Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

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| CANDIDATE NAME | |
| CENTRE NUMBER | |
| CANDIDATE NUMBER | |

*7004325696*

**PHYSICS** **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2015**

**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 | |

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

**1** In this experiment, you will investigate the equilibrium of a wooden rod.

**(a)** Set up the apparatus as shown in Fig. 1.1.

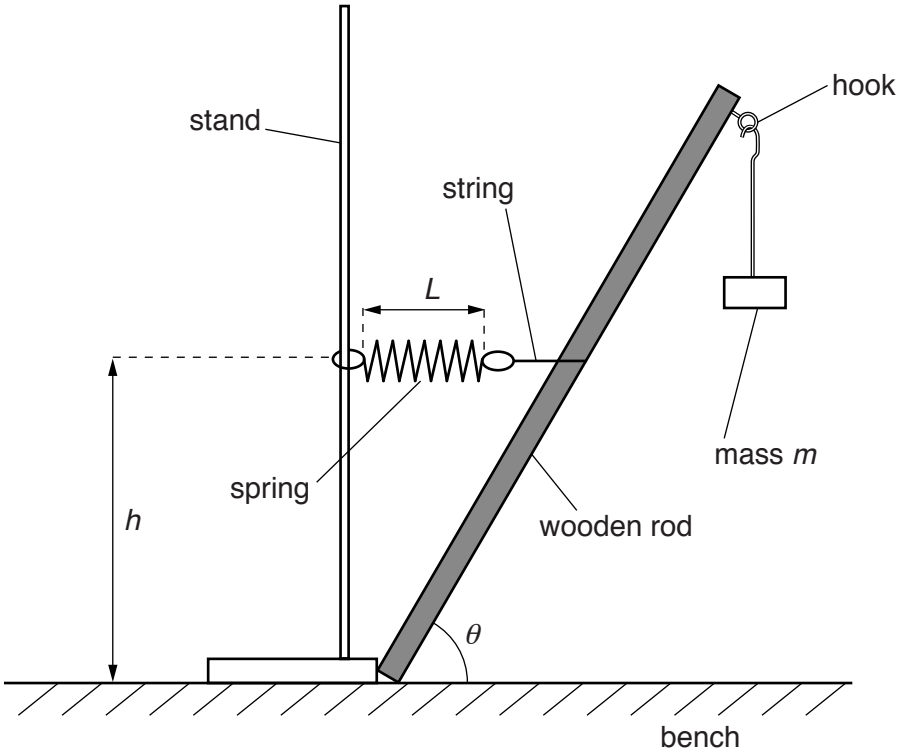



**Fig. 1.1**

The mass *m* should be 60g. The string should be approximately half-way along the wooden rod. The spring should be horizontal.

**(b)** **(i)** Measure and record the length *L* of the coiled part of the spring.

*L* = ..... [1]

**(ii)** Measure and record the height *h* of the loop of the spring above the bench.

*h* = .....

**(iii)** Measure and record the angle $\theta$ between the wooden rod and the bench.

$\theta$ = .....°

**(c)** Change mass $m$ to 80 g.

Adjust the position of the spring and string so that the length $L$ **is the same as in (b)(i)** and the string is horizontal.

Repeat **(b)(ii)** and **(b)(iii)**.

$h$ = .....

$\theta$ = .....°

[1]

**(d) (i)** Copy your value of $L$ from **(b)(i)**.

$L$ = .....

**(ii)** Change $m$ and repeat **(b)(ii)** and **(b)(iii)** until you have six sets of values of $m$, $h$ and $\theta$.
For each value of $m$, adjust the position of the spring and string so that $L$ is the same as in **(d)(i)** and the spring is horizontal.

Include your values from **(b)** and **(c)**.

Also include values of $\frac{h}{\cos\theta}$ in your table.

[10]

**(e) (i)** Plot a graph of $\frac{h}{\cos\theta}$ on the $y$-axis against $m$ on the $x$-axis. [3]

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

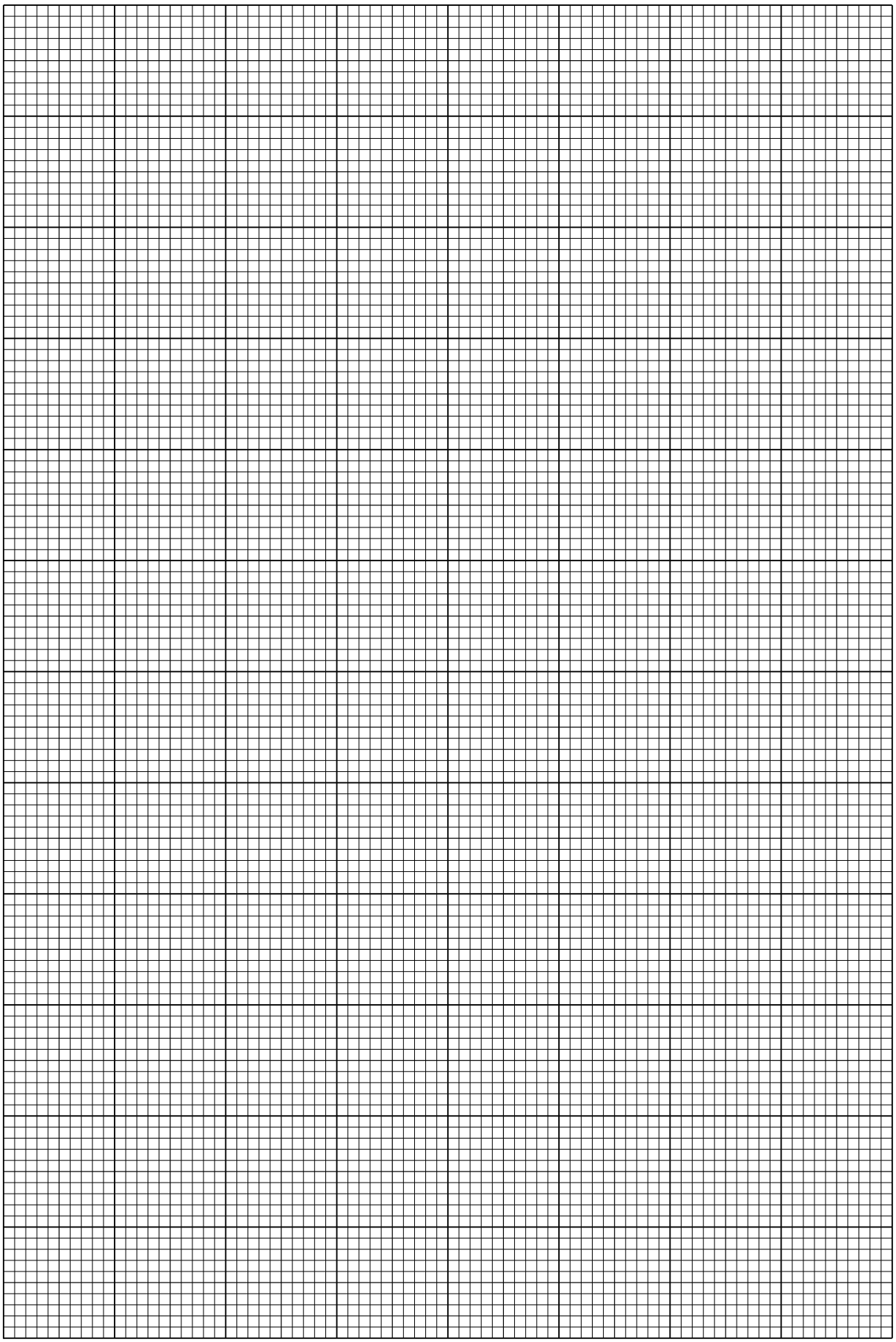
**(iii)** Determine the gradient and $y$-intercept of this line.

gradient = .....

$y$-intercept = .....

[2]

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**(f)** The quantities $h$, $\theta$ and $m$ are related by the equation

$$\frac{h}{\cos\theta} = Am + B$$

where $A$ and $B$ are constants.

Using your answers in **(e)(iii)**, determine the values of $A$ and $B$.
Give appropriate units.

$A$ = .....

$B$ = .....

[2]

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

**2** In this experiment, you will investigate the motion of a loaded wooden rod.

**(a) (i)** Set up the apparatus as shown in Fig. 2.1.

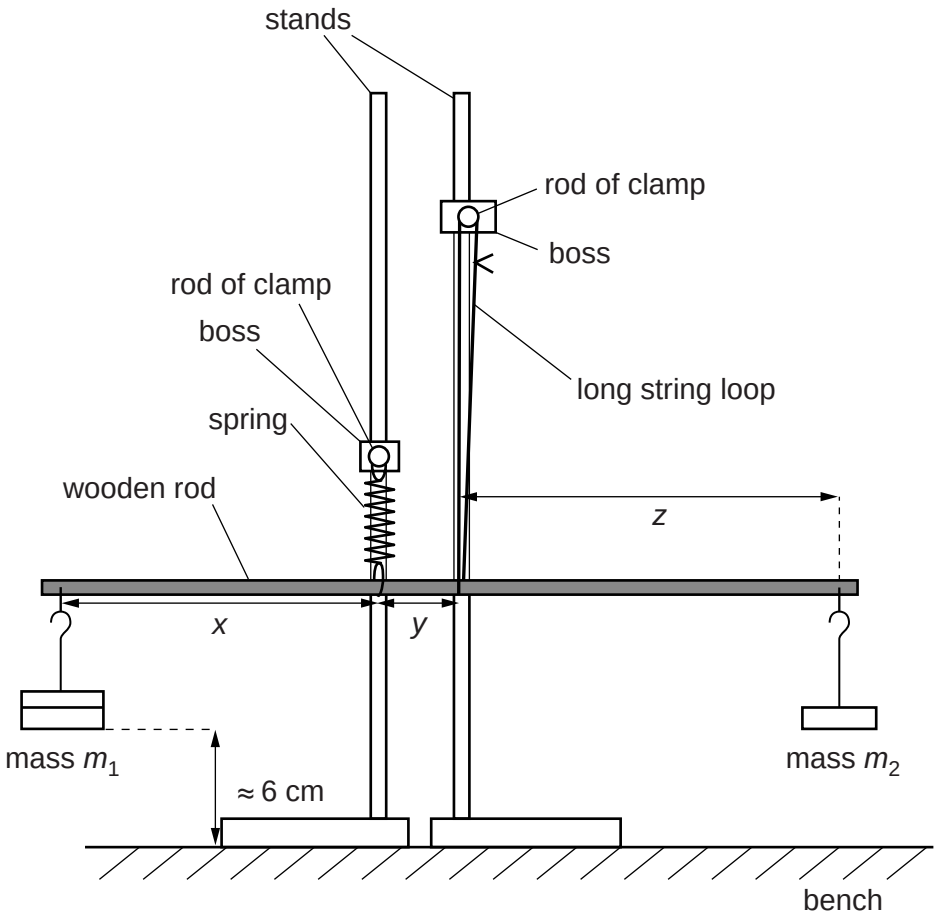



**Fig. 2.1**

Support the wooden rod by passing it through the loop of the spring and the long string loop.

Mass $m_1$ should be 200 g and mass $m_2$ should be 100 g.

The bottom of mass $m_1$ should be approximately 6 cm above the bench.

**(ii)** Adjust the apparatus until the wooden rod is balanced and horizontal. The spring and long string loop should be vertical.

**(iii)** Measure and record the distances $x$, $y$ and $z$ as shown in Fig. 2.1, where

$x$ is the distance between the loop above $m_1$ and the spring loop,
$y$ is the distance between the spring loop and the long string loop,
$z$ is the distance between the long string loop and the loop above $m_2$.

$x$ = .....

$y$ = .....

$z$ = .....
[2]

**(iv)** Estimate the percentage uncertainty in your value of $y$.

percentage uncertainty = ..... [1]

**(b)** Calculate $C$ where

$$C = m_1(x + y)^2 + m_2z^2.$$

$C$ = ..... [1]

**(c) (i)** Pull the left side of the wooden rod down by 5 cm.

Release the wooden rod and watch the movement.

The wooden rod will move up and down again, completing a cycle as shown in Fig. 2.2.

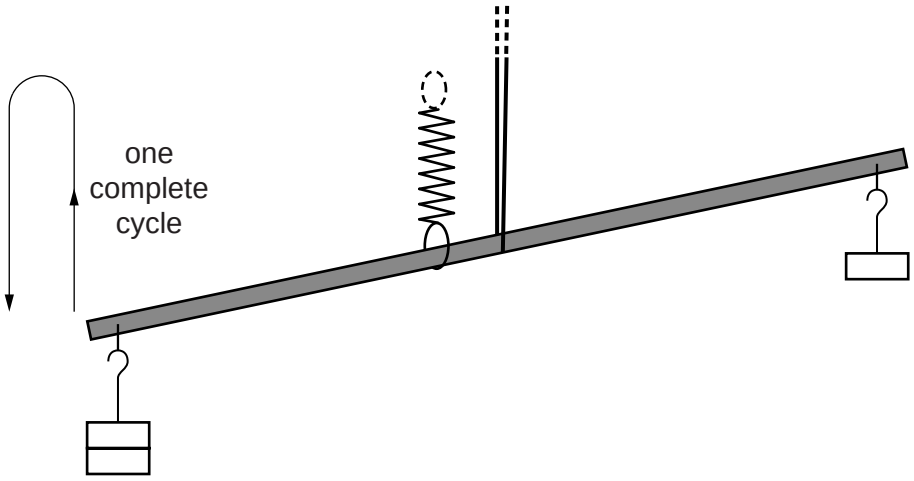



**Fig. 2.2**

**(ii)** The time taken for one complete cycle is $T$.

By timing several of these complete cycles, determine an accurate value for $T$.

$T$ = ..... [2]

**(iii)** Calculate $T^2$.

$T^2$ = .....

**(iv)** Justify the number of significant figures that you have given for your value of $T^2$.

.....

.....

..... [1]

**(d)** **Keeping distance *y* constant**, change $m_2$ to 50 g and repeat **(a)(ii)**, **(a)(iii)**, **(b)**, **(c)(i)**, **(c)(ii)** and **(c)(iii)**.

$x$ = .....

$y$ = .....

$z$ = .....

$C$ = .....

$T$ = .....

$T^2$ = .....

[3]

**(e)** It is suggested that the relationship between $T$ and $C$ is

$$T^2 = kC$$

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 **(e)(i)** 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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