Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7214772118

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2014**

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 **11** printed pages and **1** blank page.

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[Turn over

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

1 In this experiment, you will investigate the motion of a system of masses as its shape is changed.

(a) You are provided with a length of wire, bent into two arms, with a mass attached at the end of each arm as shown in Fig. 1.1.

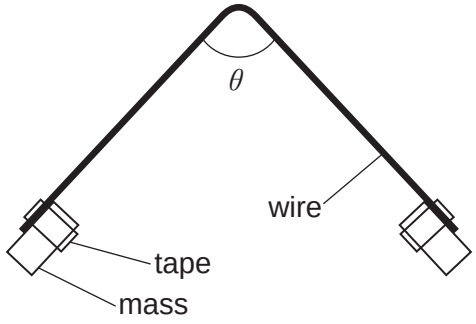


Fig. 1.1

(i) Measure and record the angle θ between the two arms.

θ = ... [1]

(ii) Calculate $\sin^2\left(\frac{\theta}{2}\right)$, where

$$\sin^2\left(\frac{\theta}{2}\right) = \sin\left(\frac{\theta}{2}\right) \times \sin\left(\frac{\theta}{2}\right).$$

$\sin^2\left(\frac{\theta}{2}\right)$ = ...

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(b) You are provided with a spring suspended from a stand. A hook is suspended from the bottom of the spring.
Hang the wire from the upper part of the hook and hang the mass hanger from the lower part of the hook as shown in Fig. 1.2.

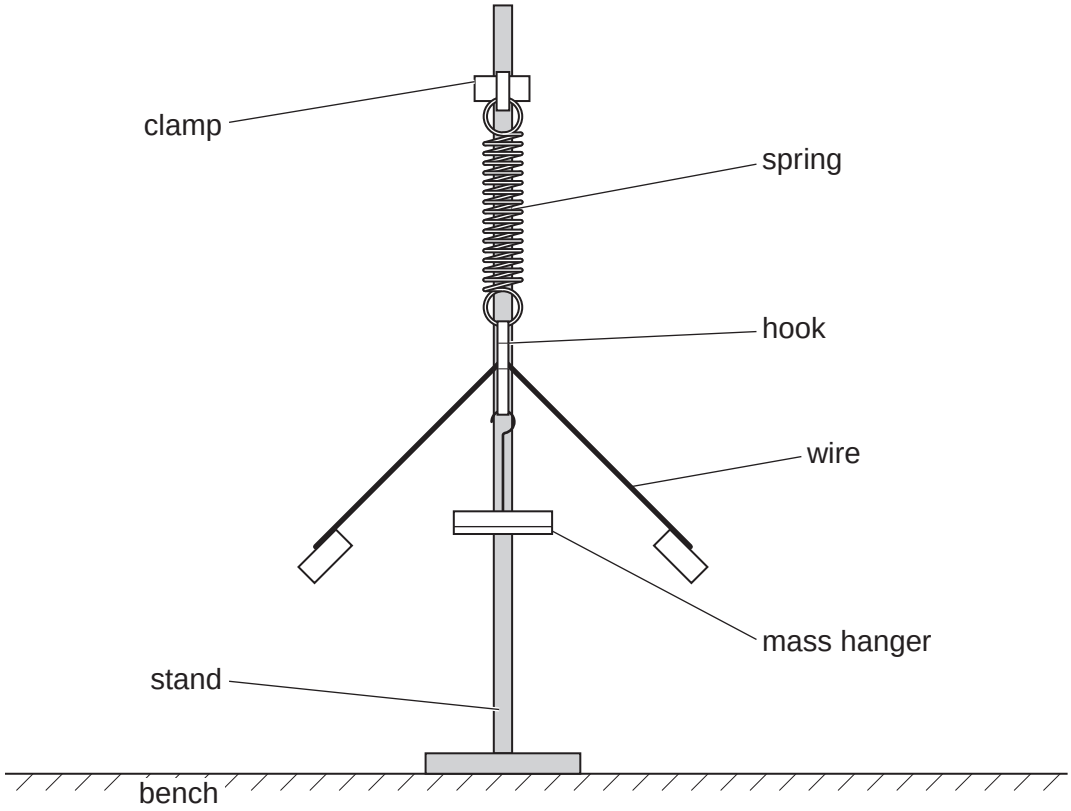


Fig. 1.2

(i) Twist the mass hanger through about 45° and release it so that the mass hanger and wire rotate back and forth as shown in Fig. 1.3.

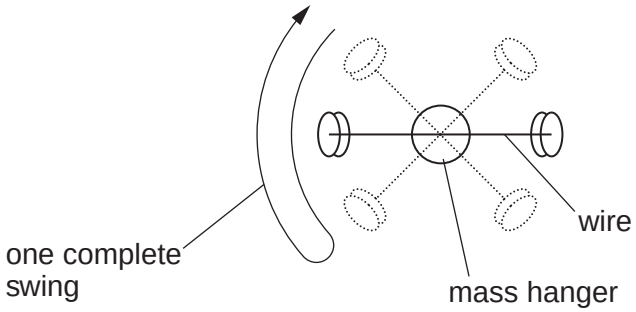


Fig. 1.3 (top view)

(ii) Measure and record the time *t* for the mass hanger and wire to make 5 complete swings.

t = ... [2]

(c) Remove the wire from its hook. Bend the wire to change the angle θ. The arms of the wire must remain straight.
Repeat **(a)** and **(b)** until you have five sets of readings for θ and t.

Include values for t^2 and $\sin^2\left(\frac{\theta}{2}\right)$ in your table.

[9]

(d) **(i)** Plot a graph of t^2 on the y-axis against $\sin^2\left(\frac{\theta}{2}\right)$ on the x-axis. [3]

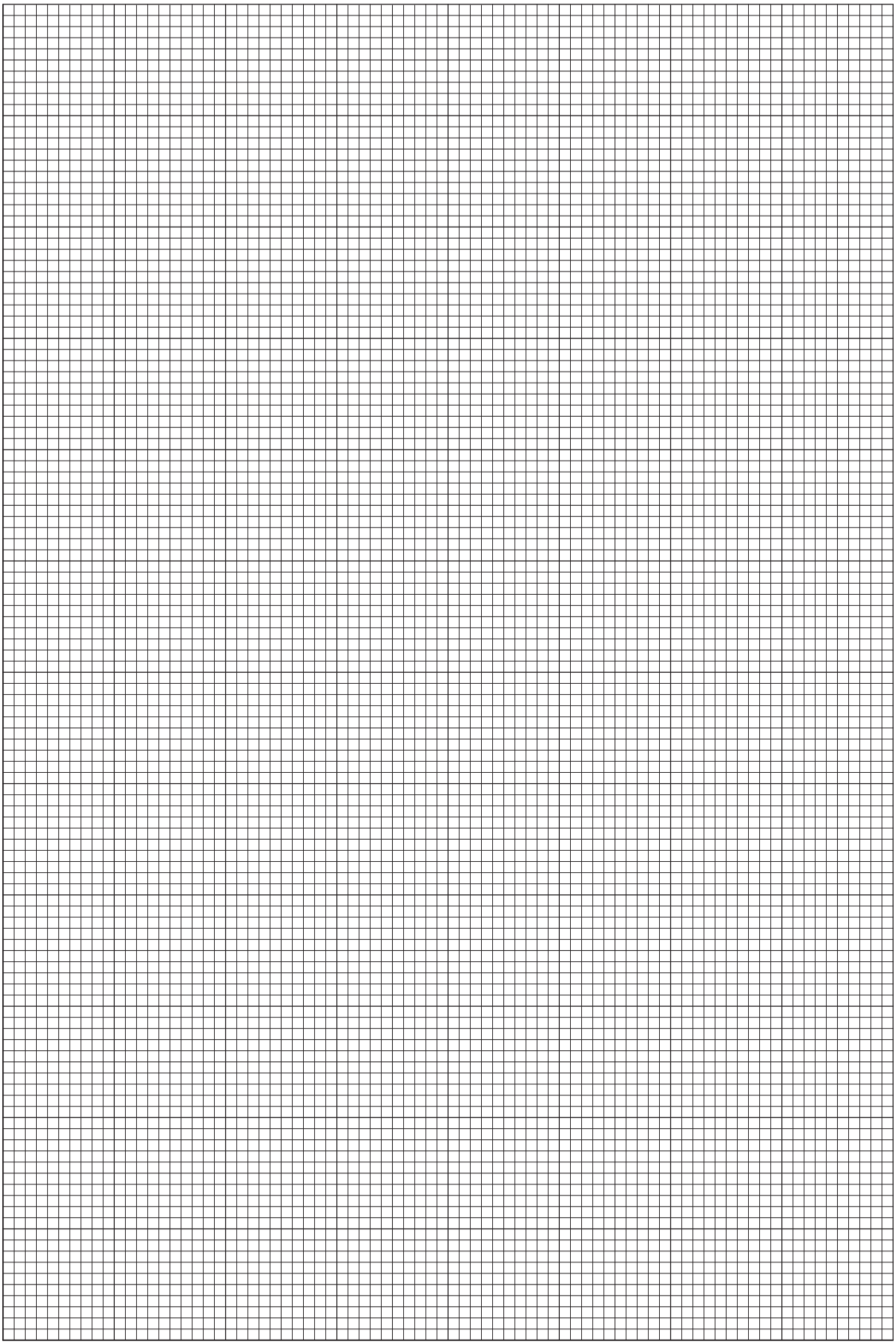
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...
[2]

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(e) The quantities t and θ are related by the equation

$$t^2 = p + q\sin^2\left(\frac{\theta}{2}\right)$$

where p and q are constants.

Using your answers from **(d)(iii)**, determine the values of p and q.
Give appropriate units.

p = ...

q = ...

[2]

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

2 In this experiment, you will investigate the collision between two spheres.

(a) You are provided with two spheres. Take measurements to find the average **radius** *r* of the spheres.

r = ... mm [1]

(b) You are provided with a flat board, as shown in Fig. 2.1.

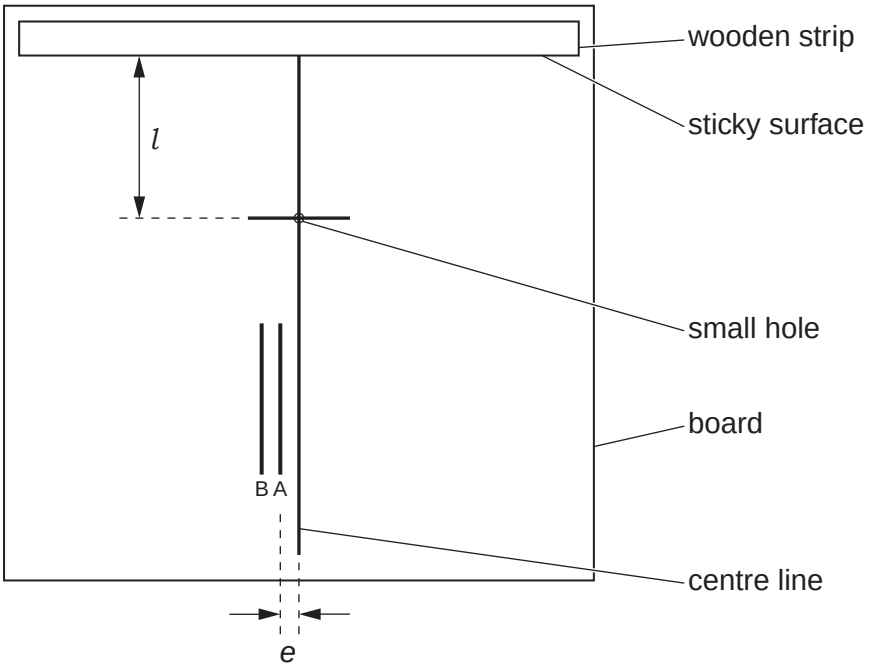


Fig. 2.1

A wooden strip with a sticky surface is attached to the board, and there is a small hole in the board.

(i) Measure and record the distance l between the small hole and the sticky surface.

l = ... mm [1]

(ii) Measure and record the perpendicular distance *e* between the centre line and the line labelled A.

e = ... mm [1]

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(c) (i) You are provided with a ramp with a groove in it.
Position the ramp on the board with the centre of the groove along line A, and position one of the spheres in the hole, as shown in Fig. 2.2.

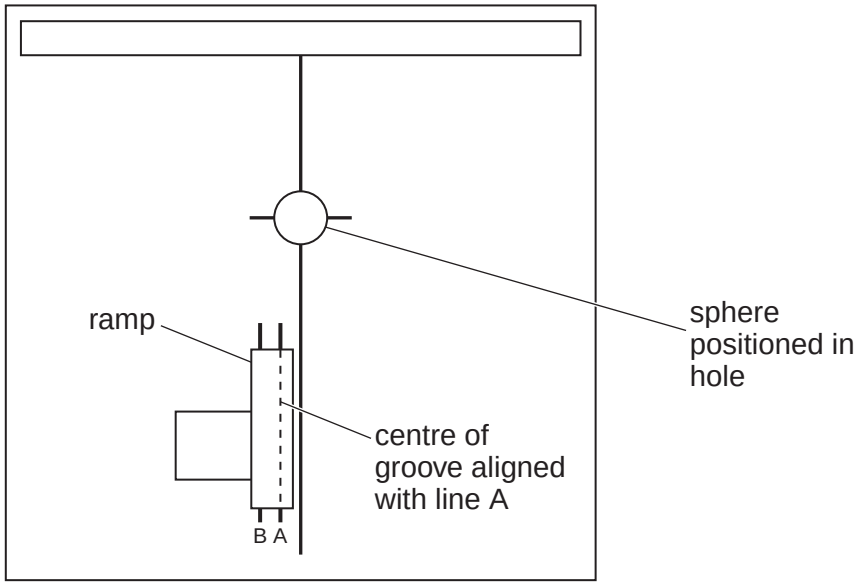


Fig. 2.2

(ii) Place the second sphere on the groove and release it so that it rolls down and hits the sphere in the hole. Both spheres will roll forward and hit the wooden strip.
Measure and record the distance *x* between the centre of the right-hand sphere and the centre line, as shown in Fig. 2.3.

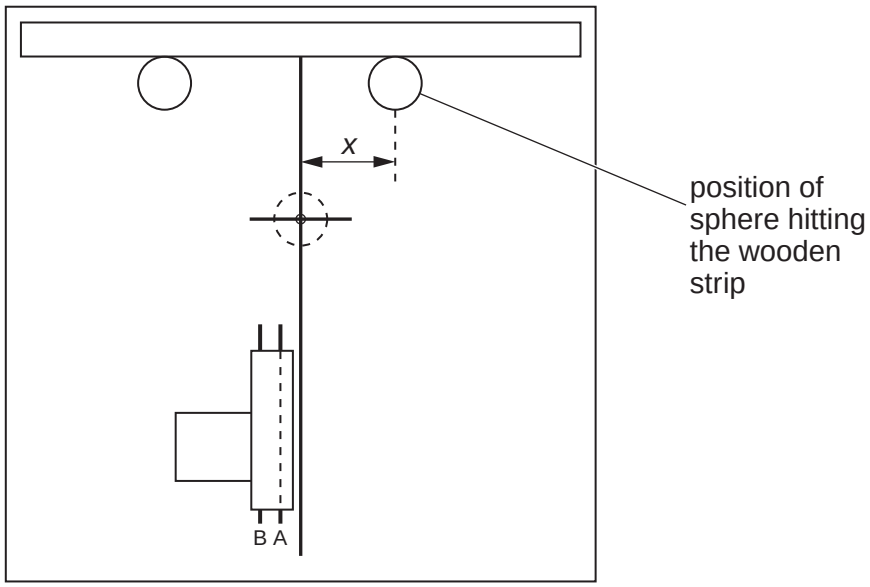


Fig. 2.3

x = ... mm [2]

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

percentage uncertainty = ... [1]

(iv) Before the sphere hits the wooden strip, its path makes an angle θ with the centre line. Calculate θ using the relationship

$$\tan\theta = \left(\frac{x}{l-r}\right).$$

θ = ... [2]

(d) Repeat **(b)(ii)**, **(c)(i)**, **(c)(ii)** and **(c)(iv)** with the distance e measured to line B and the centre of the groove along line B.

e = ... mm

x = ... mm

θ = ...
[1]

(e) It is suggested that the relationship between θ, e and r is

$$\sin\theta = \frac{ke}{2r}$$

where k is a constant.

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

first value of k = ...

second value of k = ...

[2]

(ii) Explain whether your results support the suggested relationship.

.....

.....

..... [1]

(f) **(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]

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