Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0131112034

PHYSICS **9702/51**

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.

© UCLES 2022

1 Two parallel metal plates, each of area A, are separated by a small distance d, as shown in Fig. 1.1.

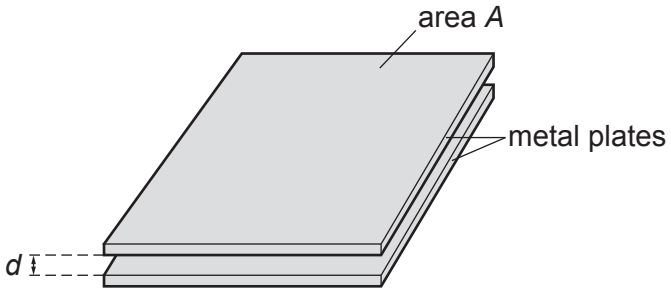


Fig. 1.1 (not to scale)

The plates are initially charged using a power supply.

The plates are then connected to an uncharged capacitor. The potential difference V across the capacitor is measured.

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

$$\frac{W}{V} = 1 + \frac{Cd}{KA}$$

where C is the capacitance of the capacitor, and K and W are constants.

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

Draw a diagram showing the arrangement of your equipment.

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

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.

© UCLES 2022

Diagram

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[15]

2 A student investigates the relationship between the luminosity L of a star and its mass M for a set of stars known as main-sequence stars.

It is suggested that L and M are related by the equation

$$L = SZM^n$$

where S is the luminosity of the Sun, and Z and n are constants.

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

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

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

Table 2.1

$M / 10^{30}$ kg	$L / 10^{28}$ W	lg ($M / 10^{30}$ kg)	lg ($L / 10^{28}$ W)
4.8 ± 0.4	1.4		
6.4 ± 0.4	3.1		
12 ± 2	32		
23 ± 2	350		
43 ± 4	3600		
91 ± 4	66 000		

Calculate and record values of lg ($M / 10^{30}$ kg) and lg ($L / 10^{28}$ W) in Table 2.1.
Include the absolute uncertainties in lg ($M / 10^{30}$ kg). [2]

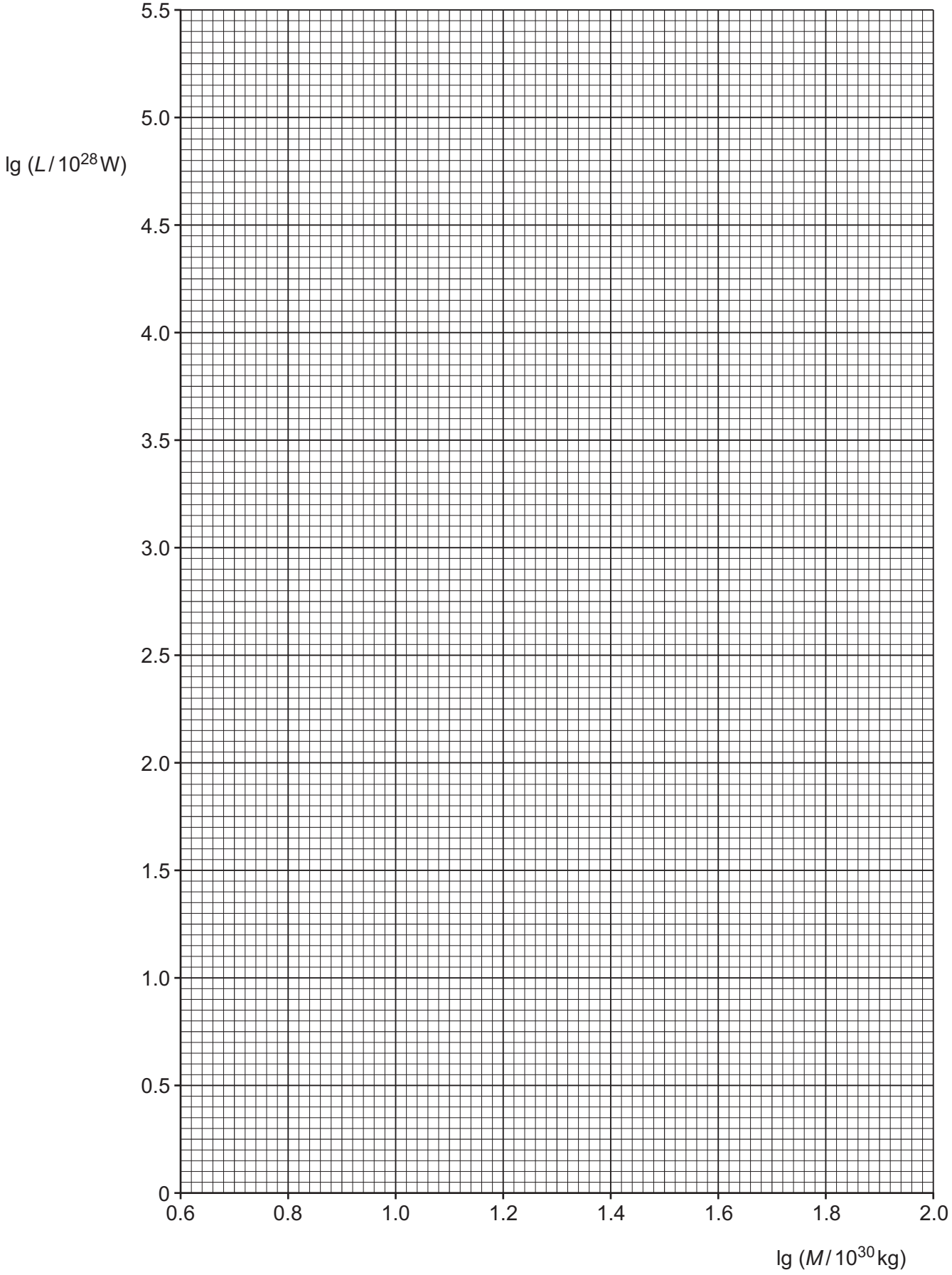
(c) **(i)** Plot a graph of lg ($L / 10^{28}$ W) against lg ($M / 10^{30}$ kg).
Include error bars for lg ($M / 10^{30}$ kg). [2]

(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]

© UCLES 2022


lg (L / 10^{28} W)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
lg (M / 10^{30} kg)

(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 n and Z. Include the absolute uncertainties in your values. You need not be concerned with units.

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

n = ...

Z = ...
[3]

(e) Another main-sequence star has a mass of 3.0×10^{30} kg.

Determine the luminosity L of this star.

L = ... W [1]

[Total: 15]

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

© UCLES 2022