Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

0948391081

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **May/June 2016**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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 **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You are reminded of the need for good English and clear presentation in your answers.

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

Additional answer paper and graph paper should be used only if it becomes necessary to do so.

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.

For Examiner's Use	
1	
2	
Total	

This document consists of **12** printed pages.

© UCLES 2016

CAMBRIDGE International Examinations

You may not need to use all of the materials provided.

1 In this experiment, you will investigate the motion of a loaded wooden strip.

(a) (i) Use the modelling clay to attach the slotted masses to the centre of the wooden strip as shown in Fig. 1.1 and Fig. 1.2.

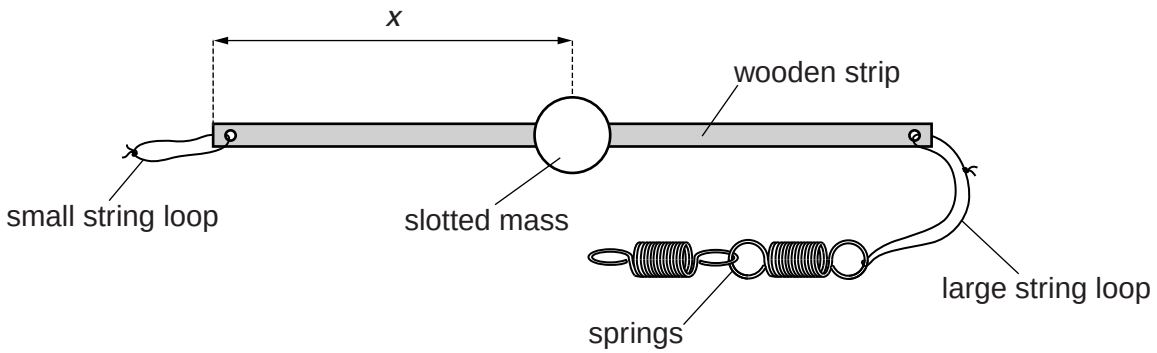


Fig. 1.1

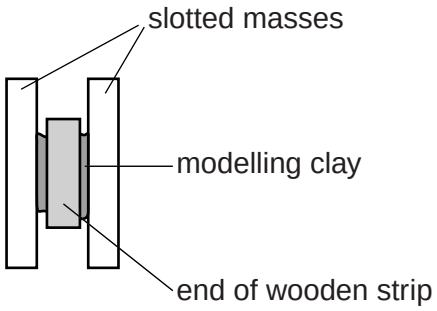


Fig. 1.2

(ii) Measure and record the distance *x* between the end of the wooden strip with the small string loop attached and the centre of the slotted masses as shown in Fig. 1.1.

x = ...[1]

(b) (i) Set up the apparatus as shown in Fig. 1.3.

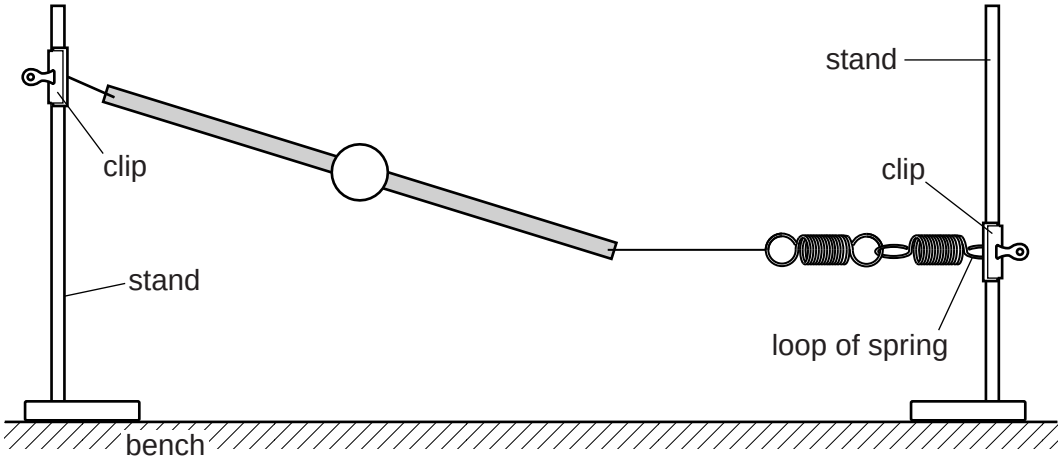


Fig. 1.3

(ii) Slide the small string loop over the rod of a stand and fix it in place using a clip.

Slide the free loop of the spring down the rod of the other stand and fix it in place using the other clip.

(iii) Adjust the apparatus until the large string loop and springs are parallel to the bench.

(iv) Use G-clamps to secure both stands to the bench.

(c) Move the right-hand end of the wooden strip downwards through a distance of approximately 3 cm. Release the wooden strip.

The wooden strip will oscillate.

Determine the period T of these oscillations.

T = ...[1]

(d) Change x by moving the slotted masses along the wooden strip.

For each value of x, adjust the position of the clips so that the large string loop and springs are parallel to the bench.

Repeat **(a)(ii)** and **(c)** until you have five sets of values of x and T.

Include values of T^2 in your table.

[10]

(e) **(i)** Plot a graph of T^2 on the y-axis against x on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

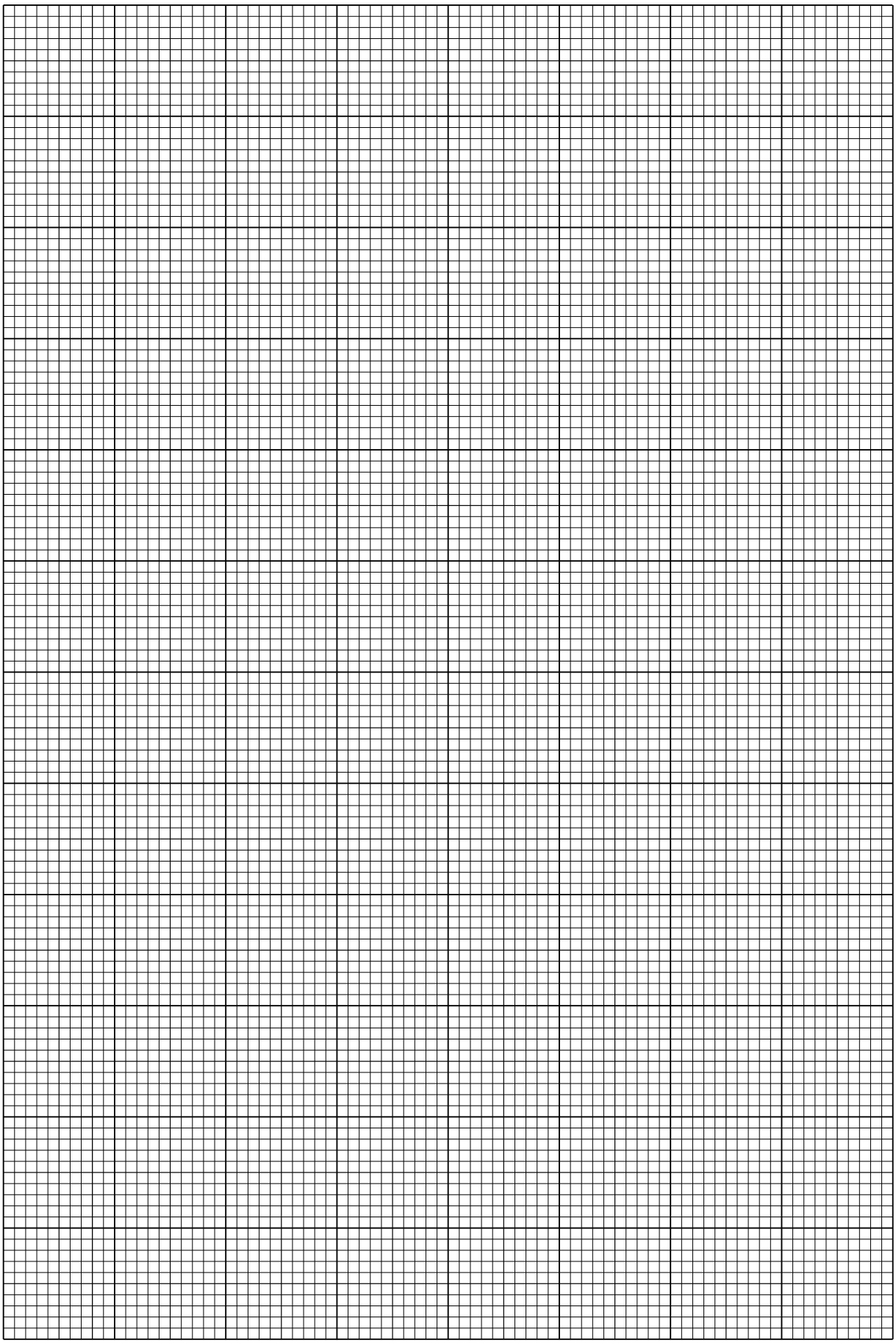
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

© UCLES 2016



(f) It is suggested that the quantities T and x are related by the equation

$$T^2 = Px + Q$$

where P and Q are constants.

Using your answers in **(e)(iii)**, determine the values of P and Q.
Give appropriate units.

P = ...

Q = ...

[2]

[Total: 20]

You may not need to use all of the materials provided.

2 In this experiment, you will investigate the motion of a container on a wooden board.

(a) Measure and record the length w of the shorter side of the wooden board, as shown in Fig. 2.1.



Fig. 2.1

w = ... m [1]

(b) (i) Set up the wooden board as shown in Fig. 2.2.

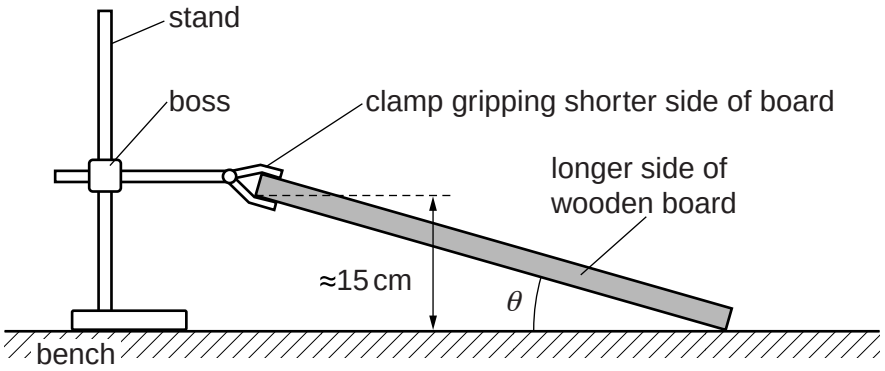


Fig. 2.2

The distance between the bottom of the board and the bench should be approximately 15 cm.

(ii) Measure and record the angle θ as shown in Fig. 2.2.

θ = ... [1]

(iii) Estimate the percentage uncertainty in your value of θ.

percentage uncertainty = ...[1]

(c) (i) Place the container on the wooden board as shown in Fig. 2.3.

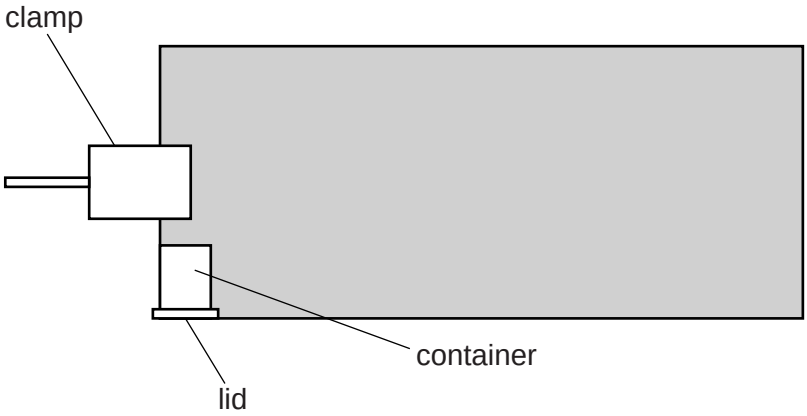


Fig. 2.3

The container should be aligned with the edges of the board as shown in Fig. 2.3.

(ii) Release the container. The container will follow the path shown in Fig. 2.4.

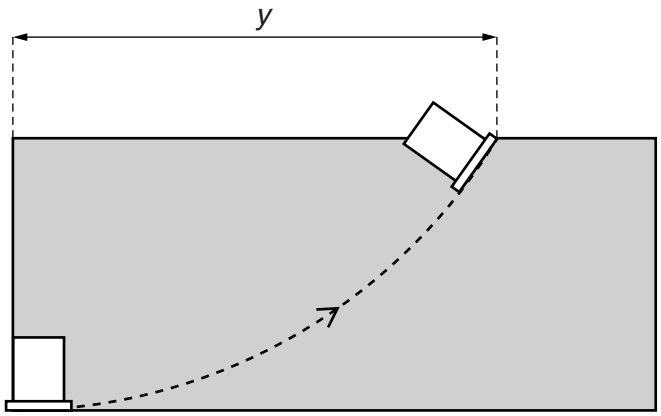


Fig. 2.4

(iii) Measure and record the distance y, as shown in Fig. 2.4.

y = ...m [2]

(d) (i) Calculate D using

$$D = \frac{w^2 + y^2}{w}.$$

D = ...m [1]

(ii) Justify the number of significant figures that you have given for your value of D.

.....

.....

.....[1]

(e) **(i)** Increase the angle θ.

(ii) Repeat **(b)(ii)**, **(c)** and **(d)(i)**.

θ = ...

y = ... m

D = ... m

[3]

(f) It is suggested that the relationship between D and θ is

$$D = k \sin \theta$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...

[1]

(ii) Explain whether your results in **(f)(i)** support the suggested relationship.

.....

.....

.....

.....[1]

(g) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

..... [4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

..... [4]

[Total: 20]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.