Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

1039941446

PHYSICS **9702/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

DC (LK) 142406

CAMBRIDGE International Examinations

[Turn over

1 A student is investigating the motion of a wooden block on an inclined plane, as shown in Fig. 1.1. A falling body causes the wooden block to accelerate.

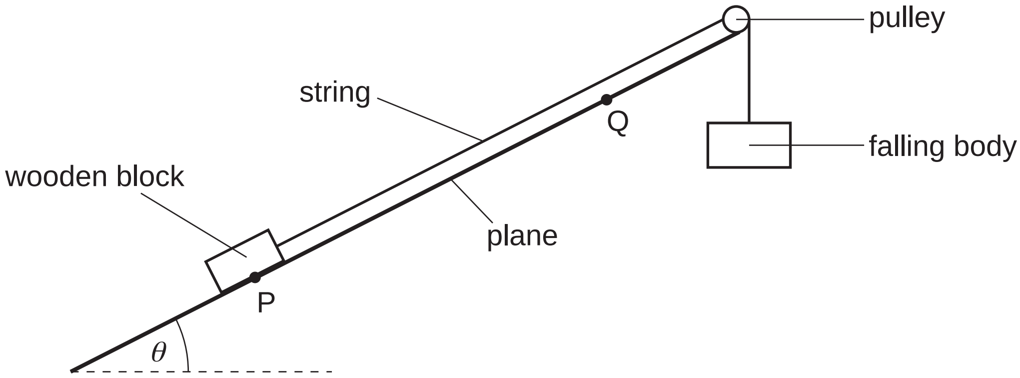

Fig. 1.1

The wooden block is initially at rest at point P and has velocity *v* at point Q.

It is suggested that the relationship between *v* and the angle θ of the plane to the horizontal is

$$\frac{(B + m)v^2}{2s} = Bg - mg\sin\theta$$

where *B* is the mass of the falling body, *m* is the mass of the wooden block, *s* is the distance between P and Q and *g* is the acceleration of free fall.

Design a laboratory experiment to test the relationship between *v* and θ. Explain how your results could be used to determine a value for *g*. You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

- the procedure to be followed,
- the measurements to be taken,
- the control of variables,
- the analysis of the data,
- any safety precautions to be taken.

[15]

Diagram

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[Total: 15]

2 A student is investigating how the time for an electrical pulse to travel in a coaxial cable varies with the length of the cable. The pulse is reflected at one end of the cable. An oscilloscope is used to display the initial pulse and the reflected pulse.

The trace on the oscilloscope is shown in Fig. 2.1.

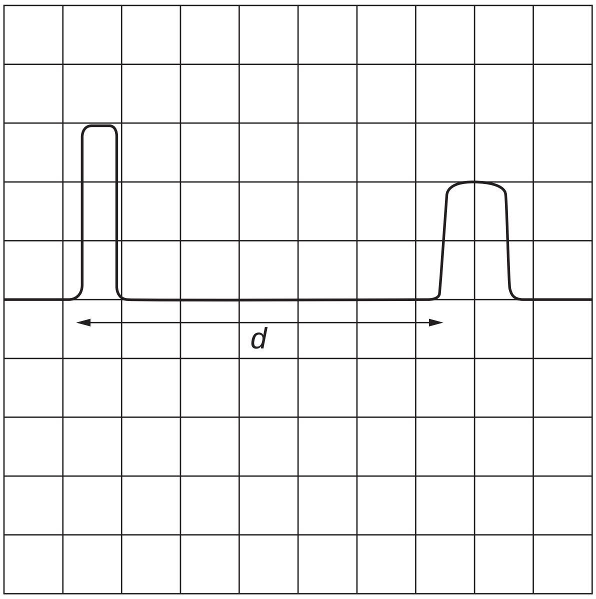


Fig. 2.1

The time t for the pulse to travel to the end of the cable and back is determined by measuring the distance d between the pulses on the screen, and then using the time-base and the relationship

$$t = d \times \text{time-base}.$$

The initial length of the cable is L. A total length Z is removed from the cable and the experiment is repeated.

It is suggested that t and Z are related by the equation

$$v = \frac{2(L - Z)}{t}$$

where v is the speed of the pulse.

(a) A graph is plotted of t on the y-axis against Z on the x-axis.

Determine expressions for the gradient and the y-intercept.

gradient = ...

y-intercept = ... [1]

(b) Values of Z and d are given in Fig. 2.2.
The time-base is $0.1\,\mu s\,cm^{-1}$.

Z / m	d / cm	t / μs
0.0	8.0 ± 0.1	
4.0	7.7 ± 0.1	
8.0	7.3 ± 0.1	
12.0	7.0 ± 0.1	
16.0	6.6 ± 0.1	
20.0	6.2 ± 0.1	

Fig. 2.2

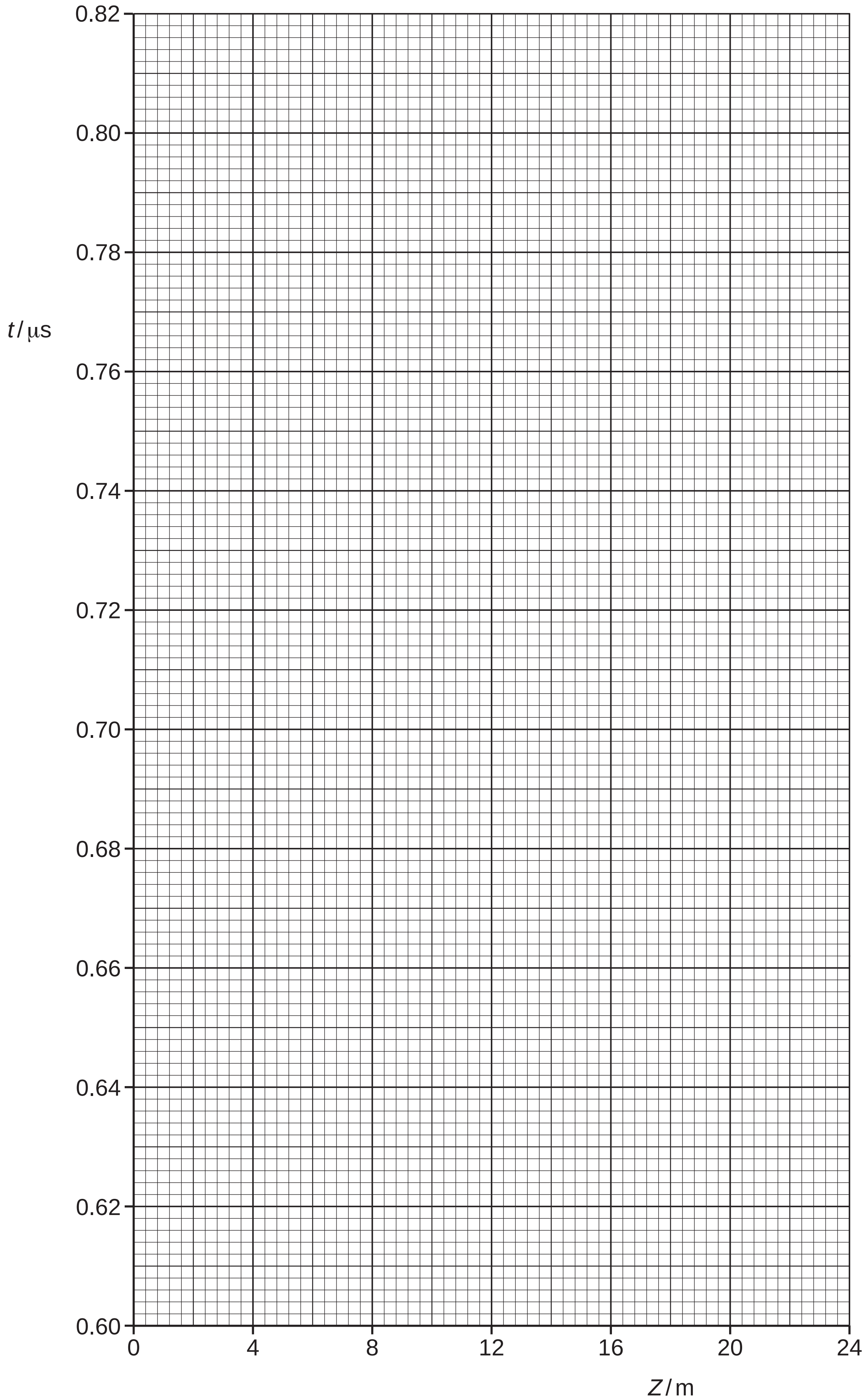
Calculate and record values of t / μs in Fig. 2.2.
Include the absolute uncertainties in t. [2]

(c) **(i)** Plot a graph of t / μs against Z / m.
Include error bars for t. [2]

(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]


t / μs
0.82
0.80
0.78
0.76
0.74
0.72
0.70
0.68
0.66
0.64
0.62
0.60
0
4
8
12
16
20
24
Z / m

(iv) Determine the *y*-intercept of the line of best fit. Include the absolute uncertainty in your answer.

y-intercept = ... [2]

(d) **(i)** Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of *L* and *v*. Include appropriate units.

L = ...

v = ...
[2]

(ii) Determine the percentage uncertainties in *L* and *v*.

percentage uncertainty in *L* = ... %

percentage uncertainty in *v* = ... %
[2]

[Total: 15]