



Cambridge International AS & A Level

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PHYSICS

9702/54

Paper 5 Planning, Analysis and Evaluation

May/June 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.



- 1 A ball is dropped on to an inclined thin metal sheet, as shown in Fig. 1.1.

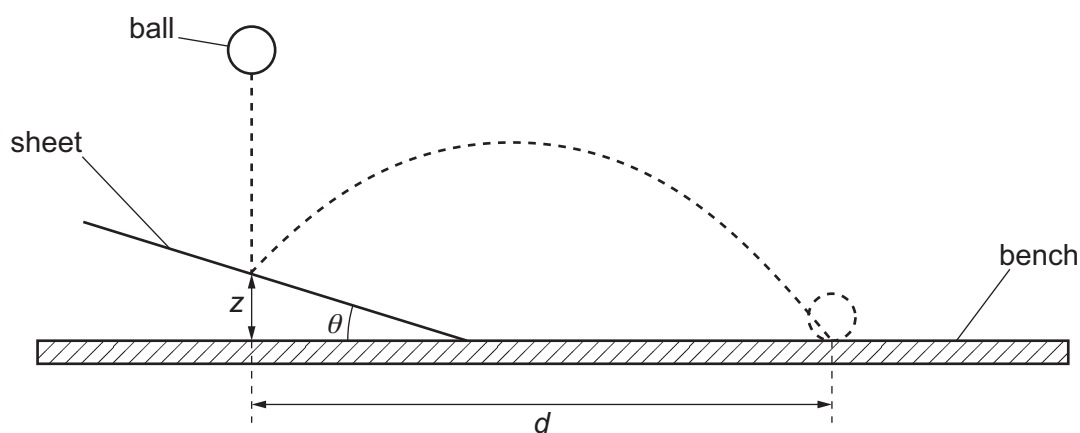


Fig. 1.1 (not to scale)

The angle between the sheet and the horizontal bench is θ . The height of the point of contact of the ball and the sheet is z . The horizontal distance travelled by the ball between its points of contact with the sheet and the bench is d , as shown in Fig. 1.1.

It is suggested that d is related to θ by the relationship

$$d = \frac{Pv^2 \sin 4\theta}{g} + Q\sqrt{z}$$

where v is the speed of the ball as it makes contact with the sheet, g is the acceleration of free fall, and P and Q are constants.

Plan a laboratory experiment to test the relationship between d and θ .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for P and Q .

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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[15]



- 2 A student investigates the relationship between the luminosity of a star and its mass.

The student obtains data of relative luminosity λ and relative mass μ for six stars, where

$$\lambda = \frac{\text{luminosity of star}}{\text{luminosity of Sun}}$$

and

$$\mu = \frac{\text{mass of star}}{\text{mass of Sun}}.$$

It is suggested that λ and μ are related by the equation

$$\lambda = k\mu^n$$

where k and n are constants.

- (a) A graph is plotted of $\lg \lambda$ on the y -axis against $\lg \mu$ on the x -axis.

Determine expressions for the gradient and y -intercept.

gradient =

y -intercept = [1]



(b) Values of μ and λ are given in Table 2.1.

Table 2.1

μ	λ	$\lg \mu$	$\lg \lambda$
4.6 ± 0.4	500		
5.4 ± 0.4	800		
8.4 ± 0.4	3200		
11 ± 1	7000		
16 ± 1	25 000		
18 ± 1	38 000		

Calculate and record values of $\lg \mu$ and $\lg \lambda$ in Table 2.1.

Include the absolute uncertainties in $\lg \mu$.

[2]

- (c) (i) Plot a graph of $\lg \lambda$ against $\lg \mu$.
Include error bars for $\lg \mu$.

[2]

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

[2]

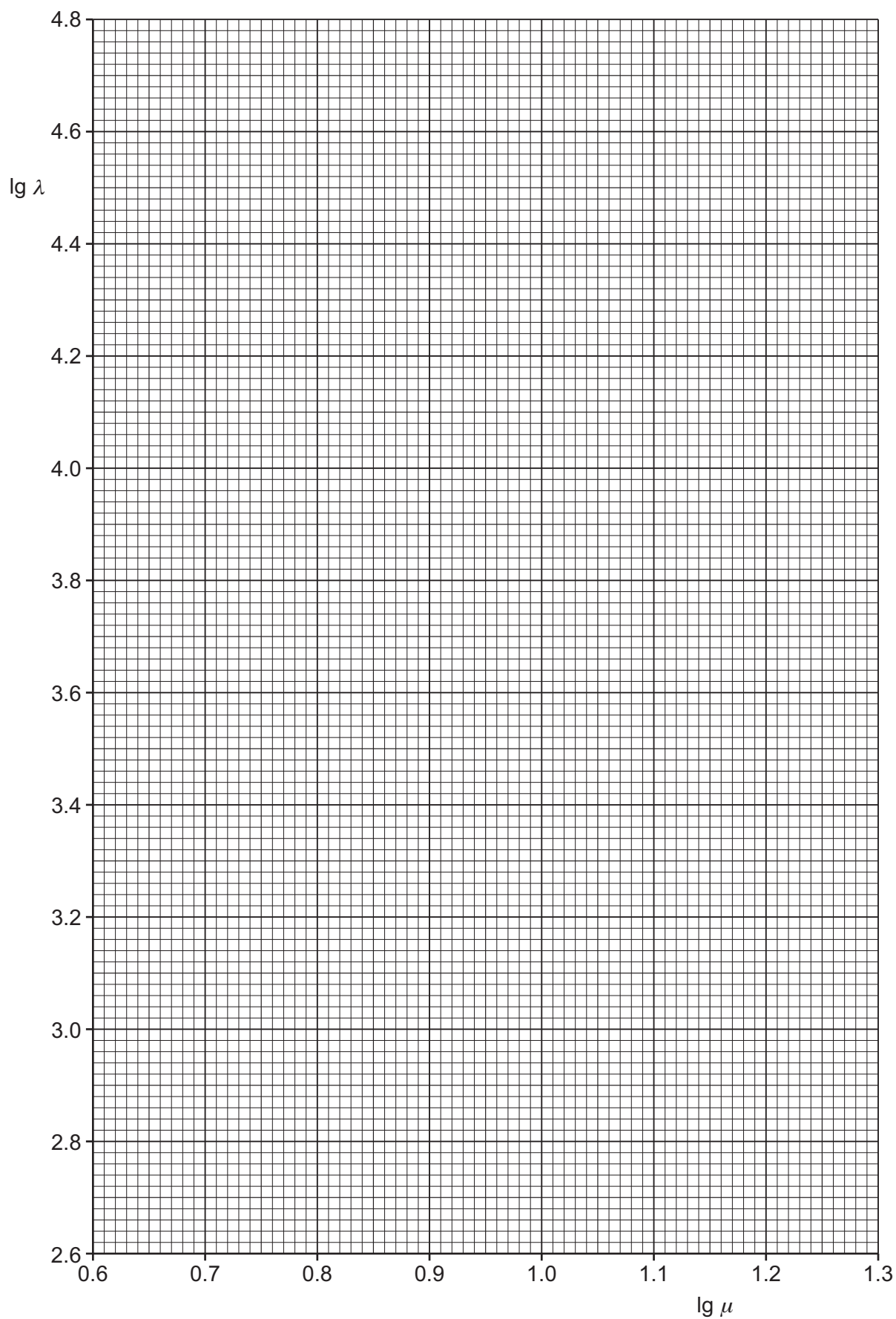
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = [2]





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- (iv) Determine the y -intercept of the line of best fit. Include the absolute uncertainty in your answer.

y -intercept = [2]

- (d) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of k and n . Include the absolute uncertainties in your values. You need not be concerned with units.

k =

n = [3]

- (e) The mass of the Sun is 2.0×10^{30} kg. The star Alpha Centauri B has a value of λ of 0.46.

Determine the mass M of Alpha Centauri B.

M = kg [1]

[Total: 15]

