Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*6384944725*

**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.




[Turn over

**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.

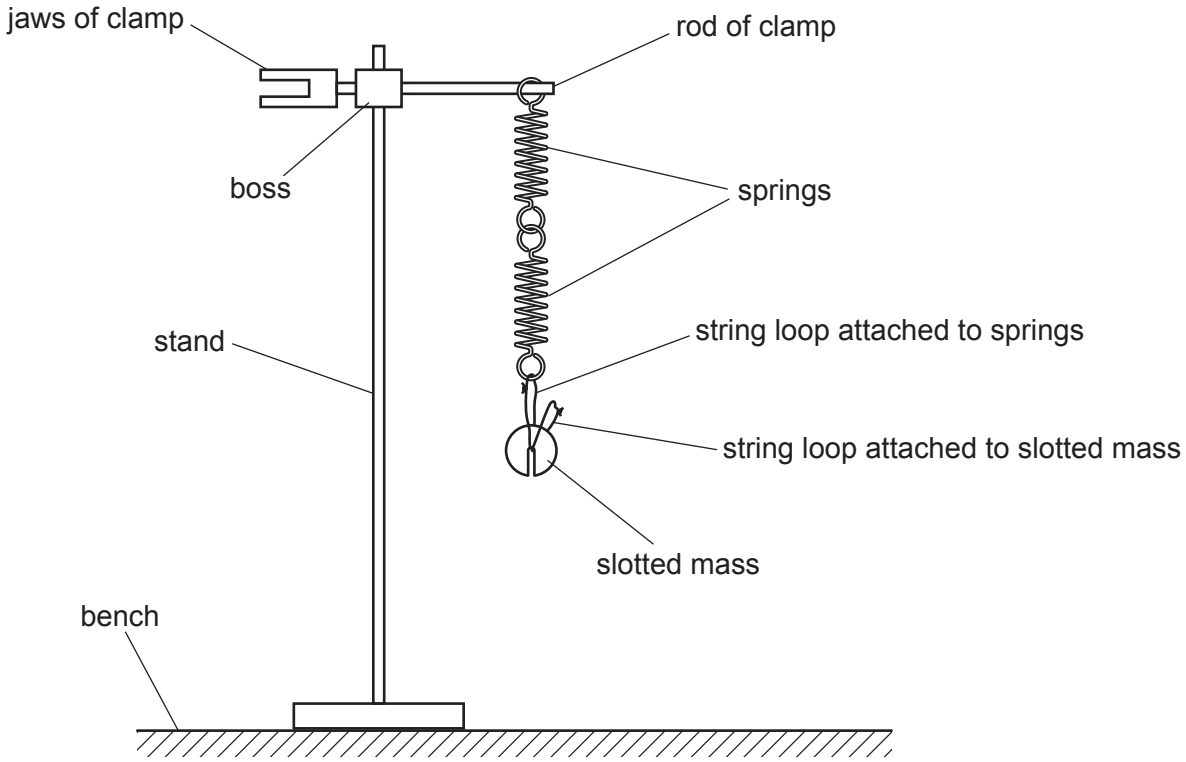



**Fig. 1.1**

- 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.

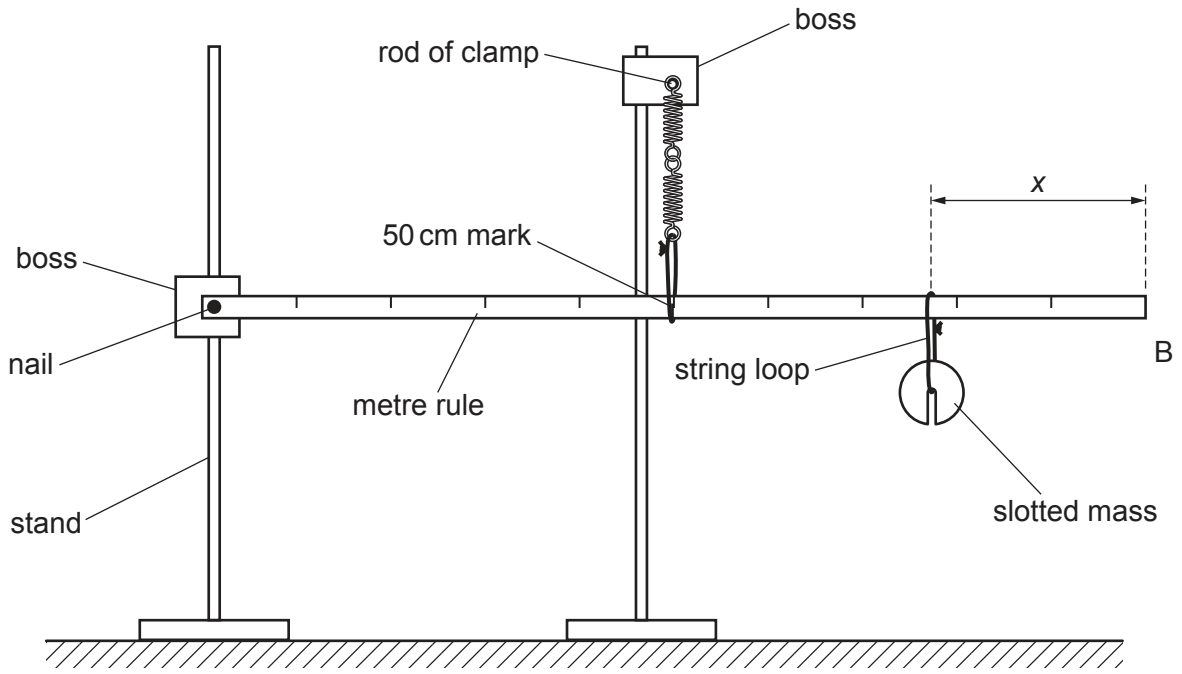



**Fig. 1.2**

- 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]

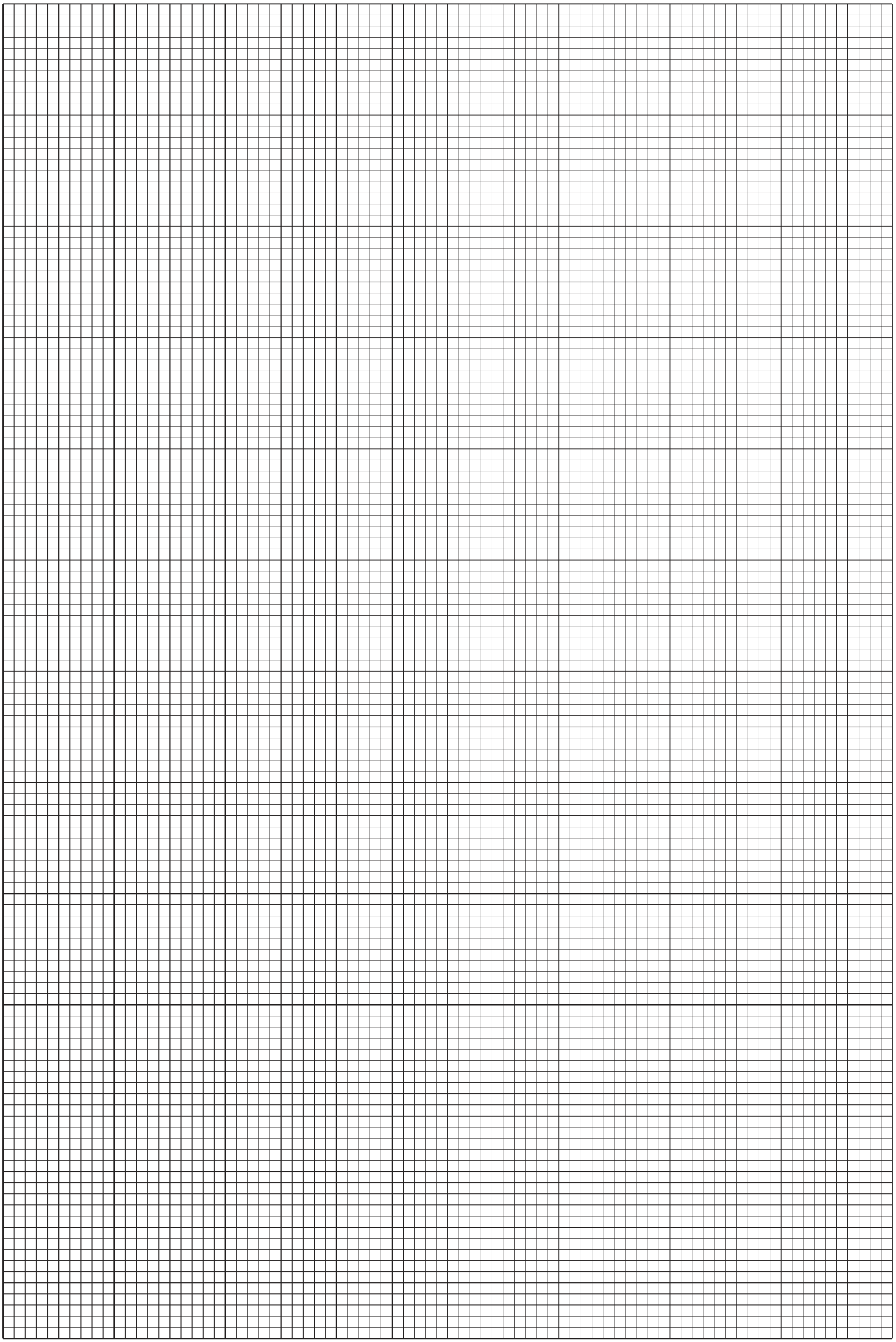
**(ii)** Draw the straight line of best fit. [1]

**(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.

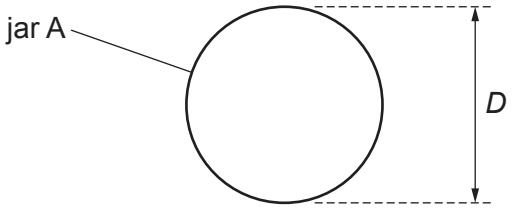



**Fig. 2.1**

Measure and record *D*.

*D* = ..... [1]

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

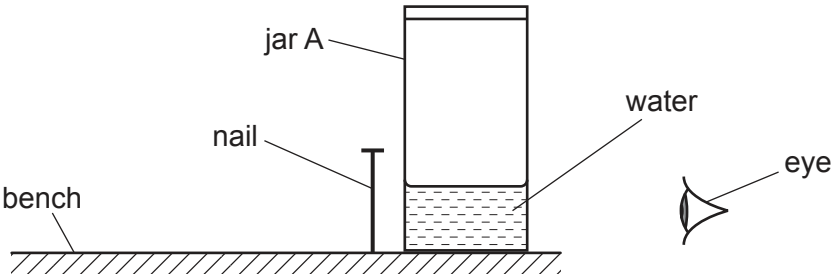



**Fig. 2.2**

● 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.

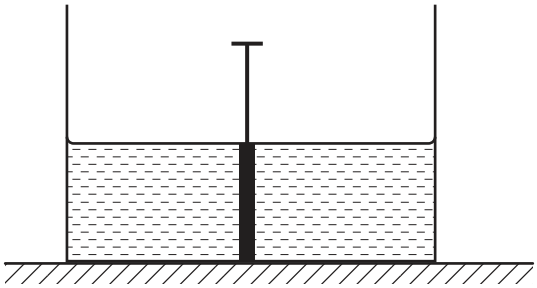


**Fig. 2.3**

● 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.

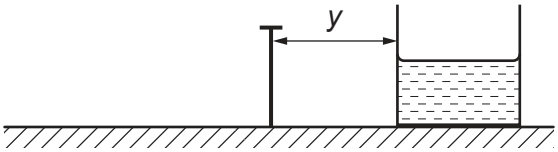



**Fig. 2.4**

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.

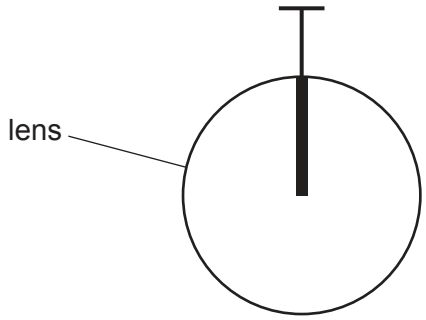



**Fig. 2.5**

- 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]