 'no unit'.

Gradient = _____ Unit = _____ [4]

(b) (i) The area A of the front face of the cyclist is $0.22\,m^2$ and the density of the air through which the cyclist is moving is $1.23\,kg\,m^{-3}$. Use your answer to part **(a)** to calculate the value for C_D for the cyclist.

C_D = _____ [3]

(ii) Express the newton in base units and use this to determine the unit, if any, for C_D. If there is no unit write 'no unit'.

Unit of C_D = _____ [2]

[Turn over

3 The fundamental frequency f of an oscillating stretched string depends on the length L of the string, the tension T in the string and the mass per unit length μ of the string as shown in **Equation 3.1**.

$$f = \frac{1}{2L}\sqrt{\frac{T}{\mu}} \qquad \textbf{Equation 3.1}$$

A metre rule was used to measure the length of the string. The value of the length was recorded in **Table 3.1**.

To find the mass per unit length, one metre of the string was placed on an electronic balance. The reading on the balance is shown in **Fig. 3.1a**.

A newton-meter, with a scale range from 0 to 15 N, was used to measure the tension in the string. The reading on the newton-meter is shown in **Fig. 3.1b**.

Fig. 3.1a

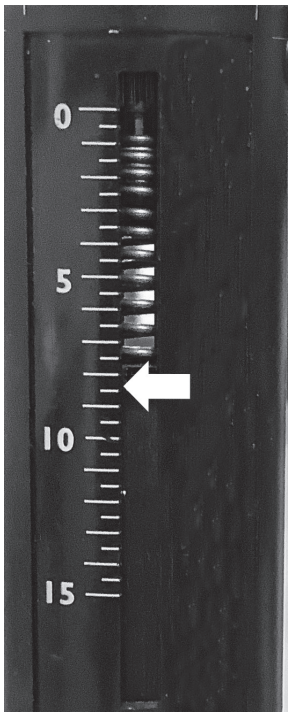

Fig. 3.1b

(a) (i) Insert the two missing values in **Table 3.1** and include their units. [2]

(ii) State the uncertainty for all three of the values in **Table 3.1**. [3]

Table 3.1

Measurement	**Value**	**Uncertainty**
Length	0.750 m	
Mass		
Tension		

(b) Calculate a value for f and the absolute uncertainty in the f value.

f = _____ Hz

Uncertainty in f = _____ Hz [7]

[Turn over

4 An insulated strip of copper of length **0.60 m** has one end maintained at a constant temperature above room temperature. Points have been plotted on the grid of **Fig. 4.1** showing the temperature θ of the strip at various distances along its length l.

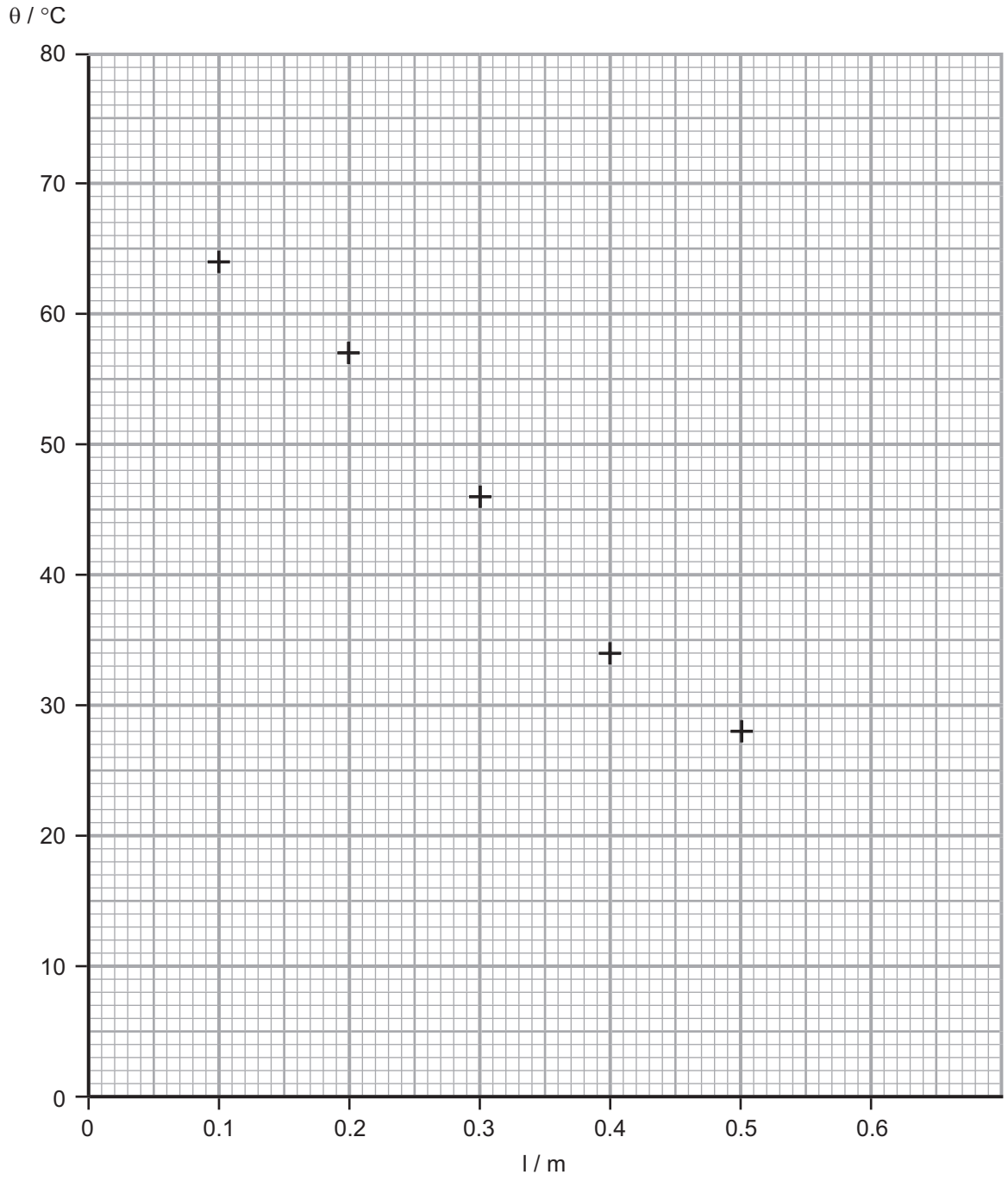

Fig. 4.1

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(a) Draw the best fit straight line for the plotted points. [1]

(b) Determine the difference between the temperatures at each end of the copper strip.

Show your working out clearly.

Difference in temperature = _____ °C [3]

(c) Use your graph to obtain a value for the percentage uncertainty in your answer to part **(b)**.

Percentage uncertainty = _____ % [5]

[Turn over

5 A pivot is placed under the centre of a non-uniform wooden pole and the pole tilts as shown in **Fig. 5.1**.

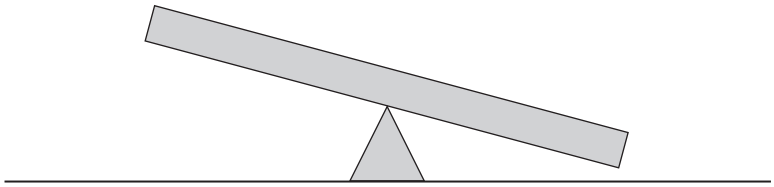

Fig. 5.1

(a) (i) How can you tell from the diagram that the pole is non-uniform?

_____ [1]

(ii) On **Fig. 5.1**, mark a possible location for the centre of gravity of the pole. Label this point X. [1]

(iii) Describe how the position of the centre of gravity could be located.

_____

_____

_____ [2]

(b) Assume the position of the centre of gravity of the wooden pole is known. Using a mass of known value and the arrangement shown in **Fig. 5.1**, describe an experimental procedure that uses the principle of moments to obtain an accurate value for the mass of the pole.

[5]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

Examiner Number