Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **May/June 2025**

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.

[Turn over

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

1 In this experiment, you will investigate the oscillation of masses on springs.

You have been provided with masses and springs.

Set up the apparatus as shown in Fig. 1.1.

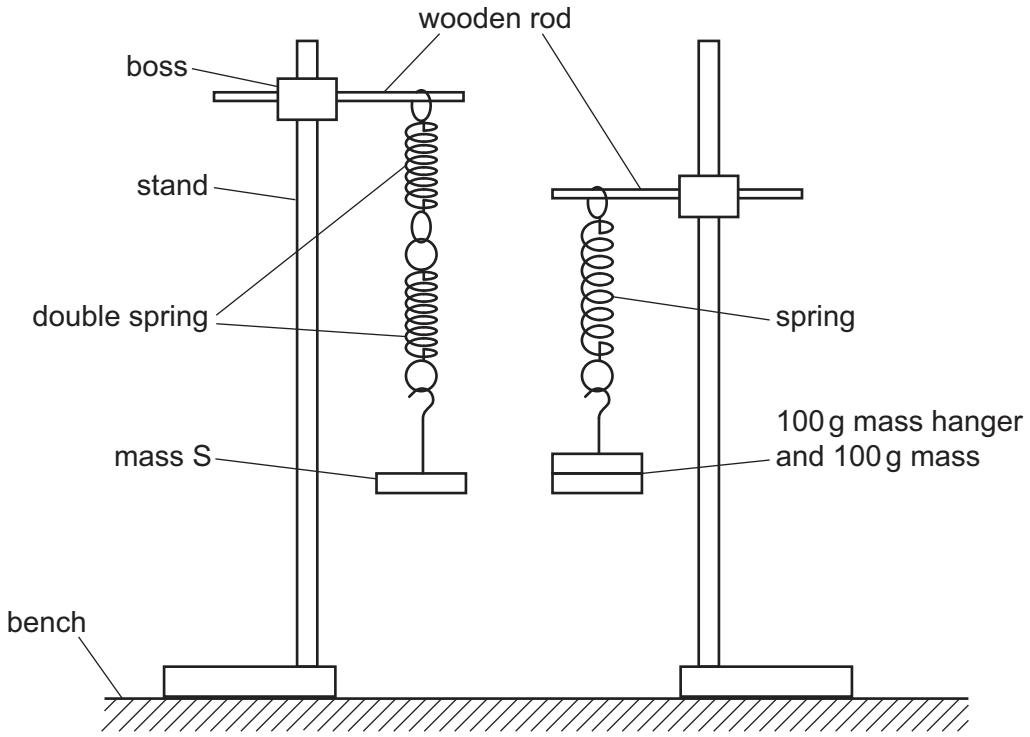


Fig. 1.1

(a)

- Ensure the bottoms of both masses are at the same level.
- Pull both masses down through a short distance and release them at the same time.
- Watch the oscillations of the masses. The masses initially oscillate in phase, then out of phase and then back in phase.
- The number of oscillations of mass S from release until the masses are back in phase for the first time is n_0.

  Determine and record n_0.

n_0 = ... [2]

(b) (i)

- Add a mass of 30 g to mass S. The added mass is *M*.
- Record *M*.

M = ...

- Repeat **(a)**. The number of oscillations of mass S from release until the masses are back in phase for the first time is *n*.
- Determine and record *n*.

n = ...
[1]

(ii) Calculate *N*, where

$$N = n_0 - n.$$

N = ... [1]

(c) Vary M by changing the number of 10 g masses added to mass S and determine n. Do **not** use $M = 0$.

Repeat until you have five sets of values of M and n.

Record your results in a table. Include values of N. Also include values of N^3 to three significant figures.

[8]

(d) (i) Plot a graph of N^3 on the y-axis against M on the x-axis. [3]

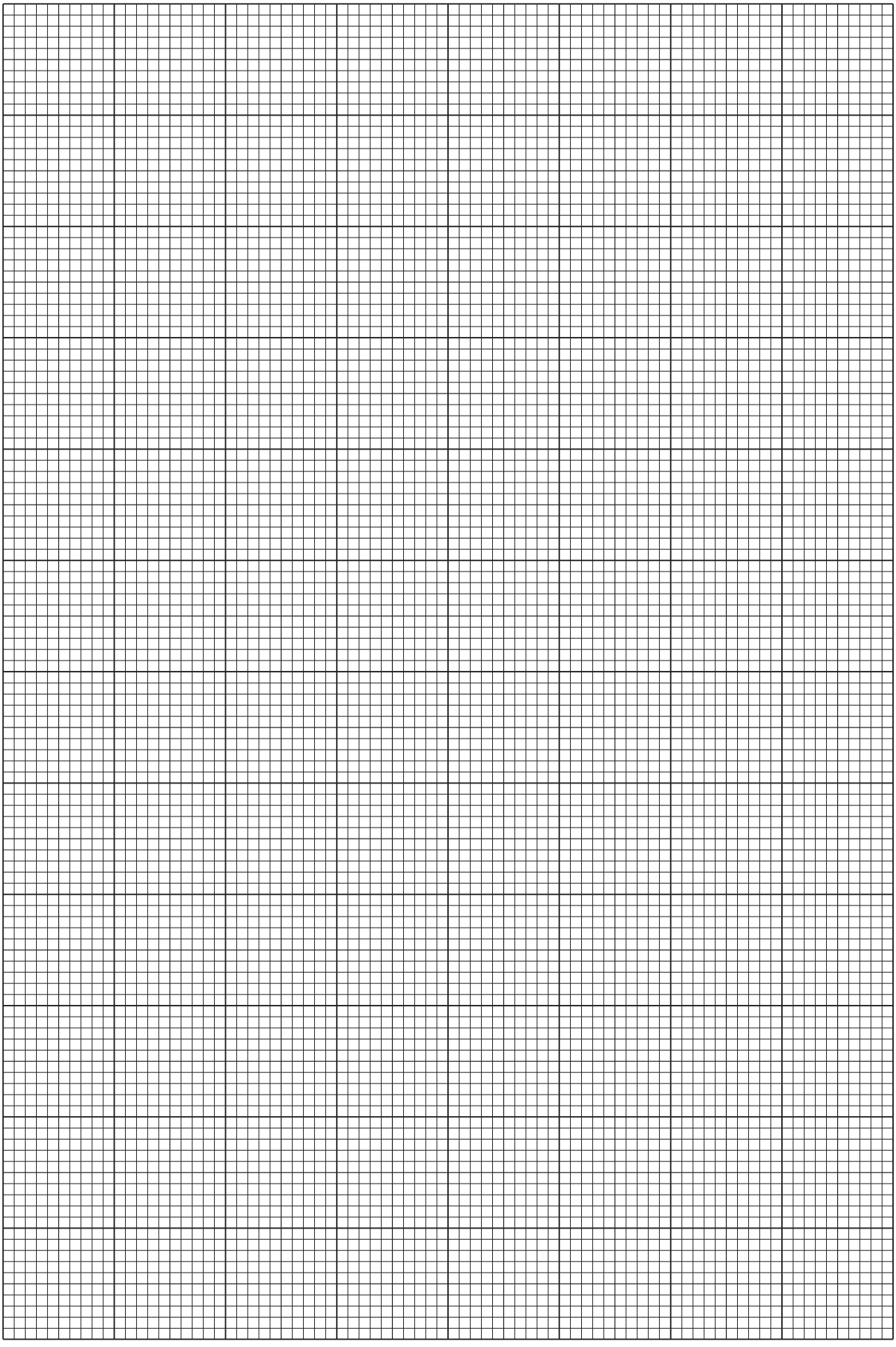
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities N and M are related by the equation

$$N^3 = PM + Q$$

where P and Q are constants.

Using your answers in **(d)(iii)**, determine the values of P and Q.
Give appropriate units.

P = ...

Q = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the behaviour of paper on water.

You have been provided with two sheets of tracing paper.

(a) • On one of the sheets of tracing paper, draw two identical rectangles as shown in Fig. 2.1 where c = 4.0 cm and d = 6.0 cm. The orientation of the rectangles must be as shown in Fig. 2.1.

• Add labels A and B to the rectangles, as shown in Fig. 2.1.

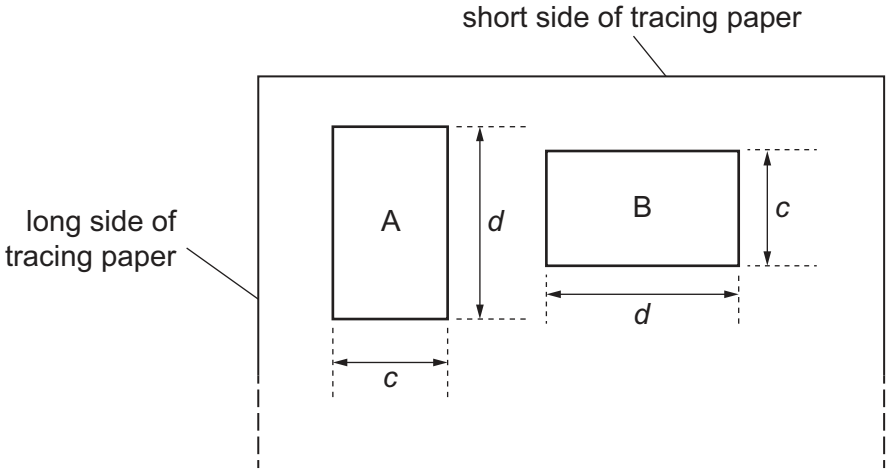


Fig. 2.1

• Use the scissors to cut out the rectangles.

• Take measurements to determine the average value of d.

d = ... cm [1]

(b) (i) • When A is placed flat on the surface of the water in one of the bowls, the shape will curl up as shown in Fig. 2.2. Two edges of the paper will curl and then meet.

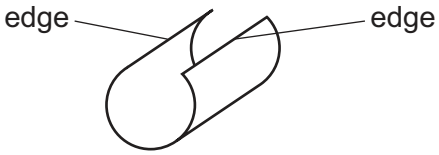


Fig. 2.2

The time between placing A on the water and the two edges meeting is T_A.

- Place A flat on the water.
- Determine T_A.

T_A = ...

- Remove A from the water and place it in the empty bowl.

[2]

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

percentage uncertainty = ... % [1]

(c) (i) • Repeat the procedure in **(b)(i)** for B. The time between placing B on the water and the two edges meeting is T_B.

T_B = ...

- Remove B from the water.
- Compare your values of T_A and T_B. Record the longer time.

longer time = ...

[1]

(ii) The quantity W is given by

$$W = \frac{\text{longer time}}{\text{shorter time}}.$$

Calculate W.

W = ... [1]

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

.....

.....

..... [1]

(d) Repeat **(a)**, **(b)(i)**, **(c)(i)** and **(c)(ii)** using new rectangles with c = 4.0 cm and d = 9.0 cm.

d = ... cm

T_A = ...

T_B = ...

longer time = ...

W = ...
[3]

(e) It is suggested that the relationship between W and d is

$$W^2 = kd$$

where k is a constant.

Using your data, calculate **two** values of k.

first value of k = ...

second value of k = ...

[1]

(f) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the relationship in **(e)**.

.....

.....

.....

..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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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