



Cambridge International AS & A Level

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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.

2

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.

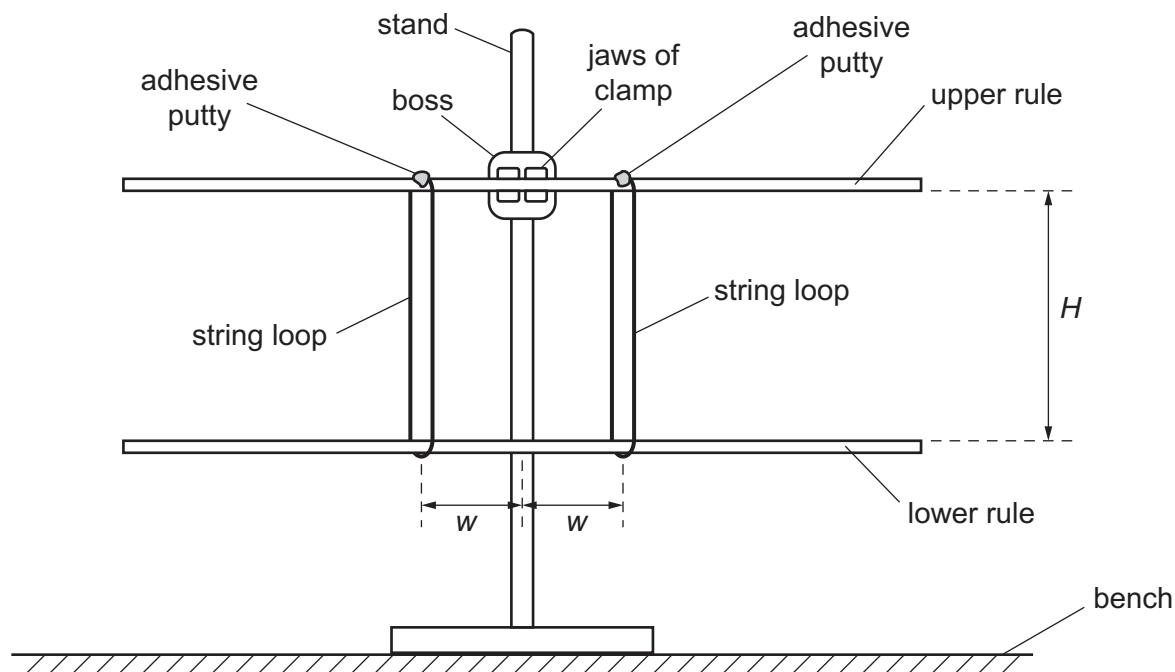


Fig. 1.1

- 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 .

$H = \dots\dots\dots$ [1]

3

- (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 .

$w = \dots\dots\dots$ cm

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

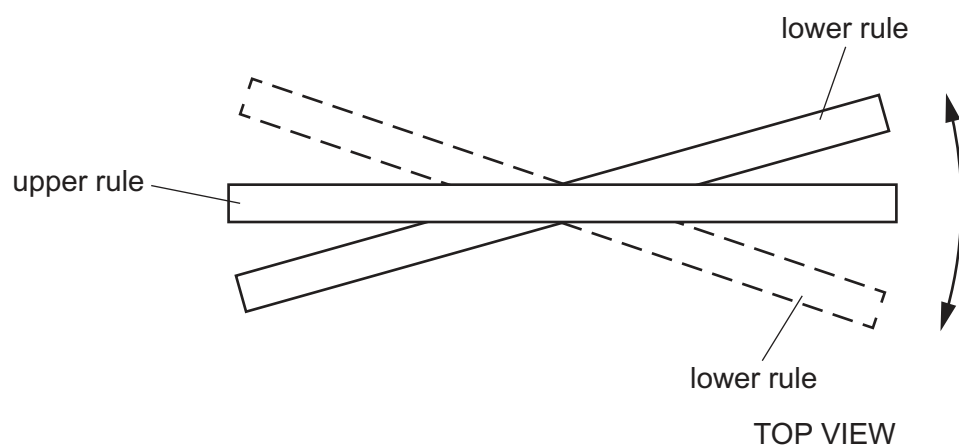


Fig. 1.2

- Take measurements to determine the period T of the oscillations.

$T = \dots\dots\dots$ s
[2]

4

- (c) Vary w in the range $5.0\text{ cm} \leq w \leq 20.0\text{ cm}$ 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.

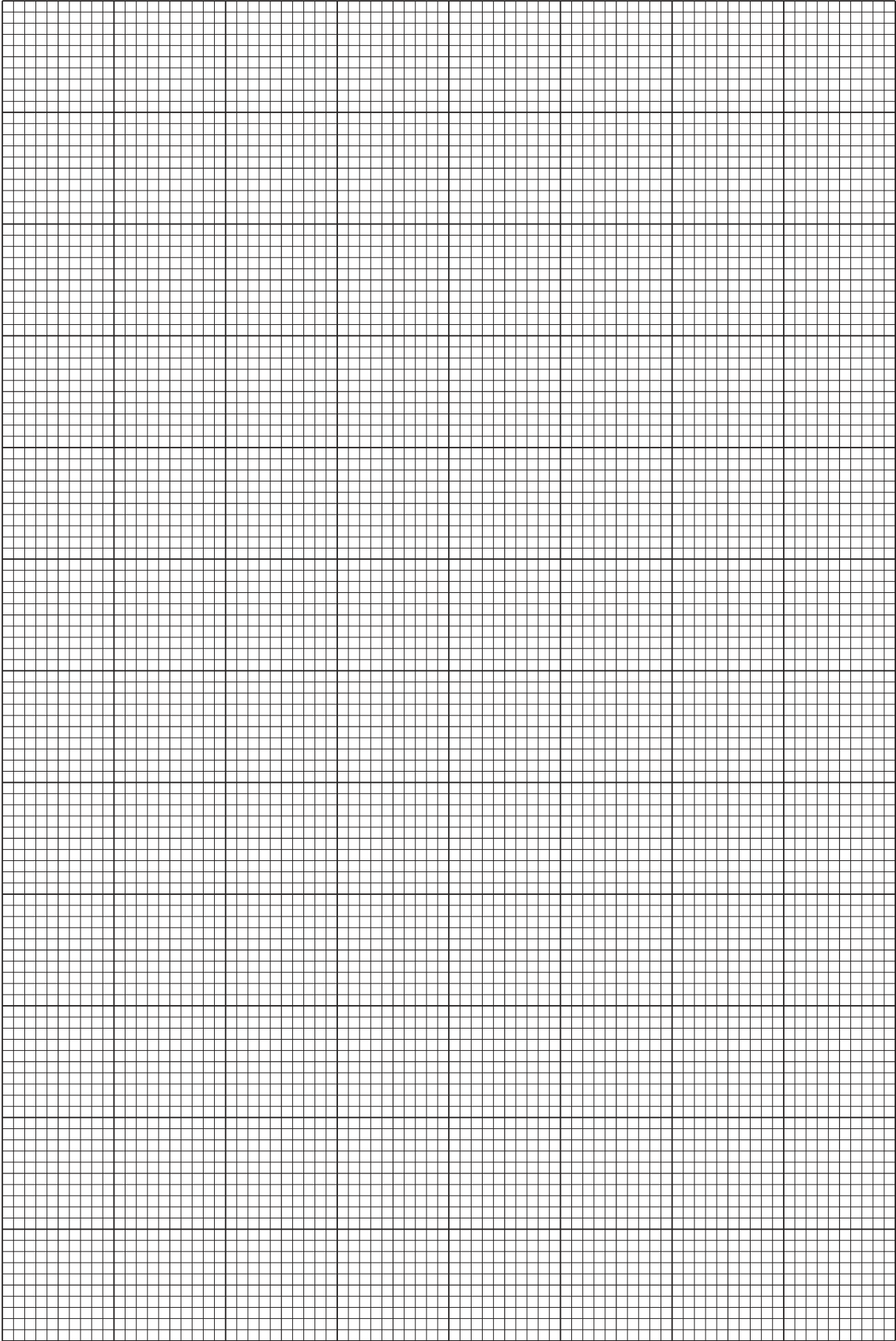
[3]

- (ii) Draw the straight line of best fit.

[1]

- (iii) Determine the gradient of this line.

gradient = [1]



6

- (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 .

$g =$ ms^{-2} [1]

[Total: 20]

7

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.

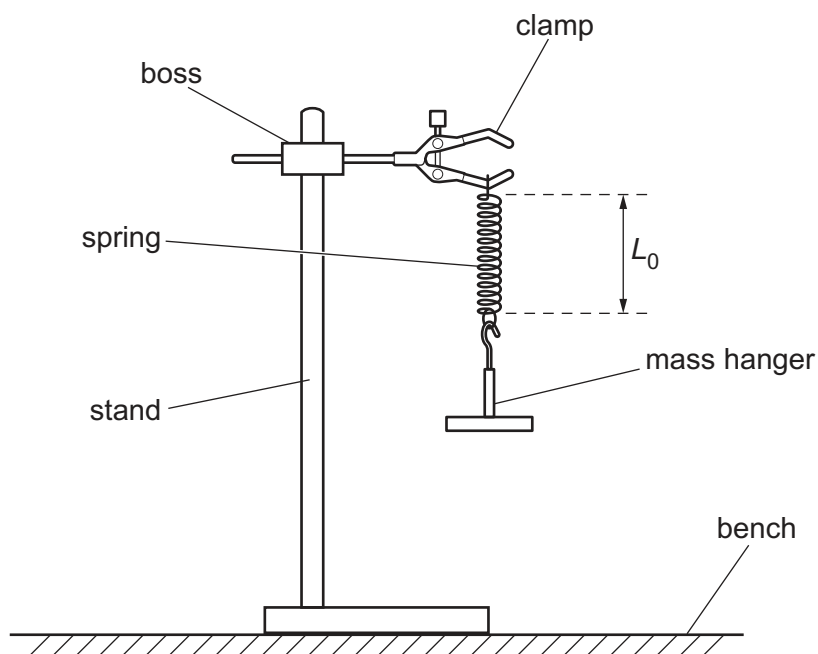


Fig. 2.1

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

Measure and record L_0 .

$L_0 = \dots\dots\dots$ cm [1]

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

percentage uncertainty = $\dots\dots\dots$ [1]

8

- (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]

9

- (c) (i) • Set up the apparatus as shown in Fig. 2.2.

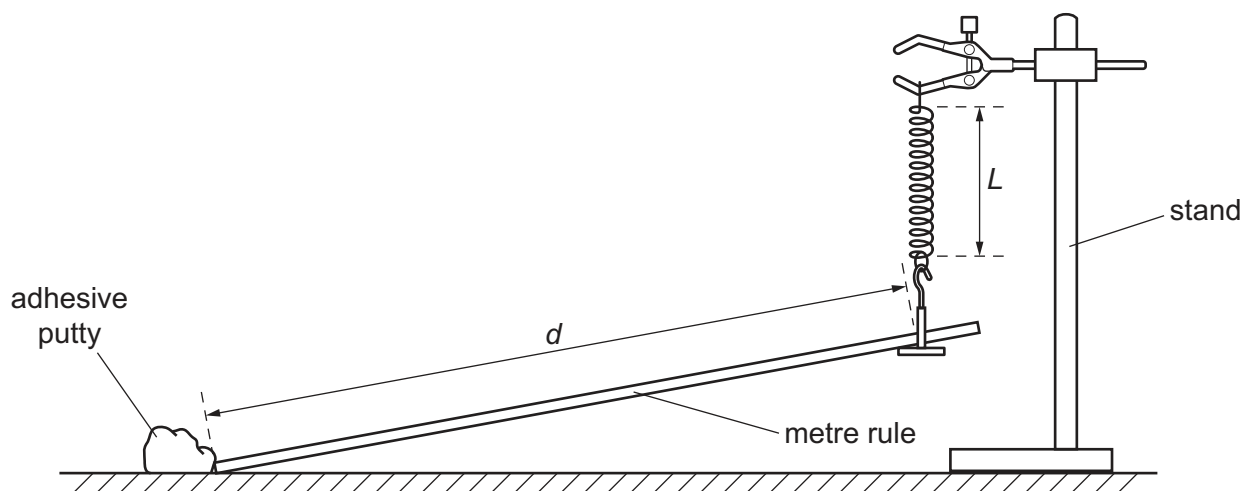


Fig. 2.2

- 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]

10

- (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 $C = \dots\dots\dots$

second value of $C = \dots\dots\dots$

[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 .

$W = \dots\dots\dots$ [1]

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

1.
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2.
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3.
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4.
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[4]

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

1.
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[4]

[Total: 20]

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