



## Cambridge International AS & A Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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### PHYSICS

9702/52

Paper 5 Planning, Analysis and Evaluation

May/June 2022

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 Two parallel cylindrical conductors each have a small cross-sectional area  $A$ . A thin metal bar connects the two conductors, as shown in Fig. 1.1.

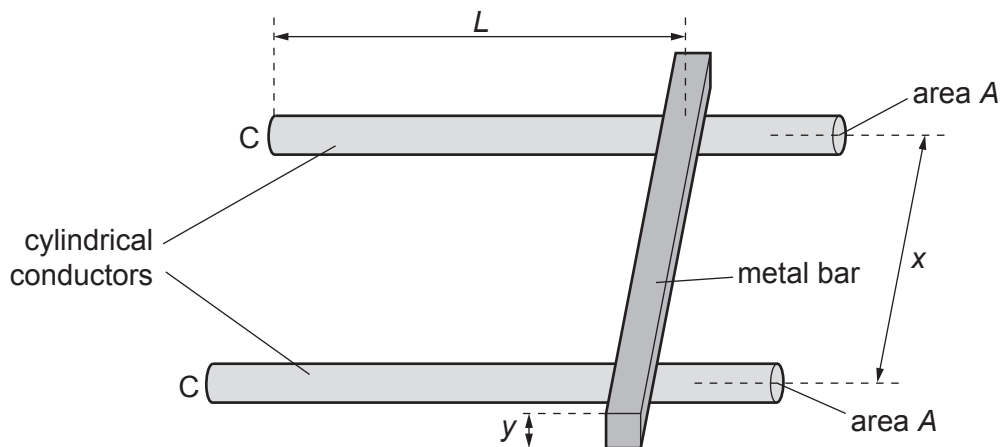


Fig. 1.1 (not to scale)

The metal bar has a square cross-section with sides of length  $y$ . For each conductor, the distance between its end  $C$  and the centre of the metal bar is  $L$ . The distance between the centres of the conductors is  $x$ .

The ends  $C$  are connected to a power supply and the current  $I$  in the conductors is measured.

It is suggested that  $I$  is related to  $L$  by the relationship

$$\frac{E}{I} = \frac{2PL}{A} + \frac{Qx}{y^2}$$

where  $E$  is the electromotive force (e.m.f.) of the power supply, and  $P$  and  $Q$  are constants.

Plan a laboratory experiment to test the relationship between  $I$  and  $L$ .

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:

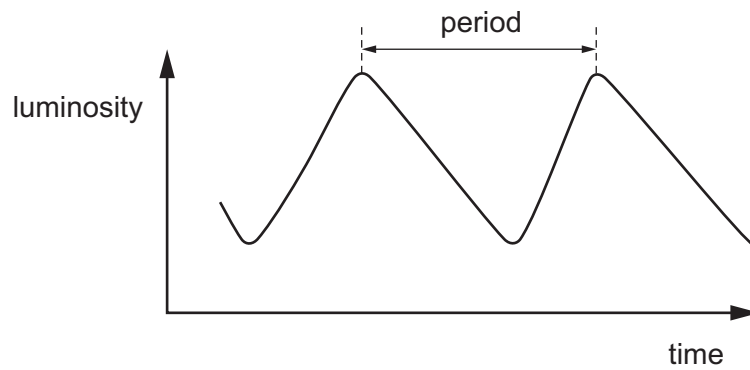
- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.





- 2 The brightness of some stars varies regularly. These stars are called variable stars.

Fig. 2.1 shows the variation of luminosity with time for a variable star.



**Fig. 2.1**

A student determines the period  $T$  and mean luminosity  $L$  of the star.

The student repeats the process for different variable stars.

It is suggested that  $L$  and  $T$  are related by the equation

$$L = SKT^a$$

where  $S$  is the luminosity of the Sun, and  $a$  and  $K$  are constants.

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

Determine expressions for the gradient and  $y$ -intercept.

gradient = .....

$y$ -intercept = .....

[1]

(b) Values of  $T$  and  $L$  are given in Table 2.1.

**Table 2.1**

$T/\text{days}$	$L/10^{30}W$	$\lg(T/\text{days})$	$\lg(L/10^{30}W)$
22	$2.9 \pm 0.2$		
32	$4.9 \pm 0.2$		
42	$6.9 \pm 0.2$		
54	$9.8 \pm 0.2$		
78	$16 \pm 2$		
97	$21 \pm 2$		

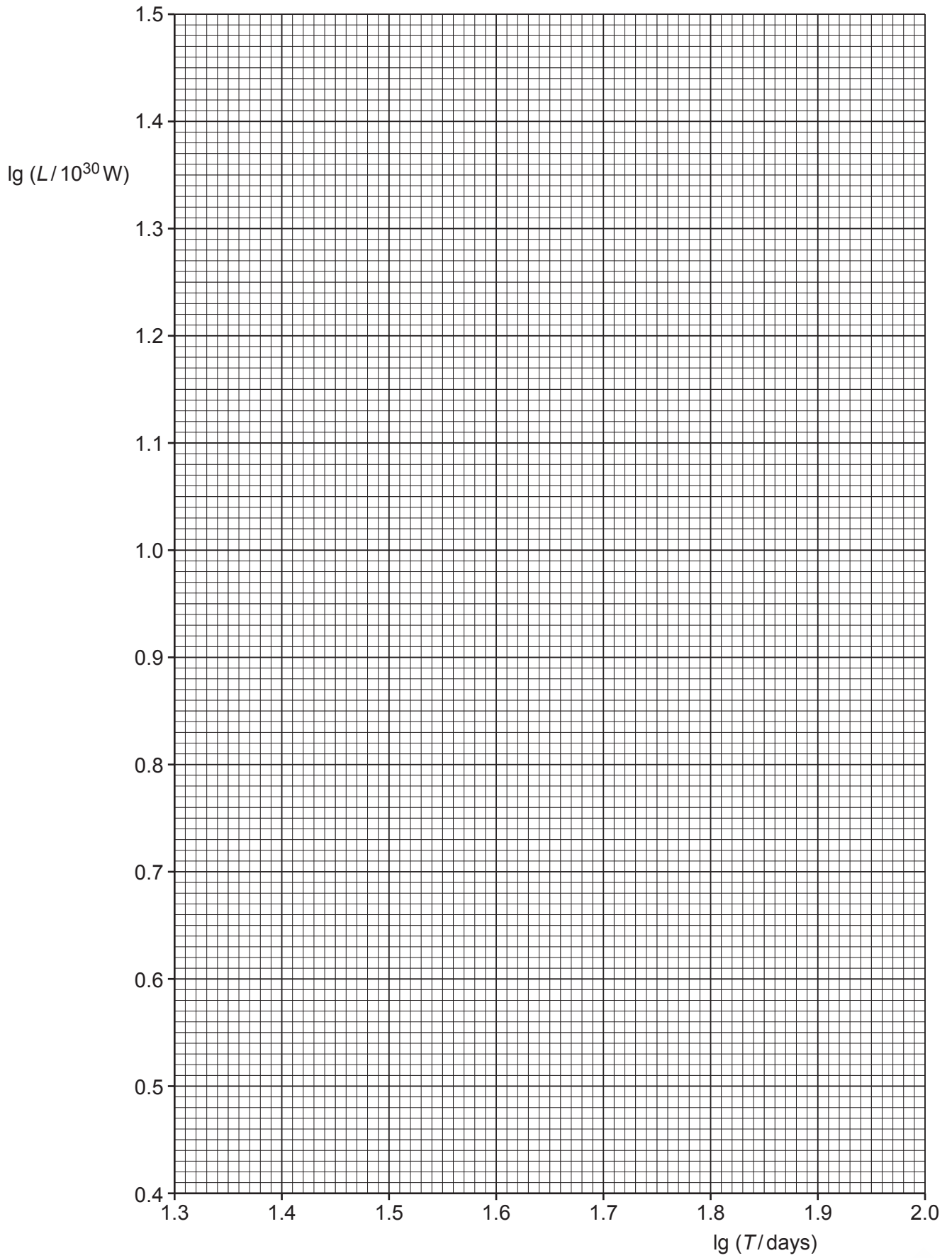
Calculate and record values of  $\lg(T/\text{days})$  and  $\lg(L/10^{30}W)$  in Table 2.1.  
Include the absolute uncertainties in  $\lg(L/10^{30}W)$ .

[2]

- (c) (i) Plot a graph of  $\lg(L/10^{30}W)$  against  $\lg(T/\text{days})$ .  
Include error bars for  $\lg(L/10^{30}W)$ . [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  $a$  and  $K$ . Include the absolute uncertainties in your values. You need not be concerned with units.

Data:  $S = 3.85 \times 10^{26} \text{ W}$

$a = \dots\dots\dots$

$K = \dots\dots\dots$   
[3]

- (e) A variable star has a period of 5.0 days.

Determine the luminosity  $L$  of this star.

$L = \dots\dots\dots \text{ W}$  [1]

[Total: 15]

