* 0000800000001 *

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 9 0 7 3 9 2 7 0 8 1 *

PHYSICS **9702/38**

Paper 3 Advanced Practical Skills 2 **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	
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Total	

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

1 In this experiment, you will investigate the properties of a pendulum.

(a) (i) • Assemble the apparatus as shown in Fig. 1.1.

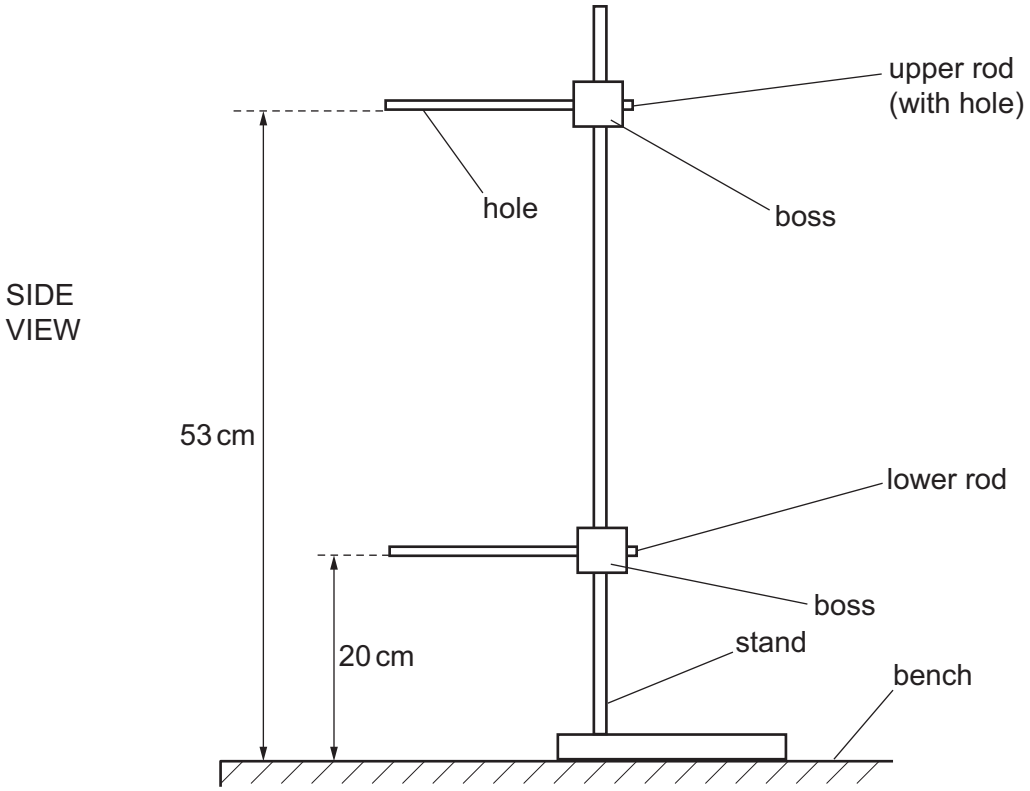


Fig. 1.1

• Rotate the upper rod in the boss so that the hole is vertical.

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- Thread the string of the pendulum up through the hole in the upper rod and pull it through until the pendulum bob is approximately 2 cm above the bench. Use the clip to fasten the string to the stand to prevent the string from slipping down through the hole, as shown in Fig. 1.2.

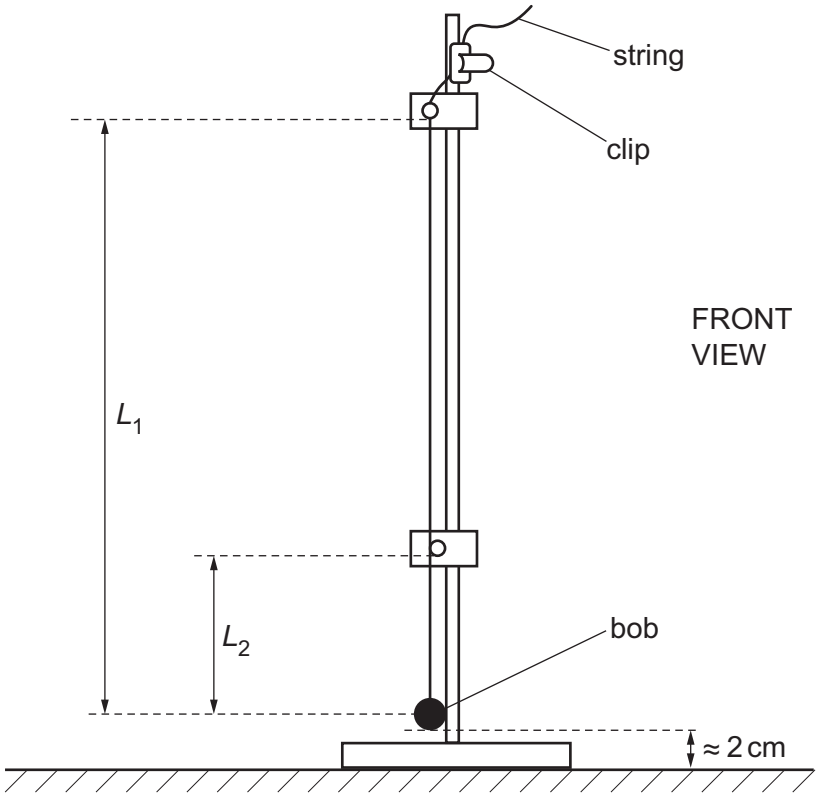


Fig. 1.2

- Turn the lower rod horizontally so that the string is just touching the rod.
  Leave both rods in these positions for the whole experiment.

- The distance of the centre of the bob below the upper rod is L_1.
  The distance of the centre of the bob below the lower rod is L_2.

  Measure and record L_1 and L_2.

  L_1 = ...

  L_2 = ...
  [1]

(ii) • Push the bob so that the string moves a short distance away from the lower rod and then release it. The bob will oscillate.

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

T = ... [2]

(b) Move the string through the hole and refasten it to change L_1. Measure and record L_1, L_2 and T.

Repeat until you have six sets of values of L_1, L_2 and T.

Record your results in a table. Include values of $(\sqrt{L_1} + \sqrt{L_2})$ to three significant figures in your table.

[8]

(c) (i) Plot a graph of T on the y-axis against $(\sqrt{L_1} + \sqrt{L_2})$ on the x-axis. [3]

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

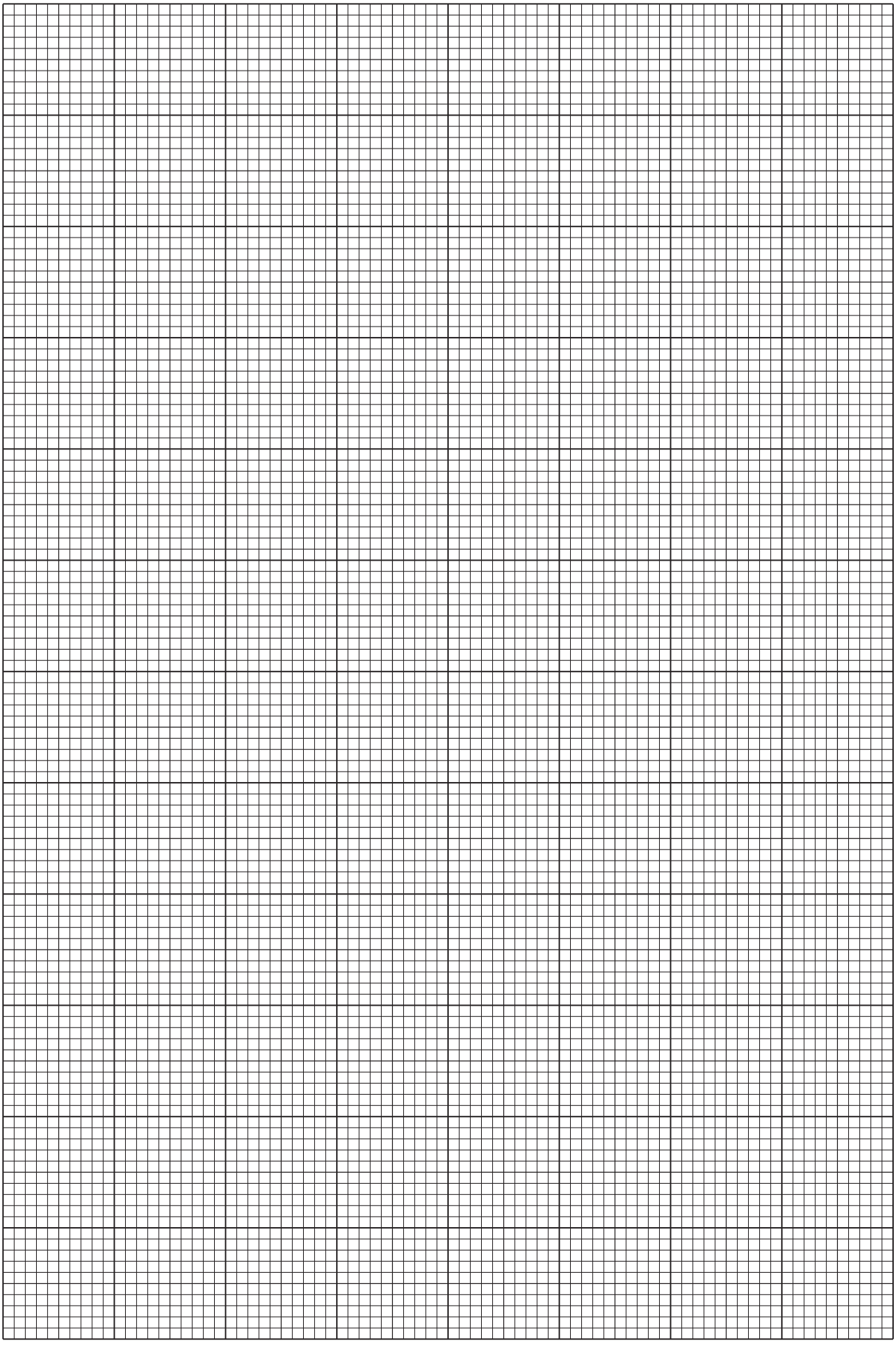
(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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(d) It is suggested that the quantities T, L_1 and L_2 are related by the equation

$$T = a(\sqrt{L_1} + \sqrt{L_2}) + b$$

where a and b are constants.

Using your answers in **(c)(iii)**, determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

(e) Theory suggests that a is related to the acceleration of free fall g by

$$g = \left(\frac{\pi}{a}\right)^2.$$

Using your value for a, calculate a value for g.
Give an appropriate unit.

g = ... [1]

[Total: 20]

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2 In this experiment, you will investigate the motion of steel balls falling through water in a tube.

(a) (i) You have been provided with a wide tube attached to a wooden strip.

Measure and record the **internal** diameter *D* of the wide tube.

D = ... [2]

(ii) • Assemble the apparatus as shown in Fig. 2.1.

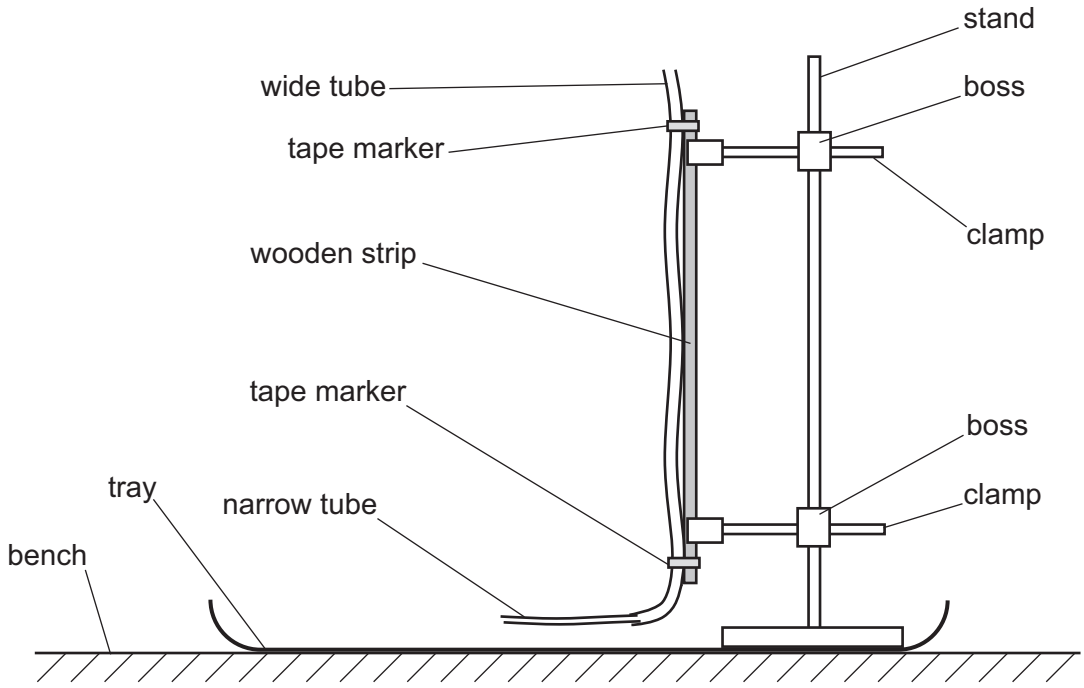


Fig. 2.1

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You have been provided with four steel balls of two different diameters.

- Measure and record the diameter d of one of the **larger** balls.

d = ...

- Fill the syringe with water from the beaker.
- Push the nozzle of the syringe securely into the narrow tube. Slowly push the syringe plunger until the wide tube is filled to the top with water.
  Leave the syringe attached to the narrow tube.
- Drop one of the **larger** balls into the wide tube and watch it fall down past the two tape markers.
- Use the magnet to retrieve the ball from the tube.

[1]

(b) (i)
- Drop one of the **larger** balls into the wide tube.
- Take measurements to determine the time t for the ball to fall from the upper tape marker to the lower tape marker.

t = ... [2]

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

percentage uncertainty = ...% [1]

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(c) • Measure and record the diameter d of one of the **smaller** balls.

d = ...

• Using one of the **smaller** balls, repeat **(b)(i)**.

t = ...
[3]

(d) It is suggested that the relationship between t, D and d is

$$\frac{1}{t} = k(D^2 - d^2)$$

where k is a constant.

(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]

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(e) It is suggested that the percentage uncertainty in the values of k is 10%.

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

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..... [1]

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(f) (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 .....

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3 .....

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4 .....

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[4]

[Total: 20]

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