



Cambridge International AS & A Level

CANDIDATE
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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.



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.

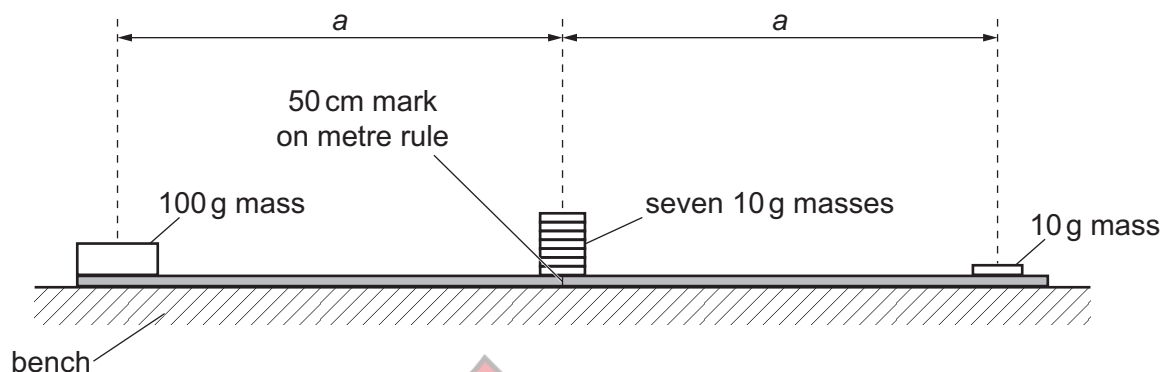


Fig. 1.1

- 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 .
 $a = \dots\dots\dots$
- 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 10g masses, where $n = 4$, from the centre of the rule onto the 10g mass near the end of the rule.
- Carefully place the rule and masses on the pivot as shown in Fig. 1.2.

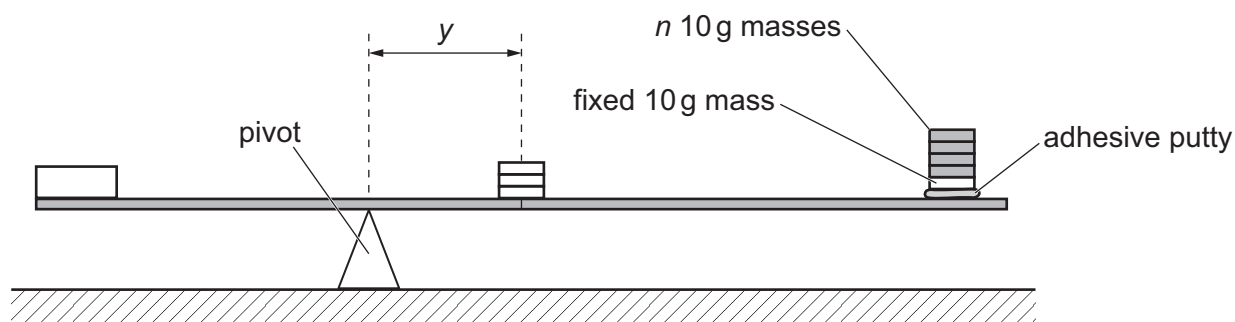


Fig. 1.2

- 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 .

$n = \dots\dots\dots$

$y = \dots\dots\dots$

- Remove the rule from the pivot and place it on the bench.
- Return the n 10g masses to the 50 cm mark.

[1]





- (c) Change n by moving some of the 10g masses from the centre of the rule onto the 10g 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.



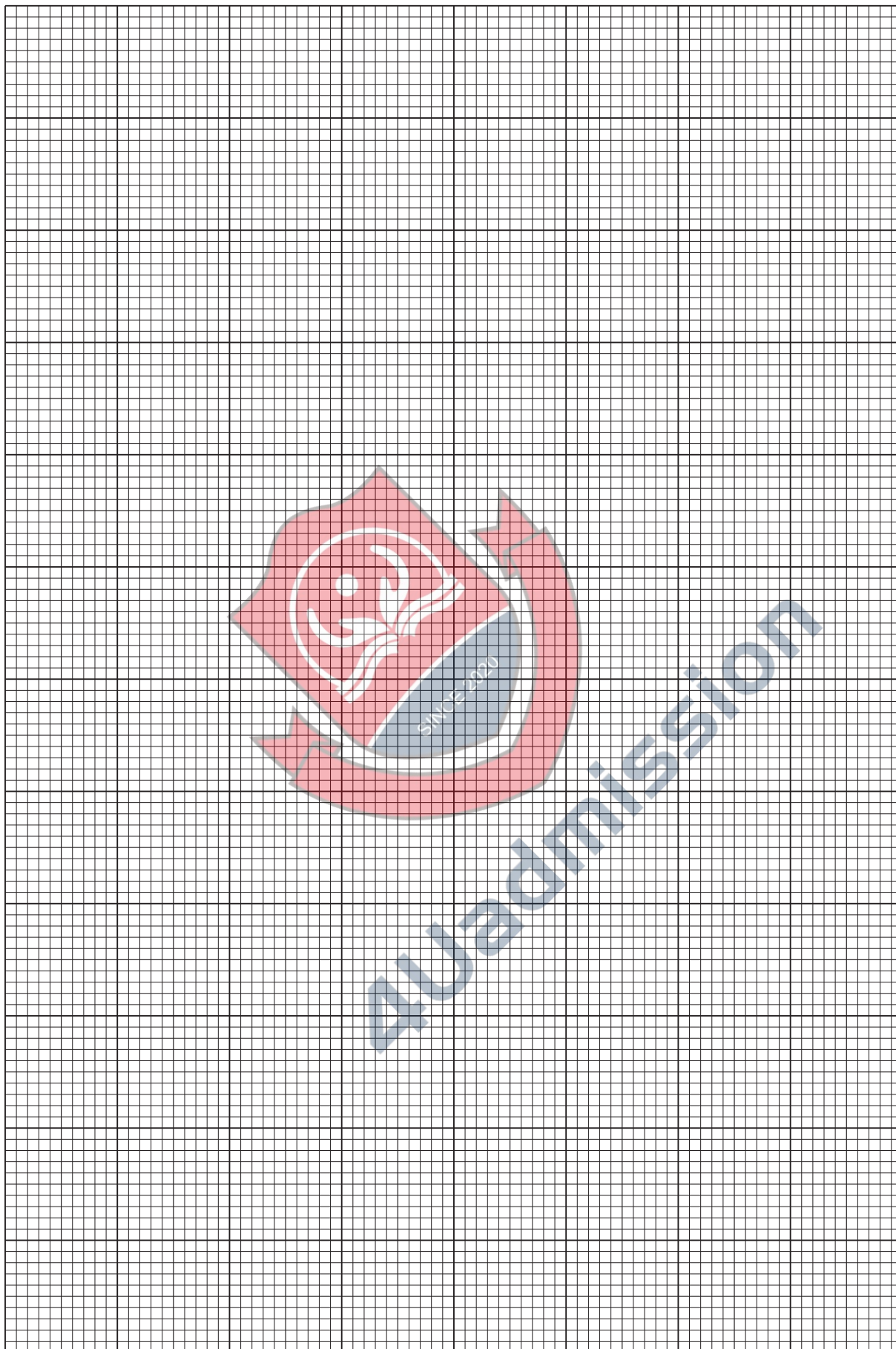
- (d) (i) Plot a graph of $\frac{y}{n}$ on the y-axis against $\frac{1}{n}$ on the x-axis. [9]
- (ii) Draw the straight line of best fit. [3]
- (iii) Determine the gradient and y-intercept of this line. [1]

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 $M = 10\text{ g}$ 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.

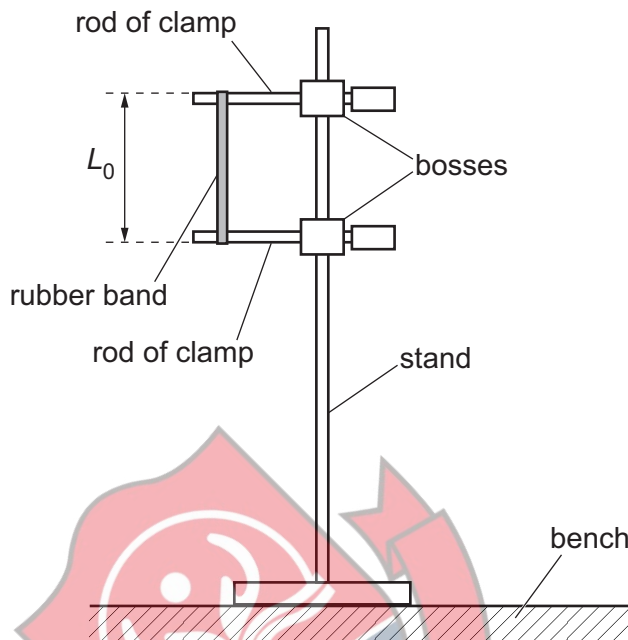


Fig. 2.1

- 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 .

$L_0 = \dots\dots\dots$ [1]

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

percentage uncertainty = $\dots\dots\dots$ % [1]





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

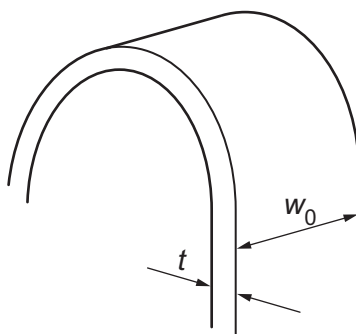


Fig. 2.2

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 $\Delta w = w_0 - w$.

$\Delta L =$

$\Delta w =$

[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).

$\Delta L =$

$\Delta w =$

[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

$$F = \frac{2Et\kappa w_0 \Delta w}{L_0}$$

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 .

$$F = \dots\dots\dots \text{ N [1]}$$





(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

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2

.....

3

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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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