Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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.

DC (SL/CB) 329822/1

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

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

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

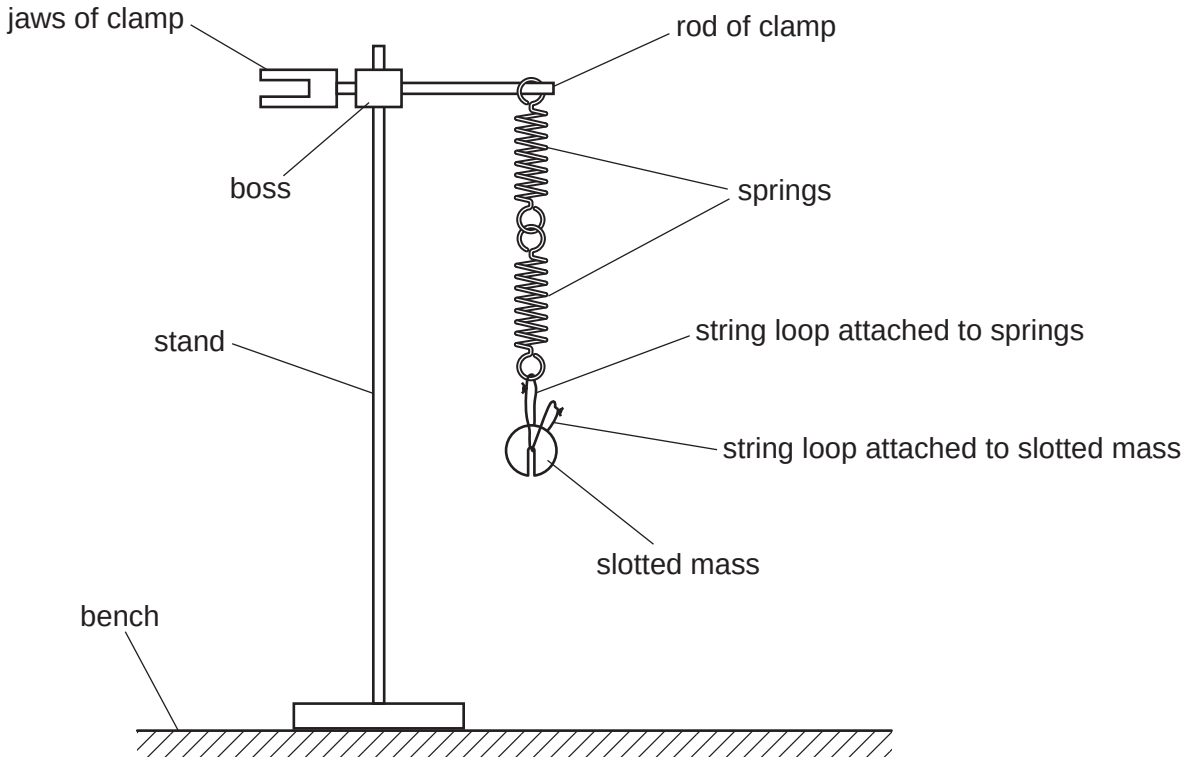


Fig. 1.1

- Place the slotted mass in the string loop attached to the springs.
- Pull the slotted mass downwards through a small distance.
- Release the mass. The mass will oscillate.
- Determine the period T_0 of the oscillations of the mass.

T_0 = ...

- Remove the slotted mass from the string loop attached to the springs.

[2]

(b) ● Set up the apparatus as shown in Fig. 1.2.

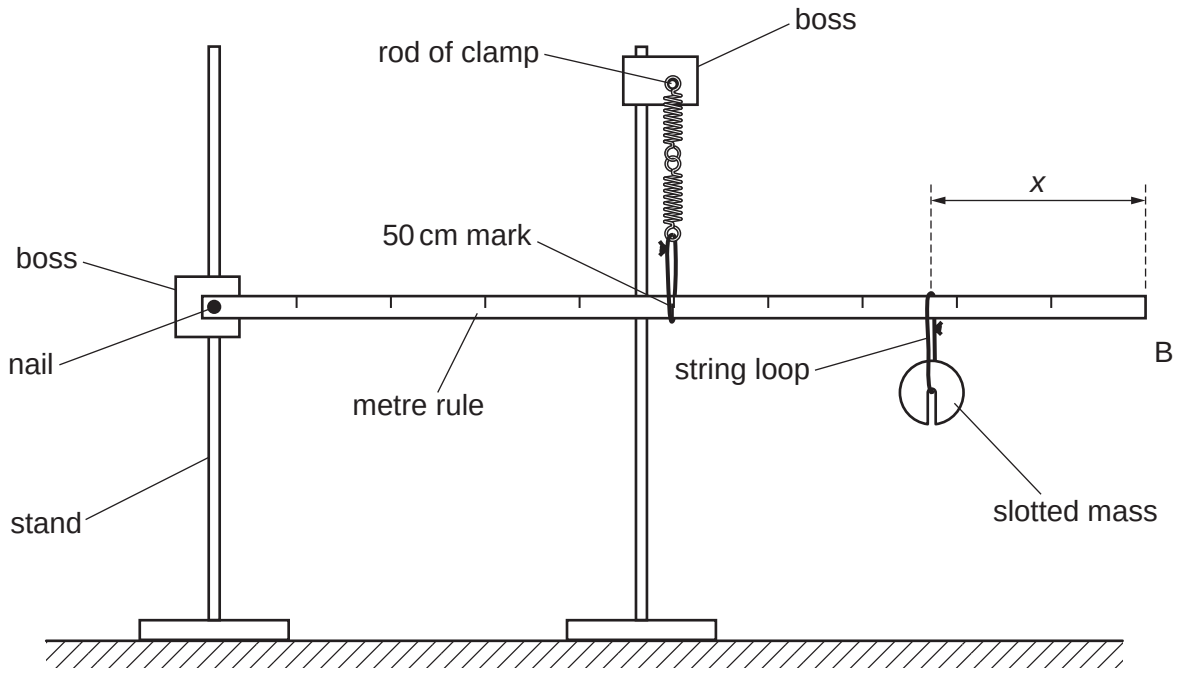


Fig. 1.2

- Position the string loop attached to the springs at the 50 cm mark on the rule. **This string loop must remain in this position throughout the experiment.**
- The distance between the string loop supporting the slotted mass and the end B of the rule is *x*.

  Position the mass so that *x* is approximately 20 cm.
- Adjust the apparatus so that the rule is parallel to the bench and the springs are vertical.
- Record *x*.

x = ...

- Pull B downwards through a small distance.
- Release B. The rule will oscillate.
- Determine the period *T* of the oscillations of the rule.

T = ...
[1]

(c) Change x by moving the mass along the rule. For each value of x, adjust the apparatus so that the rule is parallel to the bench and the springs are vertical, then determine T.

Repeat until you have six sets of values of x and T with x in the range $10\,\text{cm} \leqslant x \leqslant 40\,\text{cm}$.

Record your results in a table. Include values of $(T - T_0)^2$ in your table.

[9]

(d) **(i)** Plot a graph of $(T - T_0)^2$ on the y-axis against x on the x-axis. [3]

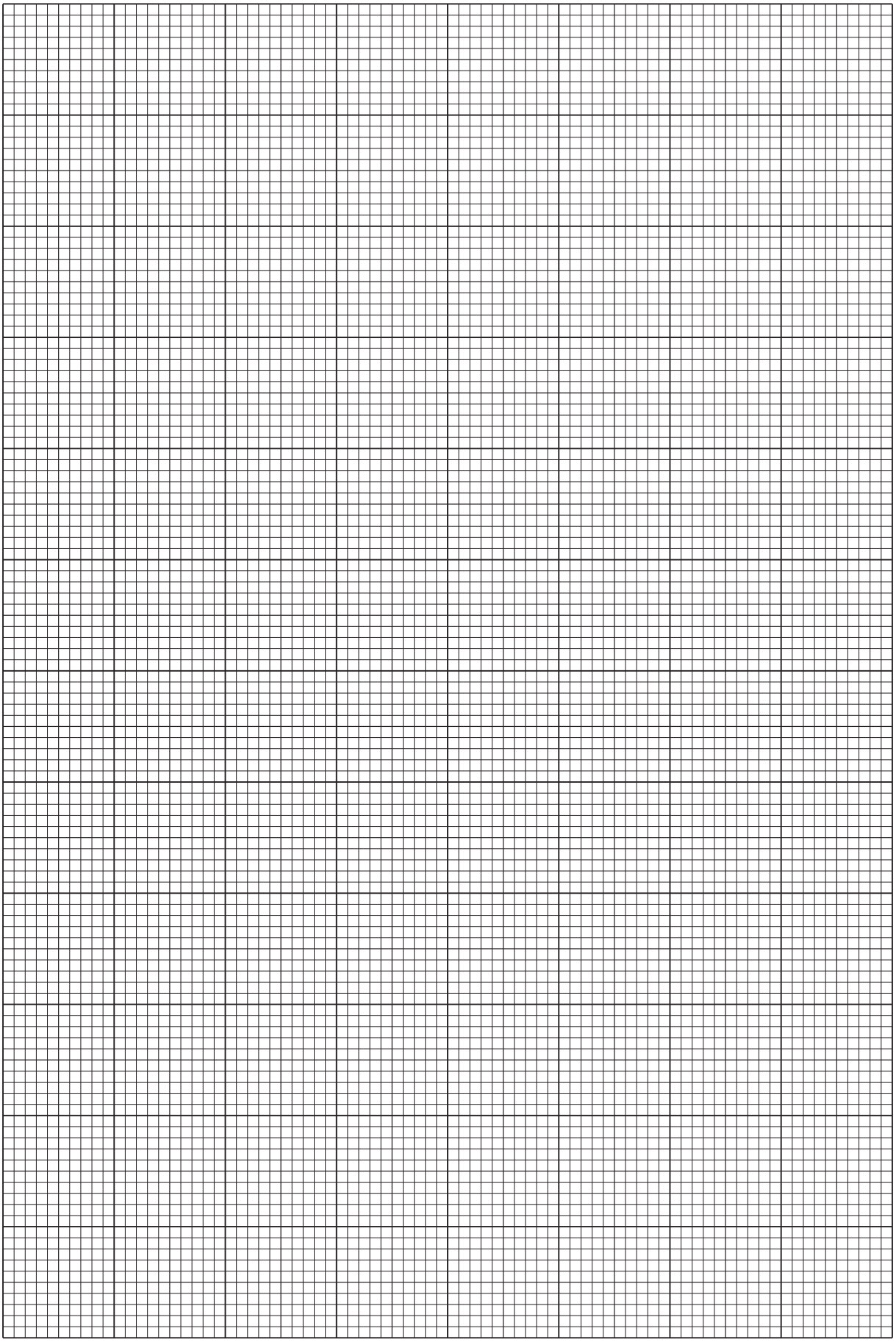
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities T, T_0 and x are related by the equation

$$(T - T_0)^2 = -Px + Q$$

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 optical properties of glass jars.

You have been provided with two glass jars A and B, each containing water. Each jar has a lid.

(a) The diameter of jar A is *D*, as shown in Fig. 2.1.

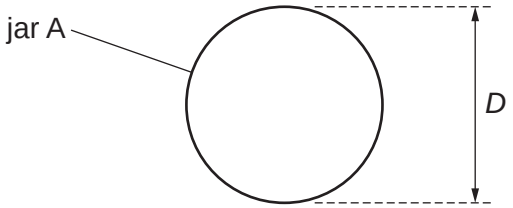


Fig. 2.1

Measure and record *D*.

D = ... [1]

(b) (i) ● Hold the nail next to jar A, as shown in Fig. 2.2.

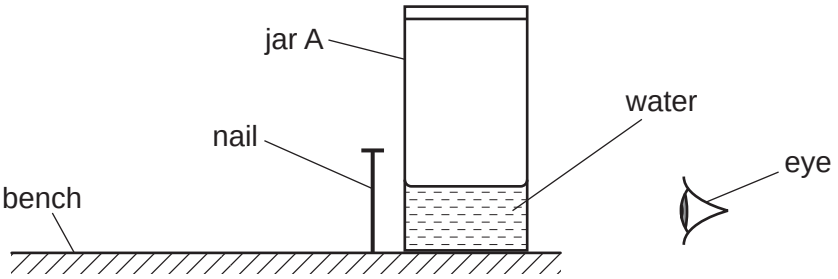


Fig. 2.2

● Close one eye and look at the nail **through the water**.

The bottom of the nail seen through the water will appear to be wider than the top of the nail, as shown in Fig. 2.3.

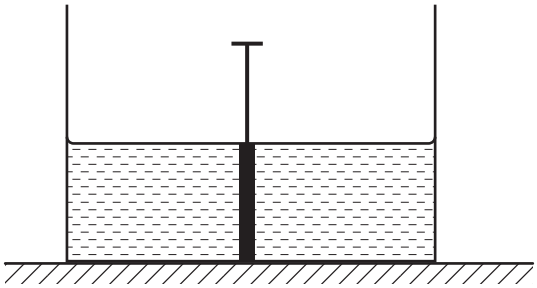


Fig. 2.3

● Move the nail away from the jar. The bottom of the nail will appear to become wider until it suddenly disappears. Hold the nail at this point.

● The distance between the nail and jar A is *y*, as shown in Fig. 2.4.

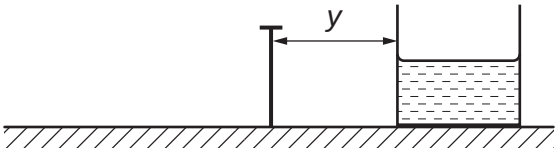


Fig. 2.4

Measure and record *y*.

y = ... [2]

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

percentage uncertainty = ... % [1]

(iii) The radius r of jar A is given by

$$r = \frac{D}{2}.$$

Calculate $(r + y)$.

$(r + y)$ = ... [1]

(c) Repeat **(a)**, **(b)(i)** and **(b)(iii)** using jar B.

D = ...

y = ...

$(r + y)$ = ...
[3]

(d) It is suggested that the relationship between r and y is

$$\frac{(r + y)}{r} = k$$

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]

(e) 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 **(d)**.

.....

.....

.....

..... [1]

(f) ● View the nail through the lens as shown in Fig. 2.5.

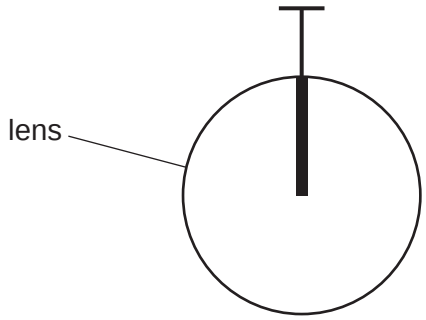


Fig. 2.5

- Increase the distance between the nail and the lens until the bottom of the nail seen through the lens disappears.
- Measure and record the distance *y* between the nail and the surface of the lens.

y = ...

- Use your second value of *k* to determine a value of *r* for the lens.
  Give an appropriate unit.

r = ...
[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]