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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8556116330

PHYSICS **9702/54**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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 may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages.

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[Turn over

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1 Fig. 1.1 shows a horizontal turntable.

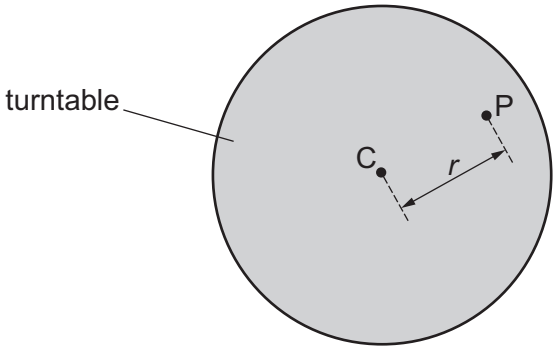


Fig. 1.1

Point C is at the centre of the turntable. Point P is a distance *r* from the centre.

Fig. 1.2 shows a side view of a d.c. motor attached to the turntable with a belt.



Fig. 1.2

The motor is used to rotate the turntable at frequency f_0. The motor is switched off and the turntable continues to rotate at frequency f_0.

A sphere of adhesive putty of mass *m* is dropped onto the turntable at point P. The frequency of the turntable is now *f*.

It is suggested that *f* is related to *m* by the relationship

$$\frac{Kf_0}{f} = \beta K + mr^2$$

where β and *K* are constants.

Plan a laboratory experiment to test the relationship between *f* and *m*.

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for β and *K*.

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

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Diagram

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2 A student places a slide with a double slit on a support clamped to the bench as shown in Fig. 2.1.

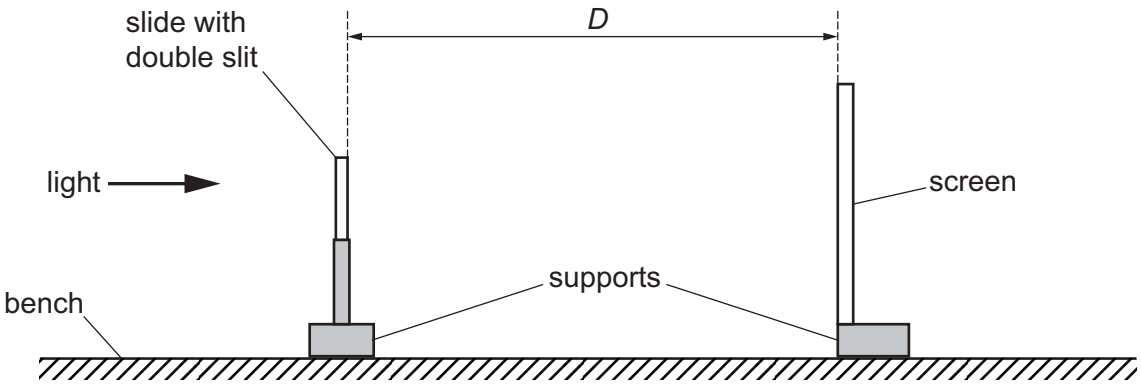


Fig. 2.1

The distance between the slide and the screen is *D*.

The separation *s* of the slits is determined.

Light from a laser is incident normally on the double slit. An interference pattern is observed on the screen. The distance *w* across 10 fringes is measured. The distance *y* between the centres of adjacent fringes is calculated using the equation

$$y = \frac{w}{10}.$$

The experiment is repeated with slides of different slit separation *s*.

It is suggested that *y* and *s* are related by the equation

$$\lambda = \frac{sy}{D}$$

where λ is the wavelength of the incident light.

(a) A graph is plotted of *y* on the *y*-axis against $\frac{1}{s}$ on the *x*-axis.

Determine an expression for the gradient.

gradient = ... [1]

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(b) Values of s and w are given in Table 2.1.

Table 2.1

s/mm	$\frac{1}{s}$/mm^{-1}	w/mm	y/mm
0.18 ± 0.01		33.0	
0.21 ± 0.01		28.9	
0.24 ± 0.01		25.1	
0.27 ± 0.01		22.6	
0.31 ± 0.01		19.6	
0.38 ± 0.01		15.9	

Calculate and record values of $\frac{1}{s}$/mm^{-1} and y/mm in Table 2.1. Include the absolute uncertainties in $\frac{1}{s}$. [2]

(c) (i) Plot a graph of y/mm against $\frac{1}{s}$/mm^{-1}. Include error bars for $\frac{1}{s}$. [2]

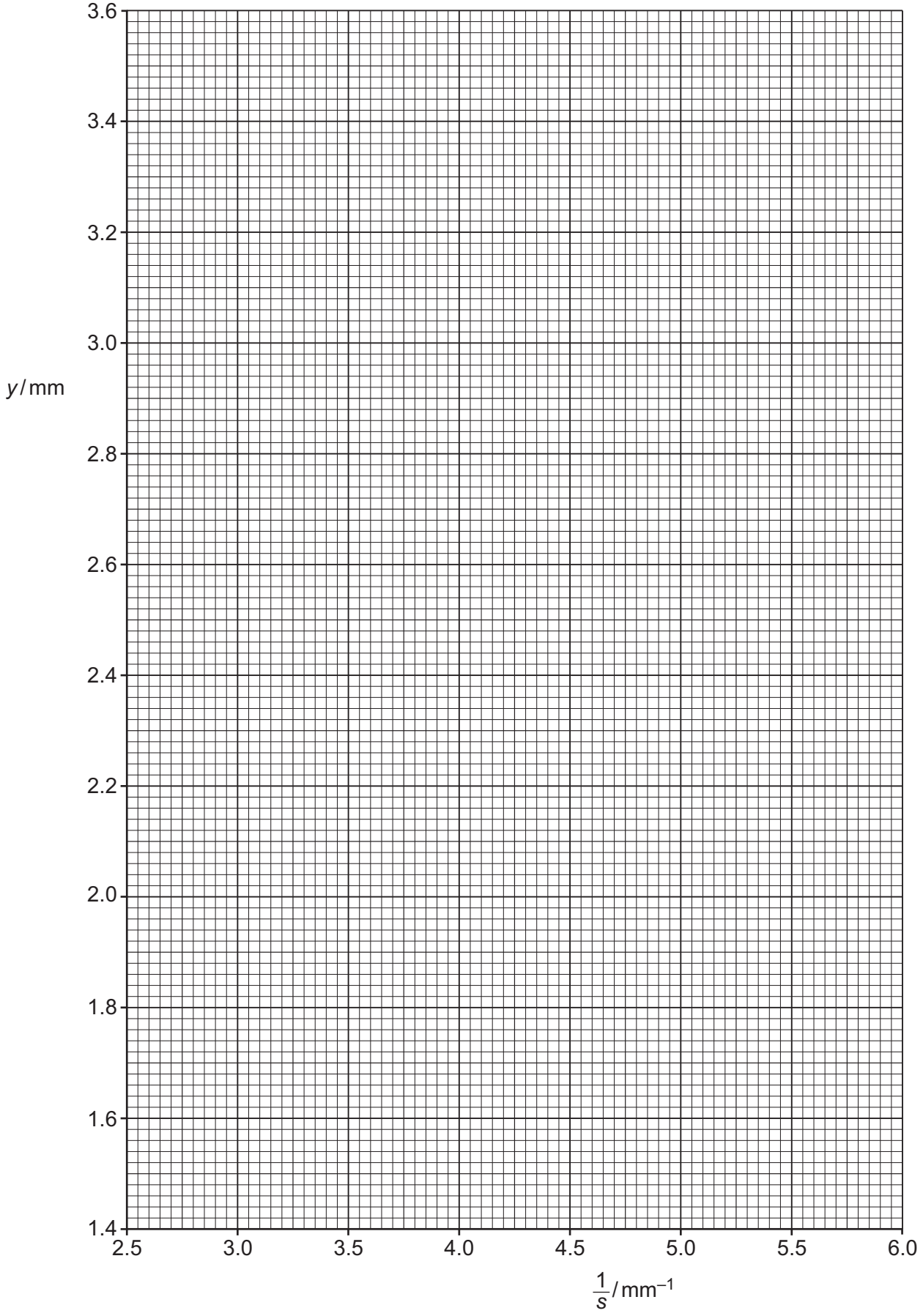
(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]

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(d) The distance between the slide and the screen is measured several times:

0.929 m 0.918 m 0.913 m 0.918 m 0.927 m.

Determine the mean distance D. Include the absolute uncertainty.

D = ... m [1]

(e) **(i)** Using your answers to **(a)**, **(c)(iii)** and **(d)**, determine the value of λ. Include an appropriate unit.

λ = ... [2]

(ii) Determine the percentage uncertainty in λ.

percentage uncertainty in λ = ... % [1]

(f) The experiment is repeated. Determine the slit separation s that gives a value of y of (0.500 ± 0.005) cm. Include the absolute uncertainty.

s = ... m [2]

[Total: 15]

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