Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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.

[Turn over

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

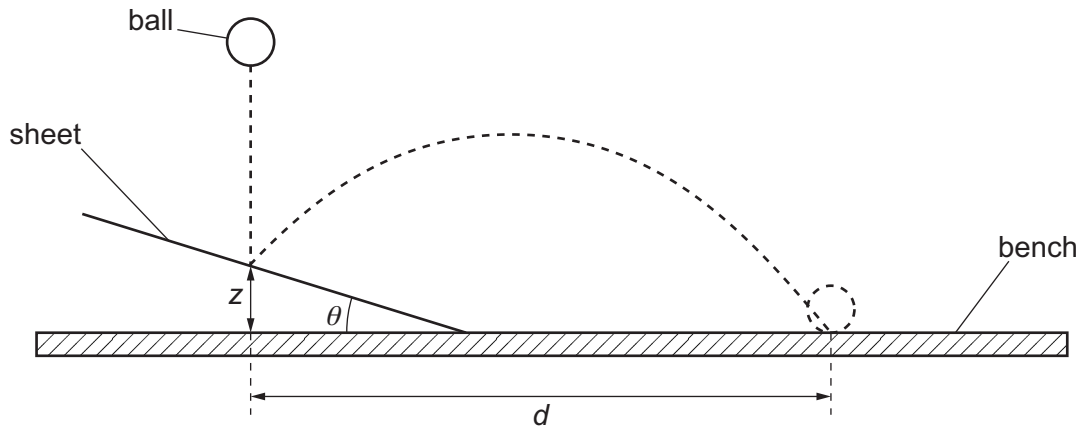


Fig. 1.1 (not to scale)

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.

Diagram

[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 λ on the y-axis against lg μ 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 μ	lg λ
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		

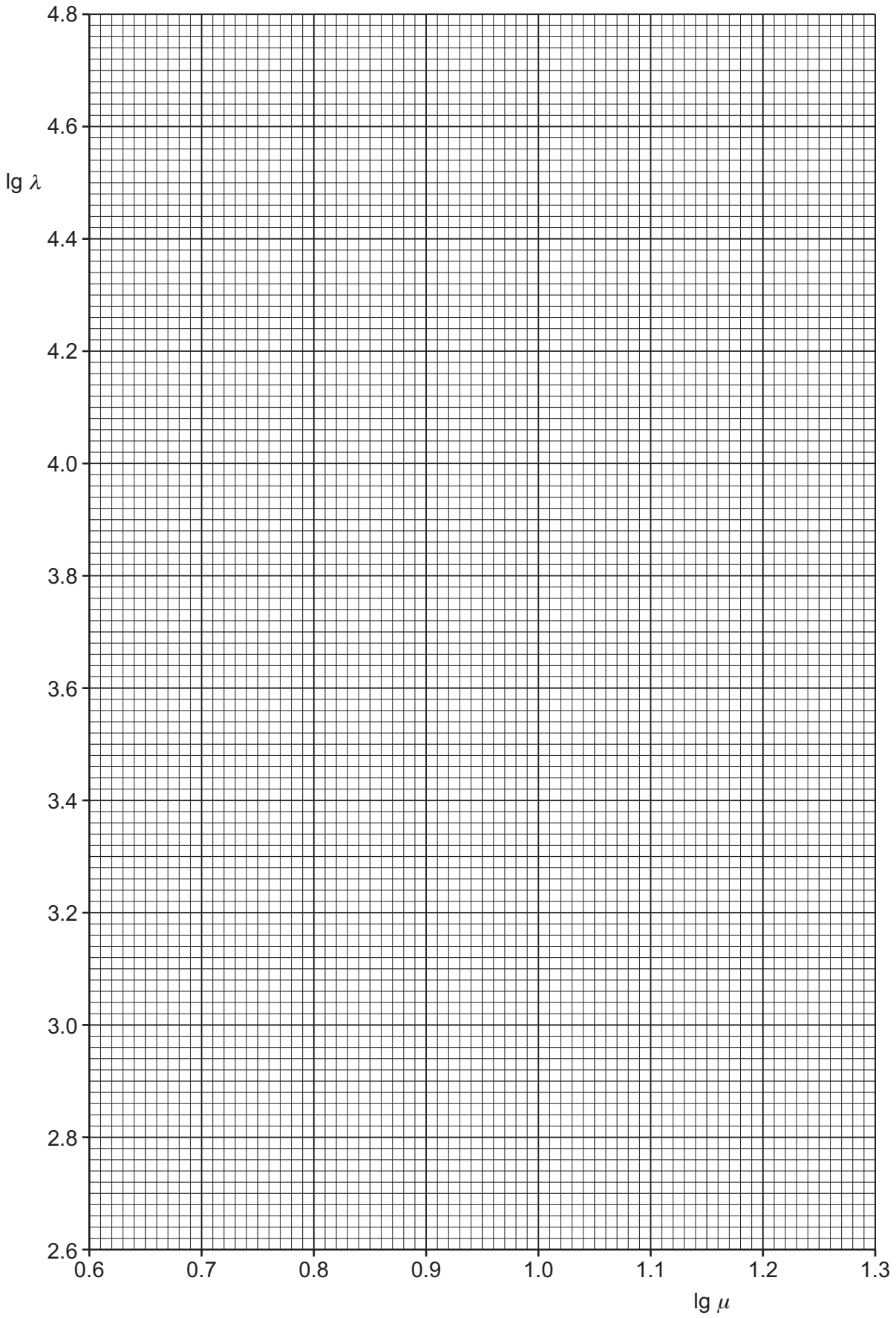
Calculate and record values of lg μ and lg λ in Table 2.1.
Include the absolute uncertainties in lg μ. [2]

(c) (i) Plot a graph of lg λ against lg μ.
Include error bars for lg μ. [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]



(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]