Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

3652236804

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2021**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION
- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
Total	

This document has **12** pages. Any blank pages are indicated.

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

1 In this experiment, you will investigate the oscillations of a metre rule.

(a) ● Set up the apparatus as shown in Fig. 1.1, with the scales on the metre rules facing upwards.

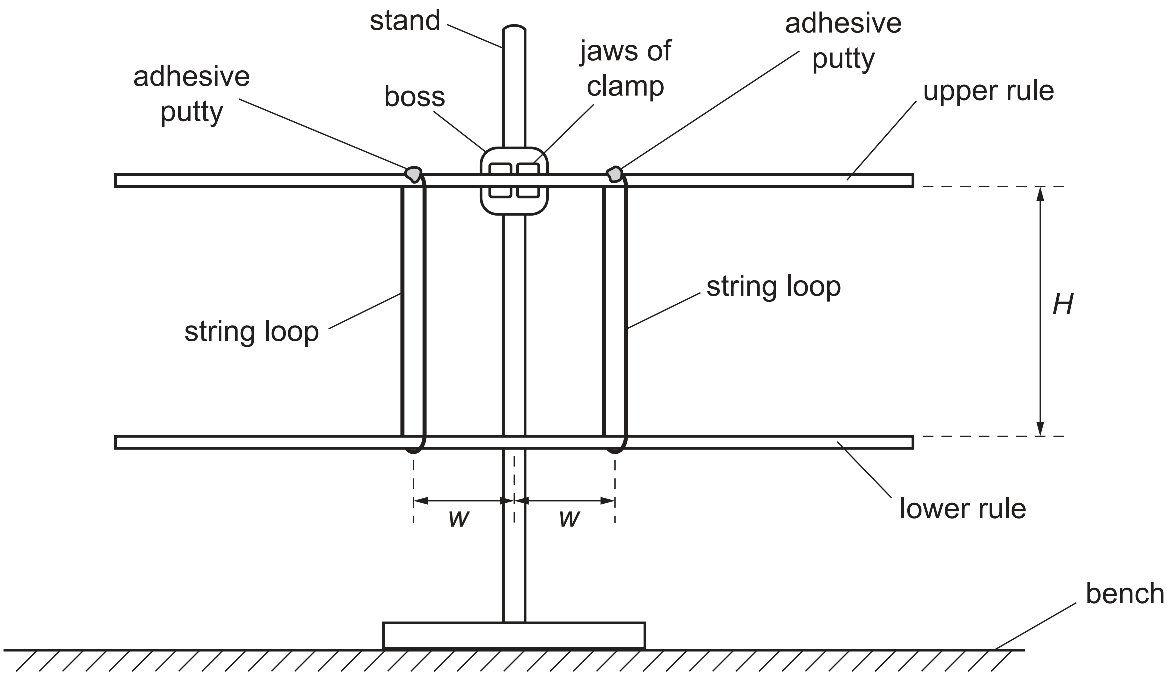

Fig. 1.1

● Adjust the clamp so that the upper rule is parallel to the bench.

● Adjust the positions of the string loops so that each loop is approximately 40 cm from the nearest ends of the two rules.

● The vertical distance between the two rules is *H*.

Measure and record *H*.

H = ... [1]

(b) ● For both rules, the distance between the 50 cm mark and each string loop is *w*, as shown in Fig. 1.1.

Adjust the positions of the string loops until the distances *w* are equal and approximately 10 cm.

● Measure and record *w*.

w = ... cm

● Gently rotate the lower rule and release it. The lower rule will oscillate as shown in Fig. 1.2.

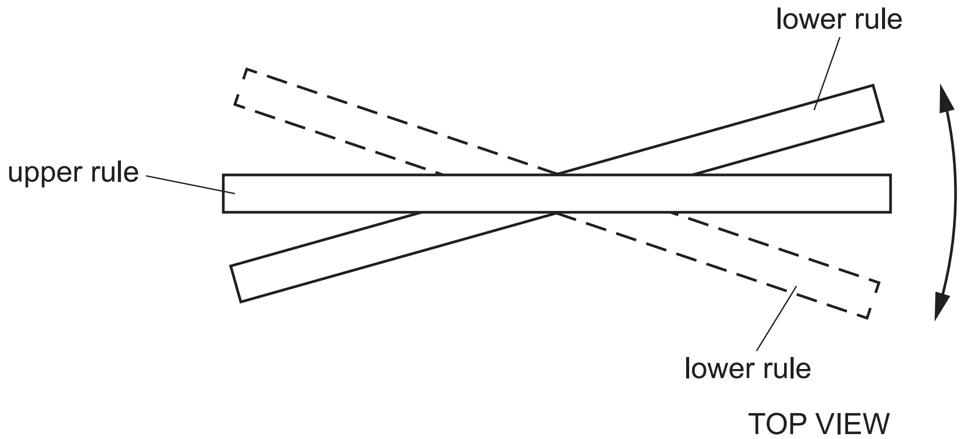

Fig. 1.2

● Take measurements to determine the period *T* of the oscillations.

T = ... s
[2]

(c) Vary w in the range $5.0\,\text{cm} \leqslant w \leqslant 20.0\,\text{cm}$ and determine six sets of readings of w and T.

Record your results in a table. Include values of $\frac{1}{w}$ in your table.

[9]

(d) **(i)** Plot a graph of T on the y-axis against $\frac{1}{w}$ on the x-axis. [3]

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

(iii) Determine the gradient of this line.

gradient = ... [1]

(e) **(i)** It is suggested that the quantities *T* and *w* are related by the equation

$$T = \frac{B}{w}$$

where *B* is a constant.

Using your answer to **(d)(iii)**, determine a value for *B*.
Give an appropriate unit.

B = ... [2]

(ii) It is suggested that *B* is given by the equation

$$B^2 = \frac{3\pi^2 H^3}{g}$$

where *g* is the acceleration of free fall.

Using your answers to **(a)** and **(e)(i)**, determine a value for *g*.

g = ... $m\,s^{-2}$ [1]

[Total: 20]

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

2 In this experiment, you will determine the weight of a metre rule.

(a) **(i)** • Attach the spring to the clamp.

• Suspend the mass hanger from the spring as shown in Fig. 2.1.

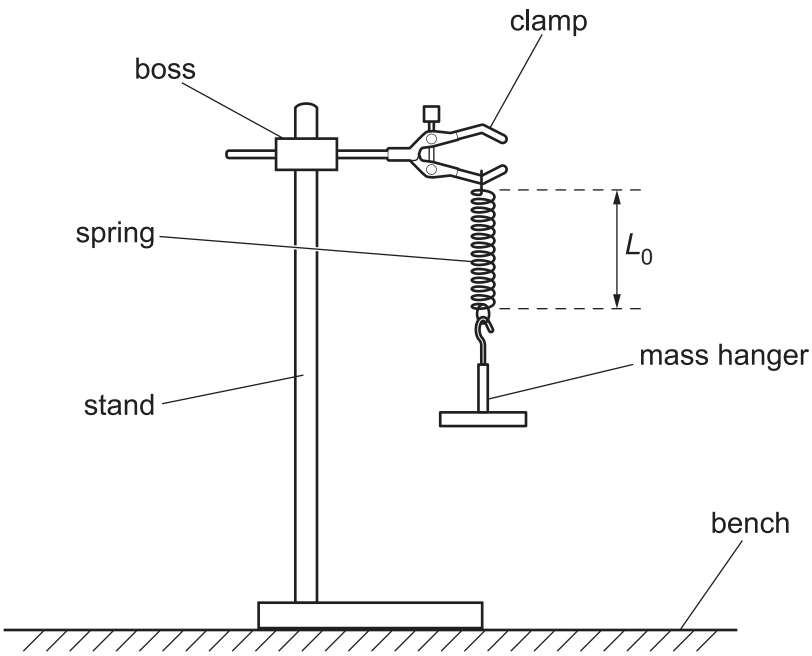

Fig. 2.1

• The length of the coiled section of the spring is L_0.

Measure and record L_0.

L_0 = ... cm [1]

(ii) Estimate the percentage uncertainty in your value of L_0. Show your working.

percentage uncertainty = ... [1]

(b) (i) ● Add an additional mass of 0.100 kg to the mass hanger.

● The new length of the coiled section of the spring is L_1.

Measure and record L_1.

L_1 = ... cm

● Remove the 0.100 kg mass.

[1]

(ii) Calculate $(L_1 - L_0)$.

$(L_1 - L_0)$ = ... cm [1]

(iii) The spring constant k is given by the equation

$$k = \frac{F}{(L_1 - L_0)}$$

where F is 0.981 N.

Calculate k.

k = ... [1]

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

....

....

.... [1]

(c) **(i)** ● Set up the apparatus as shown in Fig. 2.2.

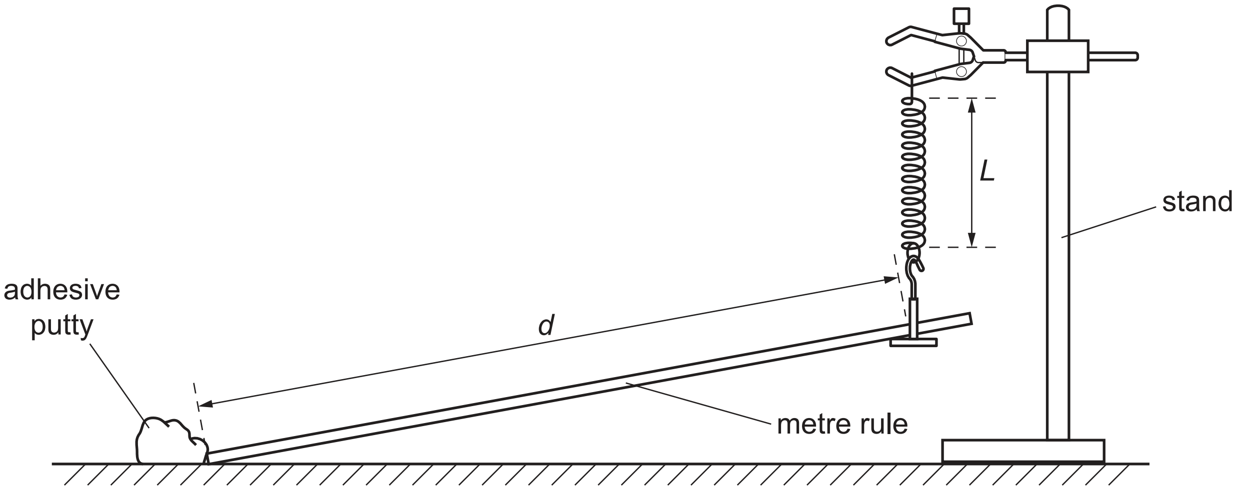

Fig. 2.2

- Support the rule on the mass hanger. You may need to use some of the adhesive putty to stop the rule from slipping off the mass hanger.
- The distance between the lower end of the rule and the mass hanger is *d*, as shown in Fig. 2.2. The length of the coiled section of the spring is *L*.

  Adjust the apparatus so that *d* is approximately 90 cm and the spring is vertical.
- Measure and record *d* and *L*.

d = ... cm

L = ... cm

- Using your answer to **(a)(i)**, calculate $(L - L_0)$.

$(L - L_0)$ = ... cm
[1]

(ii) Repeat **(c)(i)** with a distance *d* of approximately 60 cm.

d = ... cm

L = ... cm

$(L - L_0)$ = ... cm
[2]

(d) It is suggested that the relationship between $(L - L_0)$ and d is

$$C = d(L - L_0)$$

where C is a constant.

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

first value of C = ...

second value of C = ...
[1]

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

....

....

....

.... [1]

(e) The constant C is given by

$$C = \frac{Wd_0}{2k}$$

where d_0 is the length and W is the weight of the metre rule.

Use your second value of C to determine W.

W = ... [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]

[Total: 20]

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