Rewarding Learning

ADVANCED
General Certificate of Education
2024

Centre Number

Candidate Number

Physics

Assessment Unit A2 3B

assessing

Practical Techniques and Data Analysis

[APH32]

APH32

MONDAY 17 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 questions in black ink and use a dark HB pencil for drawings and graphs.
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 a scientific calculator.

1 A cathode ray oscilloscope is being used to display audible sound waves produced by a vibrating tuning fork. The audible frequency range of sound waves is 20–20,000 Hz. The pattern of waves observed on the screen is shown in **Fig. 1.1**.

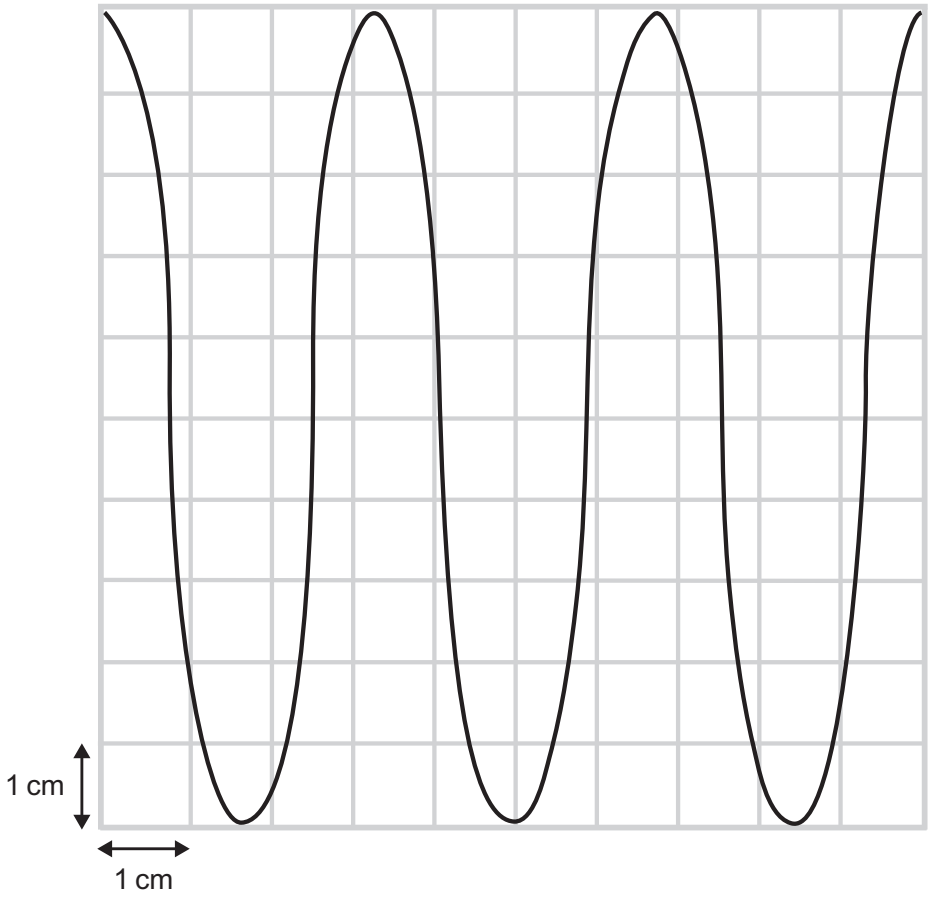

Fig. 1.1

The students using the oscilloscope cannot read the timebase setting, due to the display digits being worn away. They cannot tell whether the setting is 50 ms cm^{-1} or 500 µs cm^{-1}. Carry out calculations to determine which of the two values is the correct one for the audible sound wave, and give a reason for your answer.

Timebase setting = _____

Reason for choosing this setting:

_____

_____

_____ [6]

[Turn over

2 A 100 cm^3 laboratory beaker is shown in **Fig. 2.1**.

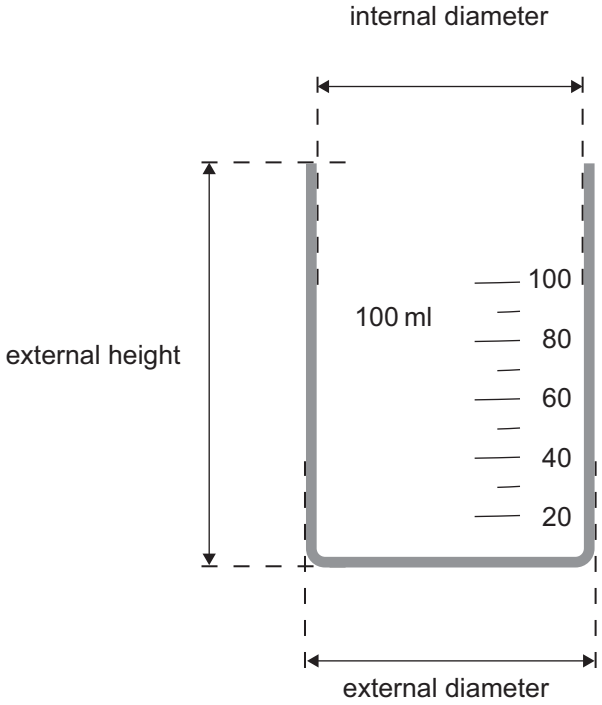

Fig 2.1

Various measurements of the beaker were made and recorded in **Table 2.1**.

Table 2.1

Measurement	Value / cm
External height	6.80
Internal diameter	4.76
External diameter	5.04

(a) What instrument was used to take these measurements?

_____ [1]

(b) The volume of a cylinder of diameter d and height h is given by **Equation 2.1**.

$$\text{Volume} = \frac{\pi d^2 h}{4} \qquad \textbf{Equation 2.1}$$

Use the values given in **Table 2.1** and **Equation 2.1** to calculate:

(i) the external volume of the beaker.

External volume = _____ cm^3 [3]

(ii) the percentage uncertainty in the value you have calculated in **(i)**.

Percentage uncertainty = _____ % [3]

[Turn over

(iii) the thickness of the glass wall of the beaker.

Thickness = _____ cm [1]

(iv) the volume of glass used to make the beaker, assuming the thickness of the wall is the same as the thickness of the base of the beaker.

Volume of glass used = _____ cm^3 [3]

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(Questions continue overleaf)

[Turn over

3 A very flexible plastic rod was clamped over the edge of a desk. The length of the rod overhanging the desk was varied and values of distances A and B, as shown in **Fig. 3.1,** were measured.

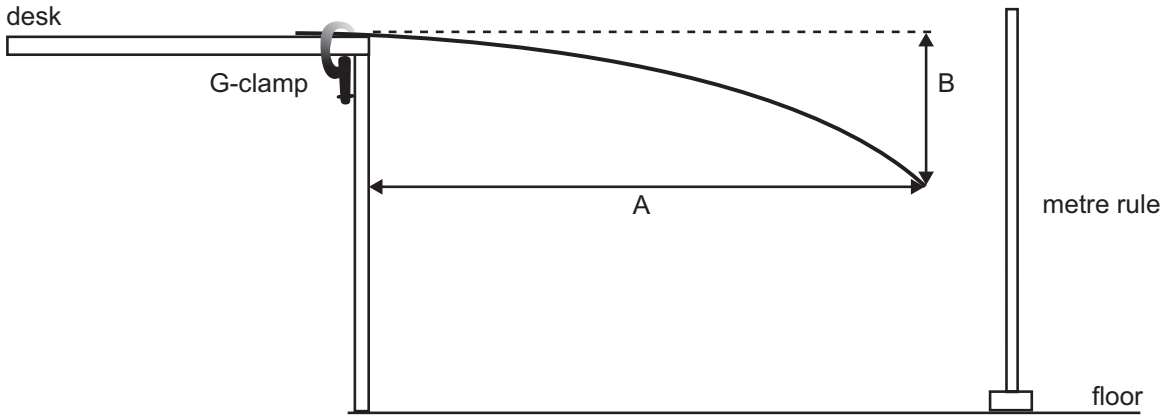

Fig. 3.1

(a) The distance B was measured using a metre rule placed on the floor as shown in **Fig. 3.1**. Suggest how the measurement can be made as accurate as possible.

_____

_____ [2]

(b) The relationship between A and B is given by **Equation 3.1**, where n is an integer.

$$B = kA^n \qquad \textbf{Equation 3.1}$$

By mapping to the equation of a straight line, show that a graph of $\log_{10}B$ against $\log_{10}A$ will be a straight line with a gradient equal to the integer n.

[2]

(c) Values of A and B are shown in **Table 3.1**.

Table 3.1

A / cm	B / cm		
106.6	38.5		
94.9	21.4		
84.3	15.0		
73.8	8.8		
63.0	4.5		

(i) Calculate the values of the additional quantities required in order to draw the graph and record these to 2 decimal places in **Table 3.1**. Head the columns appropriately. [4]

(ii) Select suitable scales and label the axes to enable you to plot a graph of log B against log A on the grid of **Fig. 3.2**. Draw the best fit straight line for the points plotted. [5]

[Turn over

(d) (i) Use your graph to determine a value for the integer n.

n = _____ [3]

(ii) Use your value of n to find a value for the constant k and determine the unit of the constant k.

k = _____

Unit of k = _____ [5]

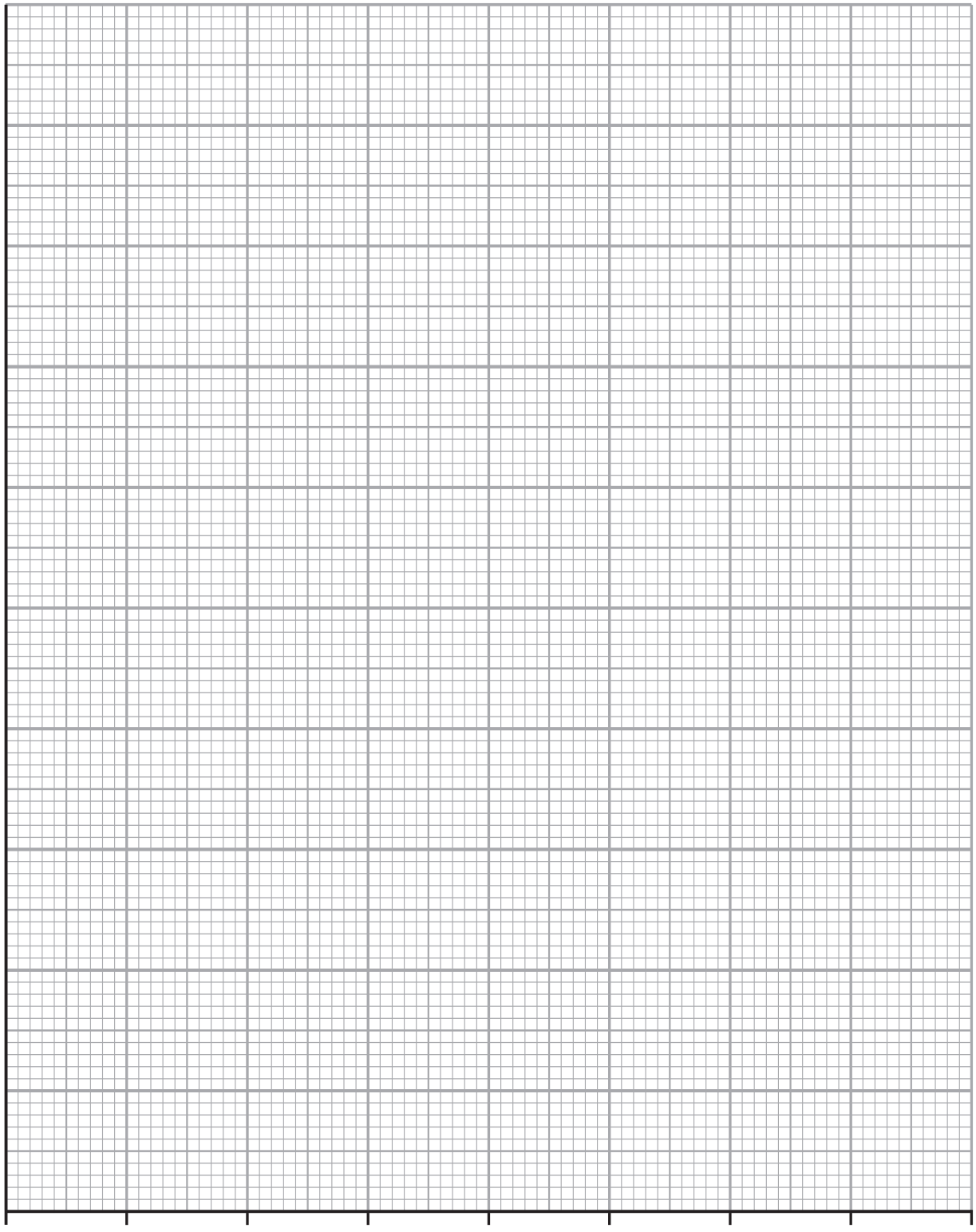

Fig. 3.2

[Turn over

4 Electric current is passed through metal wires of the same material and length but different diameters. The current is increased until the wire melts and the circuit is broken. The value of the current is recorded and the process repeated for each wire of different diameter. The 'fusing current' is the name given to the current value at which the piece of wire melts.

Table 4.1 shows the fusing currents for the wires of different diameter.

Table 4.1

Diameter d / mm	Fusing current I_f / A
1.02	84.0
0.81	58.6
0.57	36.7
0.40	20.5
0.21	7.3

Preece's law states that the fusing current I_f depends upon the diameter d of the wire as shown by **Equation 4.1**

$$I_f = C\ d^{3/2} \qquad \textbf{Equation 4.1}$$

where C is a constant called Preece's coefficient.

(a) The graph of **Fig. 4.1** indicates a proportional relationship between the two quantities that have been plotted. Given that I_f^2 has been plotted on the y-axis, use **Equation 4.1** and **Fig 4.1** to determine the quantity plotted on the x-axis and its unit.

Quantity on x-axis = _____

Unit = _____ [2]

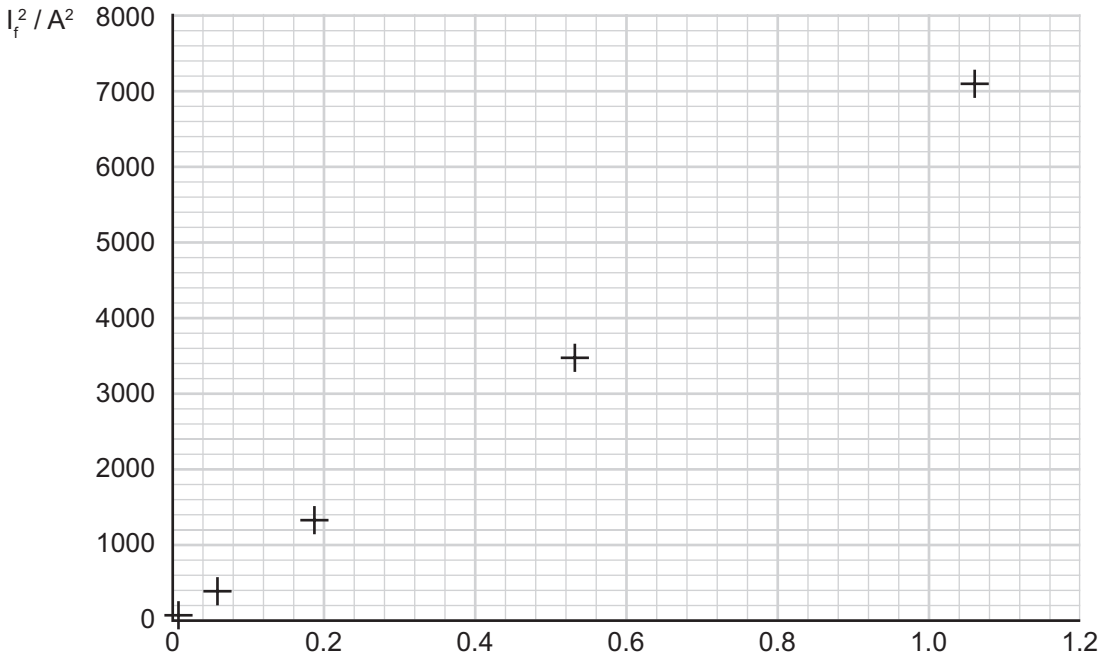

Fig. 4.1

(b) Draw the line of best fit on **Fig 4.1**. [1]

(c) Determine the fusing current that would be expected for a wire of the same material with a diameter of 0.90 mm.

Fusing current = _____ A [3]

[Turn over

5 In an experiment to investigate the pressure law, a fixed volume of gas was heated in a flask in a water bath as shown in **Fig. 5.1**.

The gas pressure was measured using a pressure gauge and the temperature using a thermometer.

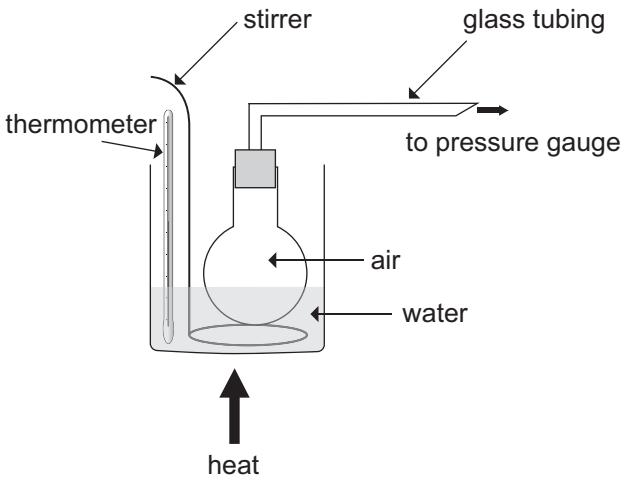

Fig. 5.1

(a) In order to obtain more accurate results, suggest how the apparatus as shown in **Fig. 5.1** should be modified and why this should be done.

_____

_____

_____

_____ [2]

(b) Why is it good practice to stir the water as it is heated?

_____

_____ [1]

(c) The pressure law states that for a constant volume of gas the absolute temperature and pressure are directly proportional. A straight line graph through the origin as shown in **Fig. 5.2** would confirm proportionality.

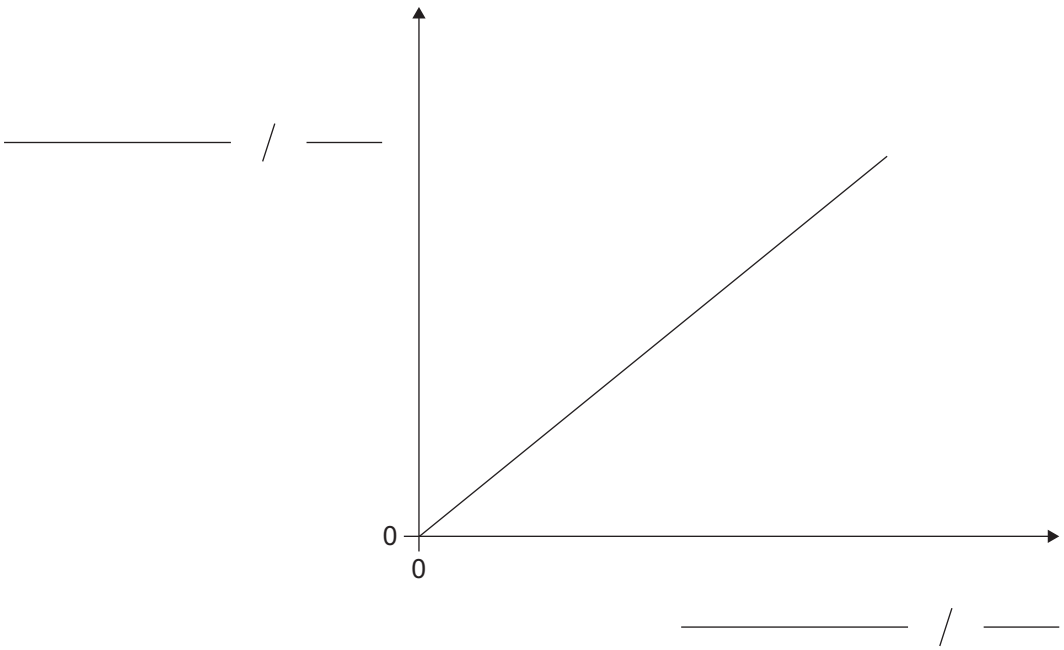

Fig. 5.2

(i) Add labels, including quantity and unit, to the axes on **Fig. 5.2**. [2]

(ii) On **Fig. 5.2**, indicate, on the line, the location of the range within which the raw data obtained using the apparatus shown in **Fig. 5.1** would be plotted. [1]

THIS IS THE END OF THE QUESTION PAPER

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

Examiner Number