Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

1420U50-1E

S23-1420U50-1E

FRIDAY, 5 MAY 2023 – MORNING

PHYSICS – A2 unit 5
Practical Examination

Practical Analysis Task

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**20**	
Total	**25**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a **Data Booklet**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
Pencil may be used to draw tables and graphs.
Answer **all** questions.
Write your name, centre number and candidate number in the spaces at the top of the page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this task is 25.
The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.

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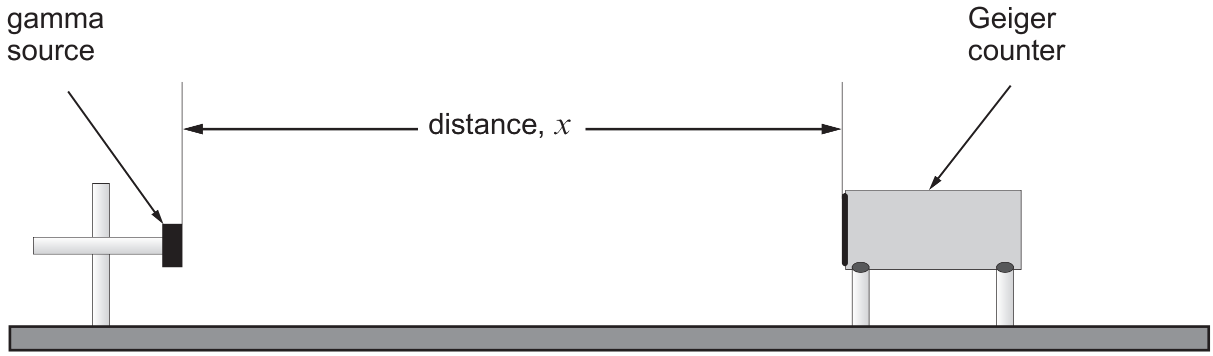
Answer **all** questions.

1. A physics student, Lisa, carried out an experiment to check the inverse square law for gamma radiation using the apparatus shown below.



She varied the distance, x, and measured the number of counts detected over periods of two minutes. She also measured the count without the gamma source over two minutes and found it to be 57 counts.
She obtained the following results.

Distance, x/m	Count	Corrected count, N
0.12	123	66
0.14	111	54
0.16	101	....
0.18	89	....
0.20	82	....

(a) **Complete the table.** [1]

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(b) Theoretically the corrected count, N, should be inversely proportional to the square of the distance from the source.
Use the data opposite to show whether or not $N = \frac{b}{x^2}$ (where b is a constant) is true.

Do **not** draw a graph. [2]

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(c) Determine the mean value of b in this relationship along with its **absolute** uncertainty. [2]

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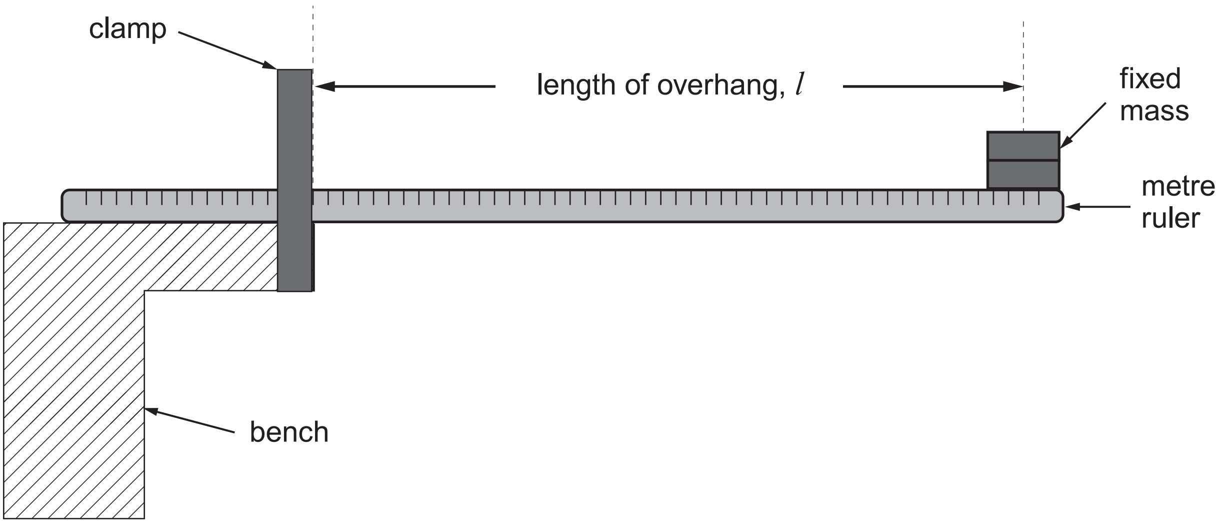
2. Jonathan used the following apparatus to investigate the relationship between the period of oscillation, T, and the length of overhang, l, for a metre ruler. A text book suggests they are linked by the following equation $T^2 = kl^3$ where k is an unknown constant.



Jonathan pushed the mass down by a small distance, released it, and measured the period of oscillation. He then adjusted the length of overhang of the metre ruler and repeated the experiment. Jonathan obtained the following results.

l/m	l^3/	Time for 20 oscillations/s			T/s	T^2/ ....
		Trial 1	Trial 2	Mean		
0.900	0.73	15.54	15.26	....	0.770	0.593
0.800	....	12.90	12.67	12.79	....	....
0.700	0.34	9.94	10.46	....	0.510	0.260
0.600	0.22	8.68	8.48	8.58	0.429	0.184
0.500	....	6.45	6.35	....	....	....

(a) Complete the above table **including the missing units**. [5]

Examiner only

(b) Plot a suitable graph to determine if the relationship $T^2 = kl^3$ is correct. **Do not include error bars on your graph.** [4]

Examiner only

(c) (i) Explain to what extent your graph supports the relationship $T^2 = kl^3$. [2]

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(ii) Determine a value for the constant k. [2]

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(d) (i) It can be shown in SI units that:

$$k = \frac{30}{bd^3E}$$

where b = width of the ruler = $(25.6 \pm 0.1) \times 10^{-3}$ m
d = thickness of the ruler = $(5.37 \pm 0.01) \times 10^{-3}$ m
E = Young modulus

Use your result from (c)(ii) and the above equation to determine a value for the Young modulus of the ruler along with its **absolute** uncertainty. Take the **percentage** uncertainty in k to be ±5%. [6]

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Examiner only

(ii) State what instrument you think Jonathan used to measure the thickness of the ruler. Give a reason for your answer. [1]

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END OF PAPER