Rewarding Learning

ADVANCED
General Certificate of Education
2019

Centre Number

Candidate Number

Physics

Assessment Unit A2 3B

assessing

Practical Techniques and Data Analysis

[APH32]

APH32

FRIDAY 10 MAY, 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 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.
You may use an electronic calculator.

12004

1 The current I through a fixed resistor was measured as the potential difference V across it was varied. The values obtained were plotted on the grid of **Fig. 1.1**.

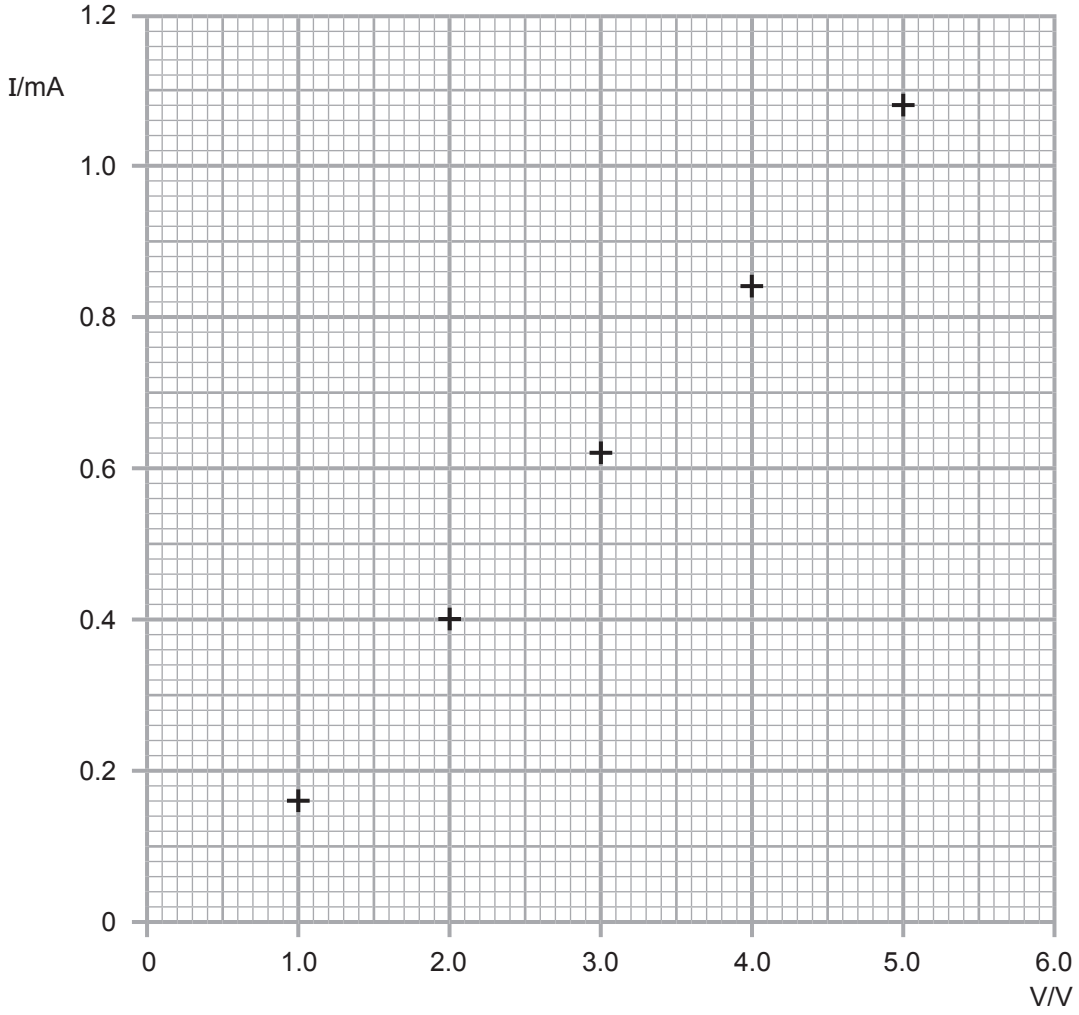

Fig. 1.1

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

(b) (i) Calculate the gradient of the graph. State the unit of the gradient.

Gradient = _____

Unit of gradient = _____ [3]

(ii) The manufacturer states the resistance of the resistor as 4.2 kΩ ± 10%. Use the graph to confirm if the resistance of the resistor falls within the range claimed.

_____

_____ [4]

[Turn over

(c) The ammeter used to obtain the values of current for the graph has a 'zero error'.

(i) What is meant by the term 'zero error'?

_____

_____

_____ [1]

(ii) Explain how the graph in **Fig. 1.1** indicates that there is a 'zero error' in the ammeter.

_____

_____ [1]

(iii) Calculate the magnitude of the 'zero error'.

Zero error = _____ mA [3]

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[Turn over

2 Two light styrofoam balls are covered in a thin layer of aluminium foil and attached at either end of a string.

The string is suspended from its mid-point and the styrofoam balls are given an equal charge q. They repel each other as shown in **Fig. 2.1**.

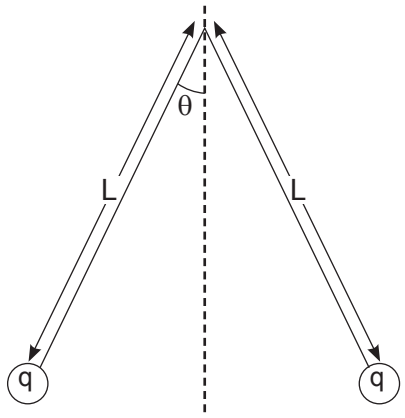

Fig. 2.1

The amount of charge q is given by **Equation 2.1**.

$$q = 2L\sin\theta\sqrt{\frac{mg\tan\theta}{k}} \qquad \textbf{Equation 2.1}$$

where:
L is equal to half the total length of the string
θ is the angle between the string and the vertical

$$k = \frac{1}{4\pi\varepsilon_0} = 8.99\times10^{9}\ F^{-1}m$$

m is the mass of each styrofoam ball
g is the acceleration of free fall.

To find the charge q, L is varied and the angle θ is recorded for each L value.

(a) A straight line graph is to be plotted that will allow a value of q to be determined.

Show that a graph of $\frac{1}{L}$ against $\sin\theta\sqrt{\tan\theta}$ will result in a straight line graph that goes through the origin.

[3]

(b) How is a value of q determined from the graph of $\frac{1}{L}$ against $\sin\theta\sqrt{\tan\theta}$?

_____

_____

_____ [1]

[Turn over

3 **Fig. 3.1** shows a container of circular cross-section area A with a tube of cross-section area B connected to it. A liquid added to the container will flow out through the tube.

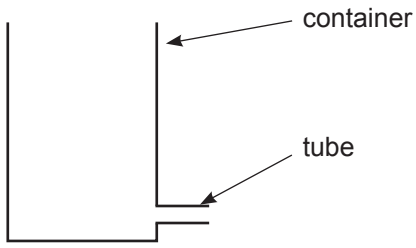

Fig. 3.1

The time t taken for the level of the liquid to fall through a height h in the container is given by **Equation 3.1**.

$$t = \frac{A}{B}\sqrt{\frac{2h}{g}} \qquad \textbf{Equation 3.1}$$

where g is the acceleration of free fall, 9.81 m s^{-2}.

(a) Show that the right-hand side of **Equation 3.1** has the unit of time.

[2]

(b) The time t taken for the liquid to fall through a height h of 0.250 ± 0.002 m is 10.3 ± 0.3 s. The diameter of the container is 9.62 ± 0.01 cm.

Calculate the cross-section area B of the tube and the percentage uncertainty in B.

Cross-section area = _____ m^2

Percentage uncertainty = _____ %

[6]

[Turn over

4 In an experiment, the loudness L in decibels (dB) was measured at various distances d from a speaker. The loudness was measured using a decibel meter as shown in **Fig. 4.1**.

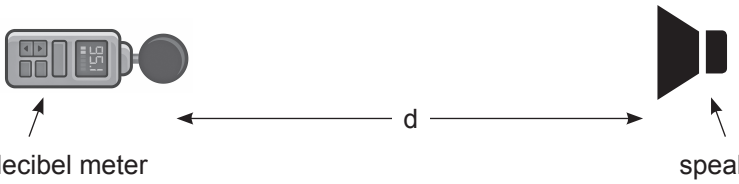

Fig. 4.1

The results have been recorded in **Table 4.1**.

Table 4.1

d / m	L / dB				log (d / m)
	1	2	3	Average	
0.100	62.3	62.0	62.5	62.3	
0.400	50.4	50.1	49.9	50.1	
0.800	43.8	44.2	44.2	44.1	
1.200	40.0	40.3	39.8	40.0	
1.600	38.1	38.3	38.4	38.3	

The loudness L of a sound measured in decibels (dB) is related to the distance d away from the source of the sound as shown by **Equation 4.1**.

$$L = -20\log d + 10\log\left[\frac{P}{2\pi I_0}\right] \qquad \textbf{Equation 4.1}$$

where P and I_0 are constants.
P is the power of the sound produced.
I_0 is the threshold intensity of hearing, equal to 1×10^{-12} W m^{-2}.

(a) Calculate values for log (d / m) and insert them in the final column of **Table 4.1**. Record the values to 3 decimal places. [2]

(b) (i) Draw a graph of L against log d on the grid of **Fig. 4.2**. Choose a suitable scale for the axes, plot the points and draw the best fit line for the points. [5]

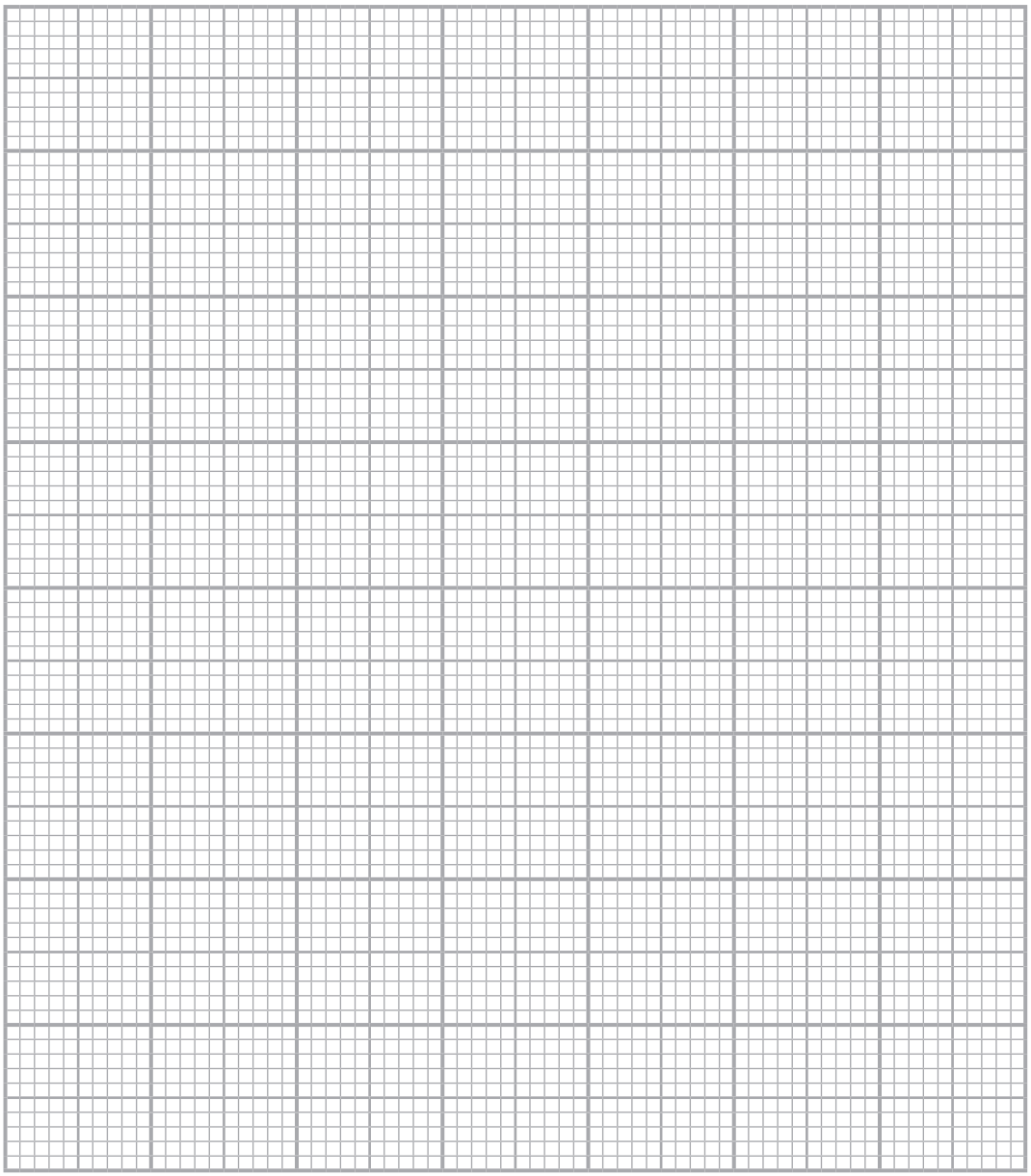

Fig. 4.2

[Turn over

(ii) Use your graph to find a value for the power P of the sound.

P = _____ W [3]

(iii) Explain how, using your plotted points, the absolute uncertainty in your value of P could be obtained.

_____

_____

_____

_____ [3]

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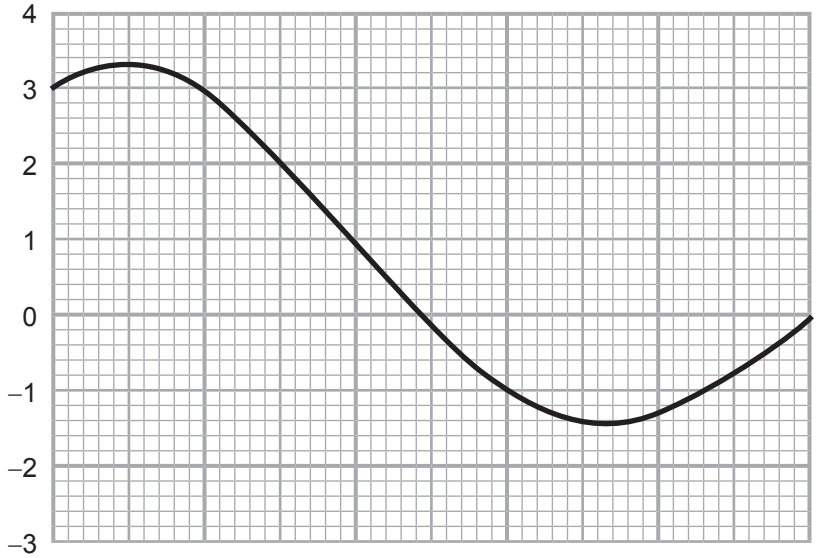
5 **(a)** The resultant interference pattern from two sound waves is displayed on a cathode ray oscilloscope (CRO) screen. The display is shown in **Fig. 5.1a**.

The same CRO screen, with the same settings, is then used to display the individual sound waves.

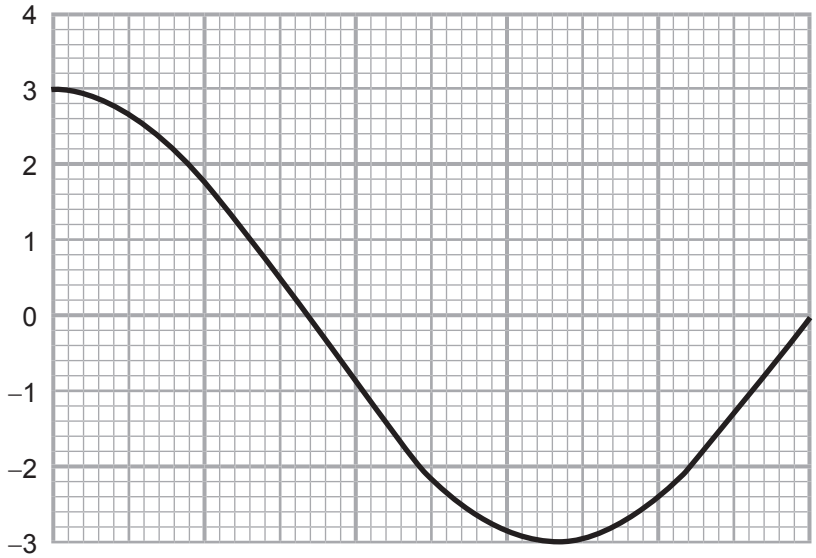
One of the sound waves that caused the interference is shown in **Fig. 5.1b**.

On **Fig. 5.1c**, draw the second wave that caused the interference. [4]



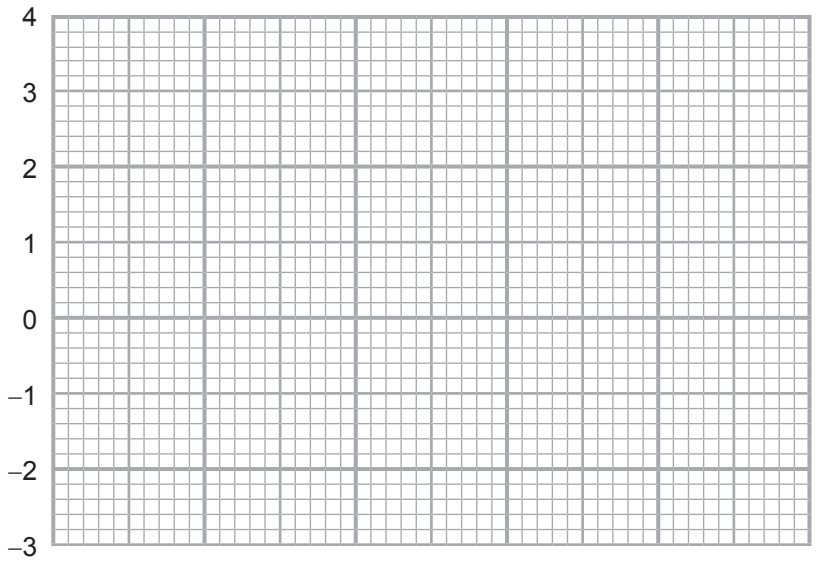
Resultant

Fig. 5.1a



Wave 1

Fig. 5.1b



Wave 2

Fig. 5.1c

[Turn over

(b) (i) The wave in **Fig. 5.1b** has a frequency of 1500 Hz. The length of the trace shown is 10 cm. What is the timebase setting on the CRO? Give an appropriate unit.

Timebase setting = _____

Unit = _____ [5]

(ii) Calculate the frequency of the wave you have drawn in **Fig. 5.1c**.

Frequency = _____ Hz [3]

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Question Number	**Marks**
1	
2	
3	
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5	
Total Marks	

Examiner Number