UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

6193613066

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2013**

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 a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, 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.

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1	
2	
Total	

This document consists of **11** printed pages and **1** blank page.

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1 In this experiment, you will investigate the motion of a swinging bob and a wooden rod.

(a) Measure and record the distance *L* between the end of the rod and the end of the hook as shown in Fig. 1.1.

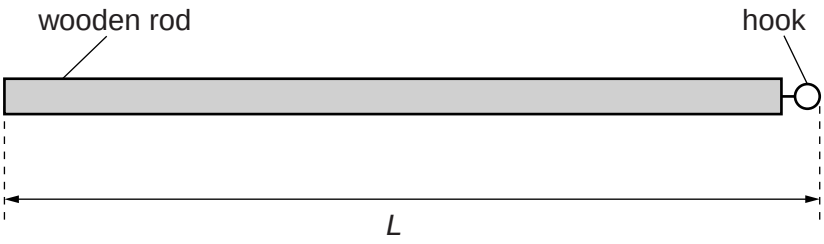


Fig. 1.1

L = ...m [1]

(b) **(i)** Set up the apparatus as shown in Fig. 1.2.

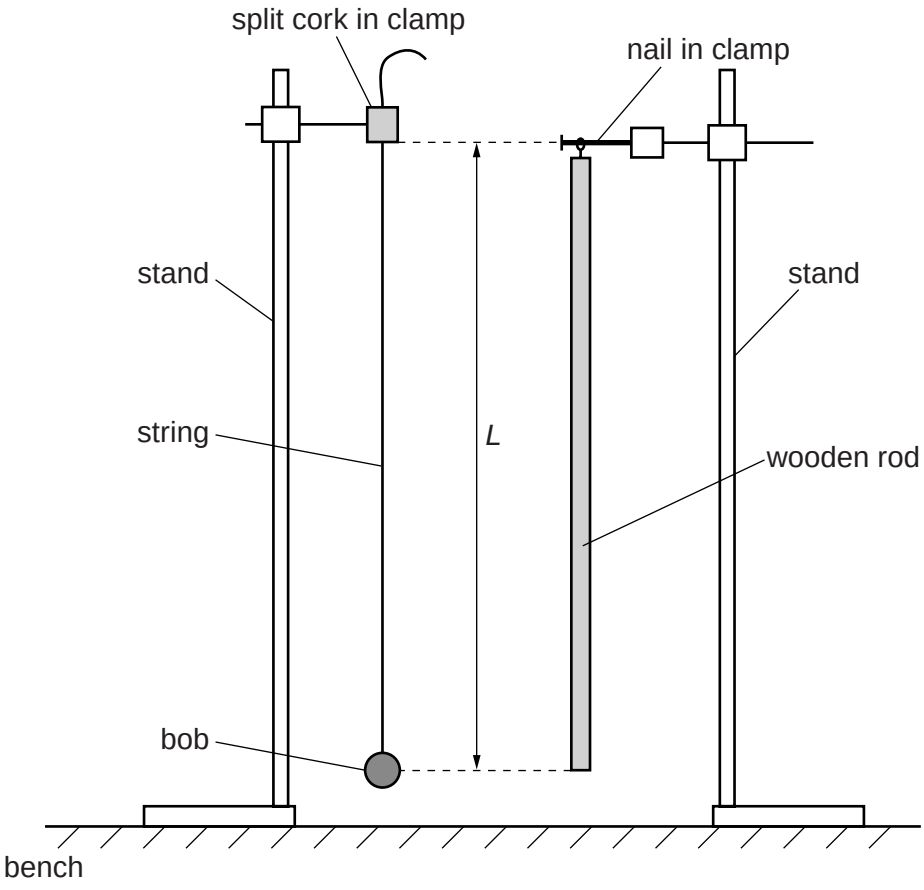


Fig. 1.2

The distance between the bottom of the split cork and the centre of the bob should be equal to the value of *L* in **(a)**.

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(ii) Reduce the distance between the bottom of the split cork and the centre of the bob by approximately 3 cm.

(iii) Measure and record the distance *D* between the bottom of the split cork and the centre of the bob, as shown in Fig. 1.3.

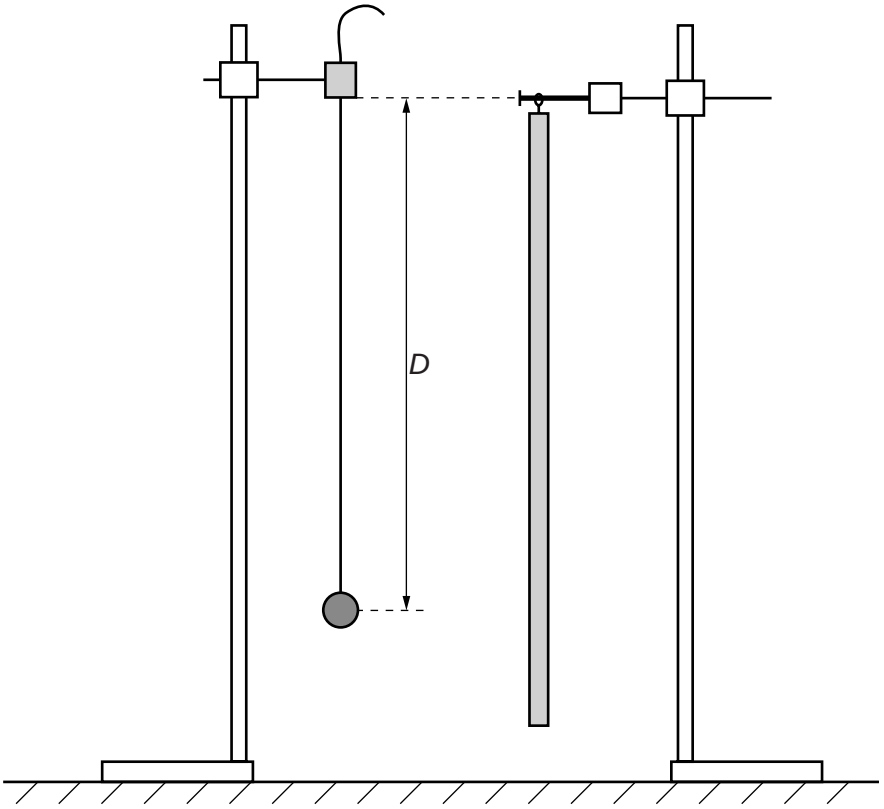


Fig. 1.3

D = ...m

(iv) Calculate *x* where $x = L - D$.

x = ...m

(c) (i) Move the bob towards you.
Release the bob and watch the movement.
The bob will move away from you and back towards you, completing a swing.

(ii) Move the bottom of the wooden rod towards you.
Release the rod and watch the movement.
The rod will move away from you and back towards you, completing a swing.

(iii) Move the bob **and** the bottom of the rod towards you.
Release the bob **and** the rod **at the same instant** and watch the movement.
The bob and the rod will swing backwards and forwards becoming out of step. Eventually they will, for a short time, move together in step.

(iv) Repeat **(iii)** and count the number *n* of swings **of the bob** between releasing the bob and rod and when they are back in step. Record *n*.

n = ...[1]

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[Turn over

(d) Decrease D and repeat **(b)(iii)**, **(b)(iv)** and **(c)(iv)** until you have six sets of values of D, x and n.
Your values of D should be in the range $D \geqslant 40\,\text{cm}$.
Include values of $\left(\frac{n+1}{n}\right)^2$ in your table.

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[10]

(e) **(i)** Plot a graph of $\left(\frac{n+1}{n}\right)^2$ on the y-axis against x on the x-axis. [3]

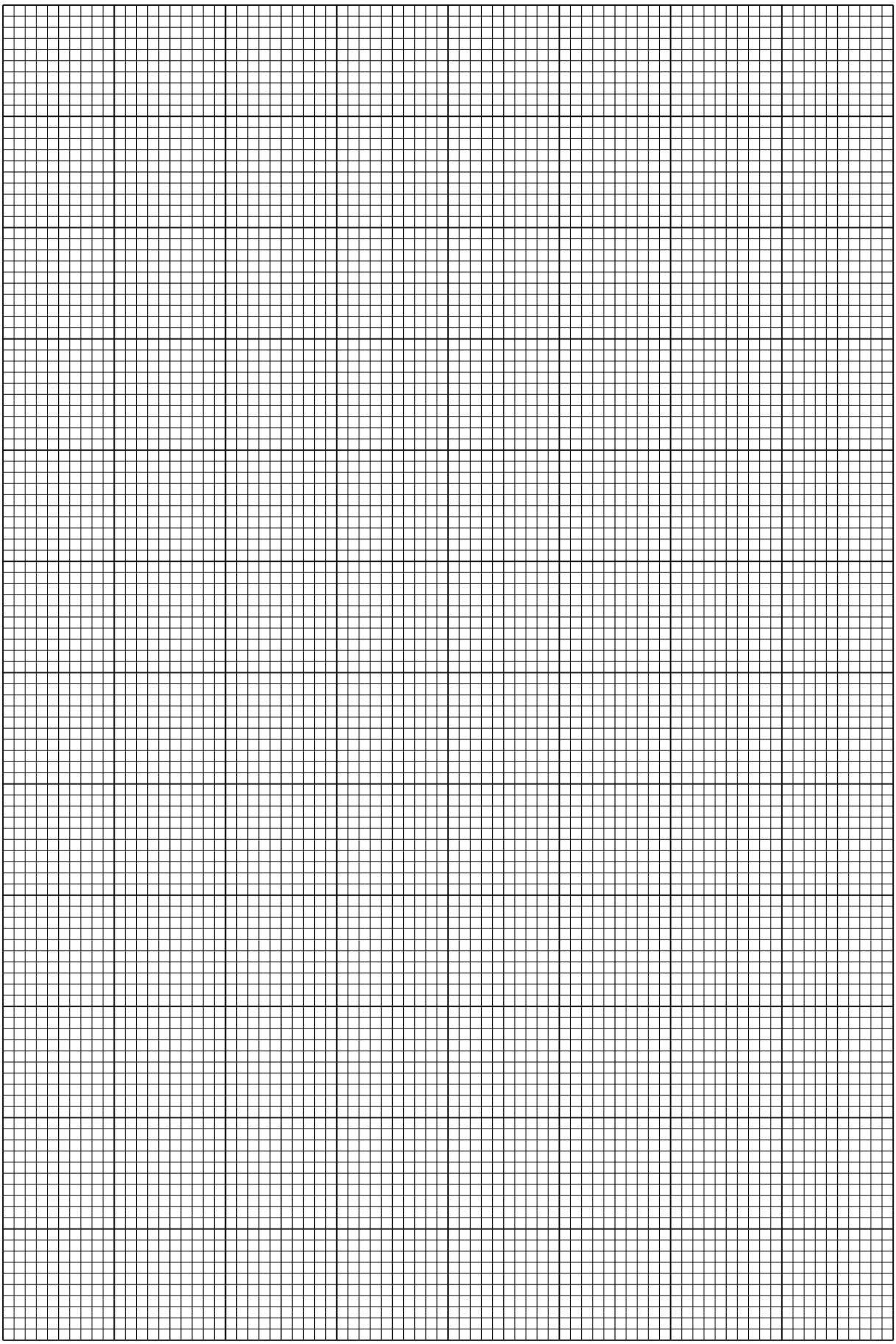
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...
[2]

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(f) The quantities n and x are related by the equation

$$\left(\frac{n+1}{n}\right)^2 = -Px + Q$$

where P and Q are constants.

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

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P = ...

Q = ...

[2]

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2 In this experiment, you will investigate the motion of a water-filled ball in a container of water.

(a) Place the rubber bands on the cylindrical container approximately 10 cm apart, as shown in Fig. 2.1. The top rubber band should be level with the surface of the water.

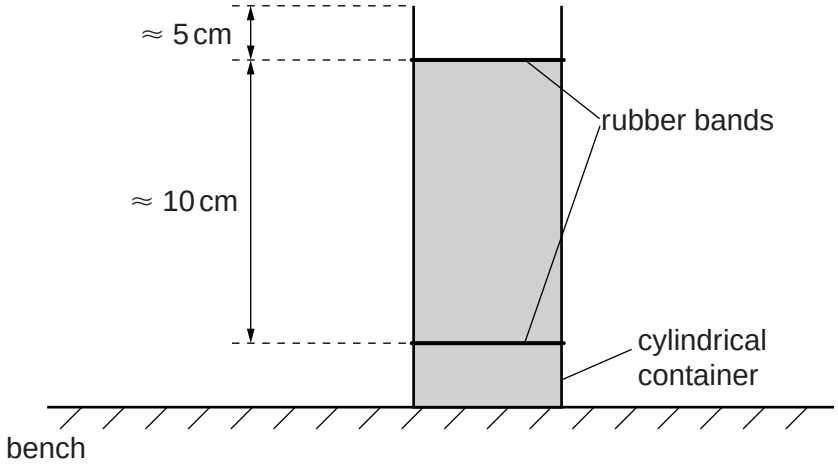


Fig. 2.1

(b) (i) You have been provided with a ball, a syringe and a beaker of water.
Draw water from the beaker into the syringe and empty the contents into the hole in the ball.
Determine the volume V_0 of water that is required to **fill** the ball.
(1 ml = 1 cm^3)

You may have to fill the syringe more than once.

V_0 = ... cm^3 [1]

(ii) Describe how you determined the value of V_0.

.....

.....

.....[1]

(iii) Hold the ball so that no water leaks out and use the syringe to remove 5 cm^3 (5 ml) of water from the ball.

(iv) Use the Blu-Tack to seal the hole in the ball to prevent the water escaping.

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(v) Calculate the volume V of water remaining in the ball.

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V = ...cm^3 [1]

(vi) Estimate the percentage uncertainty in your value of V.

percentage uncertainty = ...[1]

(c) (i) Hold the ball so that its bottom is on the surface of the water, as shown in Fig. 2.2.

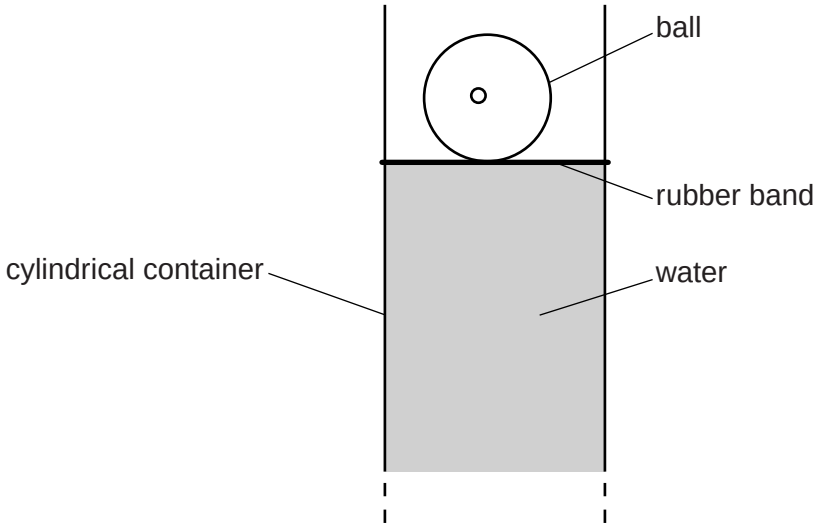


Fig. 2.2

(ii) Release the ball. It will fall and then return to the surface.
Move the lower rubber band to the lowest position reached by the bottom of the ball as shown in Fig. 2.3.

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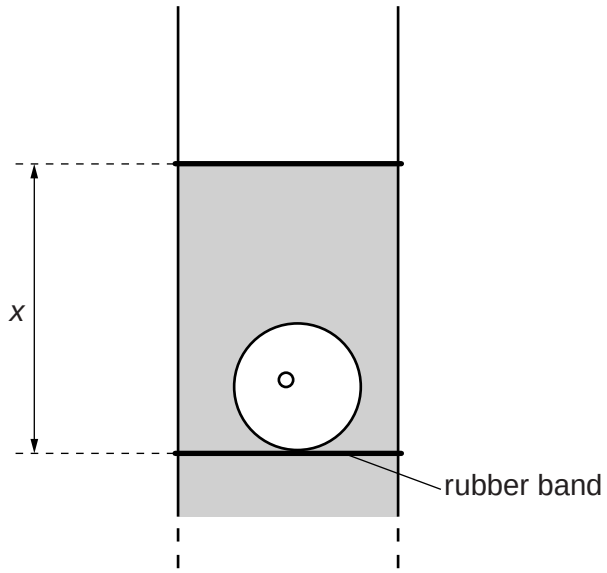


Fig. 2.3

(iii) Measure and record the distance *x* between the rubber bands.

x = ... cm [2]

(d) (i) Remove another 5 cm^3 (5 ml) of water from the ball.

(ii) Repeat **(b)(iv)**, **(b)(v)**, and **(c)**.

V = ... cm^3

x = ... cm
[3]

(e) It is suggested that the relationship between x and V is

$$x = kV^3$$

where k is a constant.

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

first value of k = ...

second value of k = ...

[1]

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

.....

.....

.....[1]

(iii) Explain whether your results in **(e)(i)** support the suggested relationship.

.....

.....

.....

.....[1]

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

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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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