Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/33**

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. 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 a balanced metre rule.

You have been provided with a metre rule and some masses.

(a) ● Place the masses on the rule as shown in Fig. 1.1.

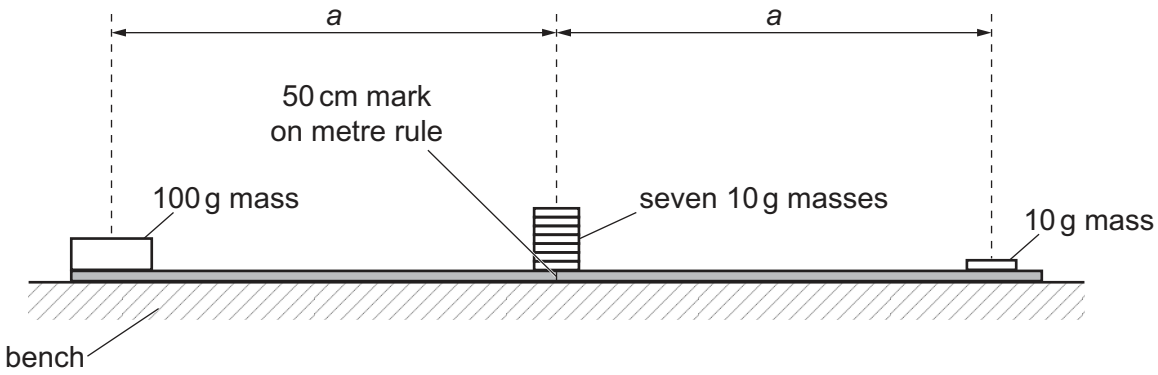


Fig. 1.1

- Place the 100 g mass at one end of the rule.
- The distance between the centre of the 100 g mass and the 50 cm mark on the rule is *a*.

  Measure and record *a*.

  a = ...
- Place a 10 g mass so that its centre is distance *a* from the 50 cm mark on the rule.
- Secure this mass in place using the adhesive putty. **This mass must remain in place throughout the experiment.**
- Place seven 10 g masses so that their centres are above the 50 cm mark on the rule.

[1]

(b) ● Transfer n of the 10 g masses, where $n = 4$, from the centre of the rule onto the 10 g mass near the end of the rule.

● Carefully place the rule and masses on the pivot as shown in Fig. 1.2.

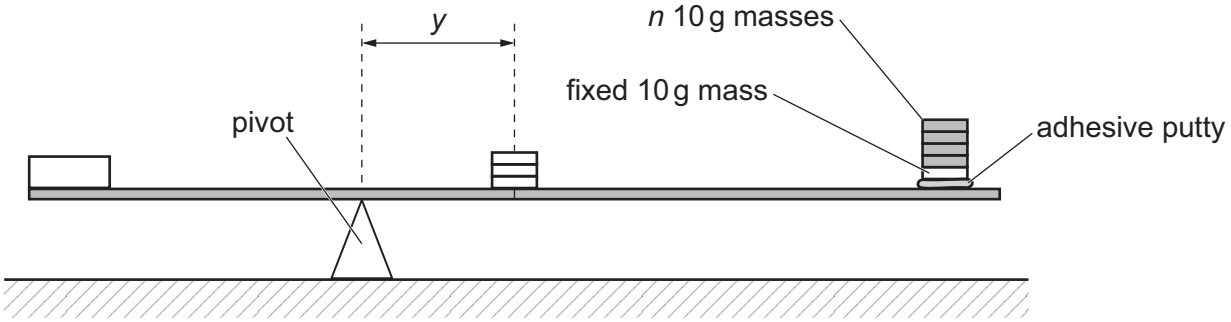


Fig. 1.2

● Adjust the position of the rule on the pivot until the rule is balanced.

● The distance between the pivot and the 50 cm mark on the rule is y.

Record n and y.

n = ...

y = ...

● Remove the rule from the pivot and place it on the bench.

● Return the n 10 g masses to the 50 cm mark.

[1]

(c) Change n by moving some of the 10 g masses from the centre of the rule onto the 10 g mass near the end of the rule and determine y.

Repeat until you have six sets of values of n and y.

Record your results in a table.

Include values of $\frac{1}{n}$ and $\frac{y}{n}$ to three significant figures.

[9]

(d) (i) Plot a graph of $\frac{y}{n}$ on the y-axis against $\frac{1}{n}$ on the x-axis. [3]

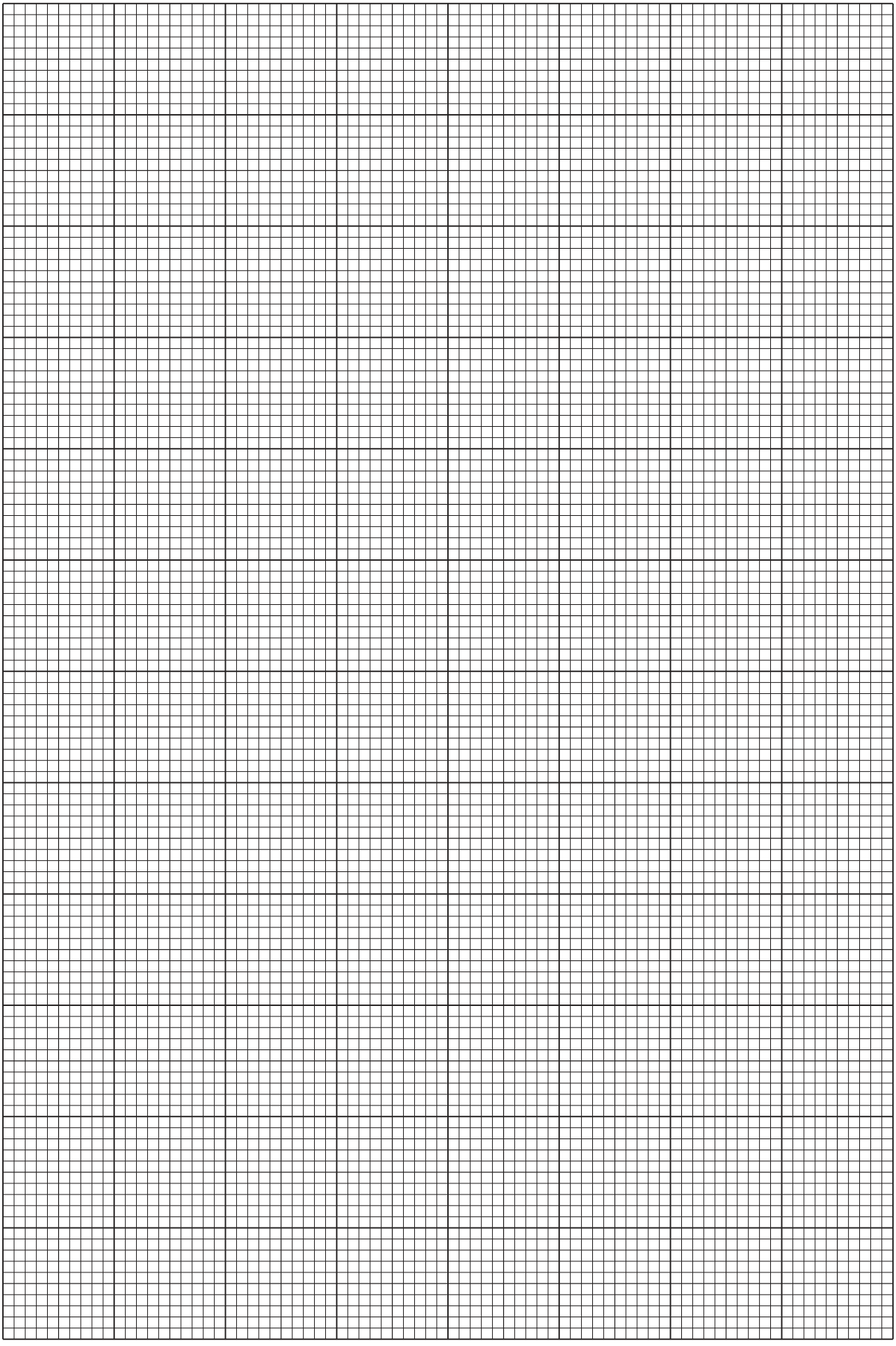
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities y and n are related by the equation

$$\frac{y}{n} = \frac{P}{n} - Q$$

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]

(f) Theory suggests that

$$P = \frac{9Ma}{18M + R}$$

where M = 10 g and R is the mass of the rule.

Determine the value of R.

R = ... g [1]

[Total: 20]

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

2 In this experiment, you will investigate the properties of a rubber band.

(a) (i) • Set up the apparatus as shown in Fig. 2.1.

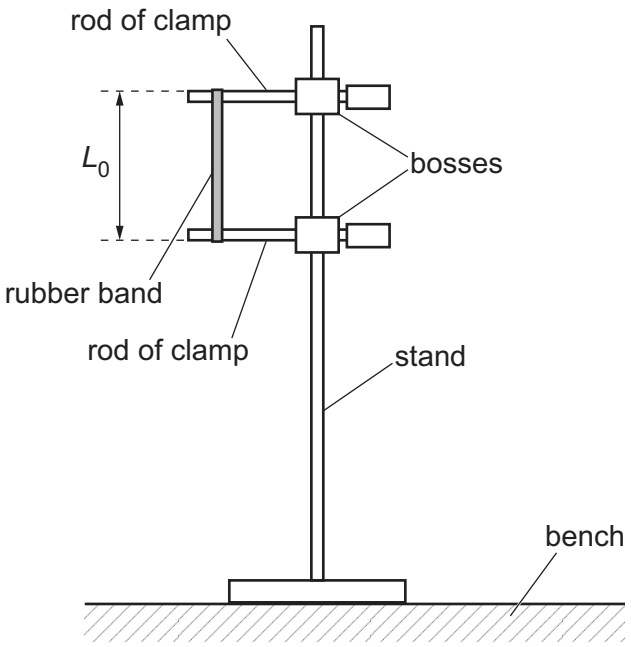


Fig. 2.1

• The rubber band should be straight but not stretched.

The distance between the ends of the rubber band is L_0, as shown in Fig. 2.1.

Measure and record L_0.

L_0 = ... [1]

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

percentage uncertainty = ... % [1]

(b) The width of the unstretched rubber band is w_0 and its thickness is t, as shown in Fig. 2.2.

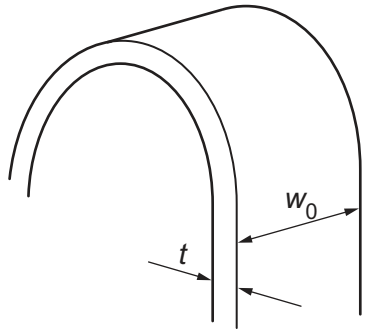


Fig. 2.2

Measure and record w_0 and t.

w_0 = ...

t = ...

[2]

(c) (i)

- Increase the distance between the clamps until the distance between the ends of the rubber band is approximately $1.5L_0$.
- The distance between the ends of the rubber band is L.

  The width of the rubber band is w.

  Measure and record L and w.

L = ...

w = ...

[1]

(ii) Calculate ΔL and Δw, where $\Delta L = L - L_0$ and $\Delta w = w_0 - w$.

ΔL = ...

Δw = ...

[1]

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

.....

.....

..... [1]

(d)
- Increase the distance between the clamps until the distance between the ends of the rubber band is approximately $2L_0$.
- Measure and record L and w.

L = ...

w = ...

- Repeat **(c)(ii)**.

ΔL = ...

Δw = ...

[2]

(e) It is suggested that the relationship between Δw and ΔL is

$$\frac{\Delta L}{\Delta w} = k$$

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 25%.

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

.....

.....

.....

..... [1]

(g) The approximate force F acting on the rubber band is given by

$$F = \frac{2Etkw_0\Delta w}{L_0}$$

where the Young modulus E of rubber is $1.0 \times 10^6\,\text{N m}^{-2}$.

Use your second value of k and your value of Δw from **(d)** to determine a value for F.

F = ... N [1]

(h) (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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