

Physics
Higher level
Paper 1B

Specimen paper

Candidate session number

2 hours [Paper 1A and Paper 1B]

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Instructions to candidates

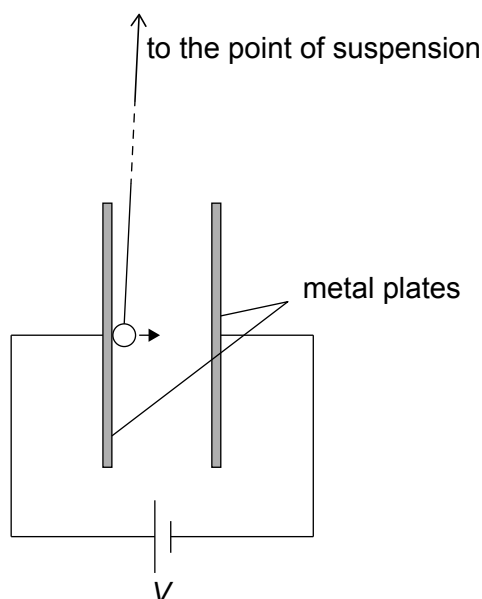
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for paper 1B is **[20 marks]**.
- The maximum mark for paper 1A and paper 1B is **[60 marks]**.



Answer **all** questions. Answers must be written within the answer boxes provided.

1. A group of students investigate the motion of a conducting ball suspended from a long string. The ball is between two vertical metal plates that have an electric potential difference V between them. The ball is touched to one plate so that it becomes electrically charged and is repelled from the plate. For a given potential difference, the ball bounces between the plates with a constant period.

diagram not to scale



- (a) The students vary V and measure the time T for the ball to move **once** from one plate to the other. The table shows some of the data.

V / kV	$T / \text{s} \pm 0.1 \text{ s}$
3.00	1.4
5.00	0.8
7.00	0.6

- (i) V is provided by two identical power supplies connected in series. The potential difference of each of the power supplies is known with an uncertainty of 0.01 kV.

State the uncertainty in the potential difference V .

[1]

(This question continues on the following page)



(Question 1 continued)

- (ii) T is measured with an electronic stopwatch that measures to the nearest 0.1 s.

Describe how an uncertainty in T of less than 0.1 s can be achieved using this stopwatch.

[2]

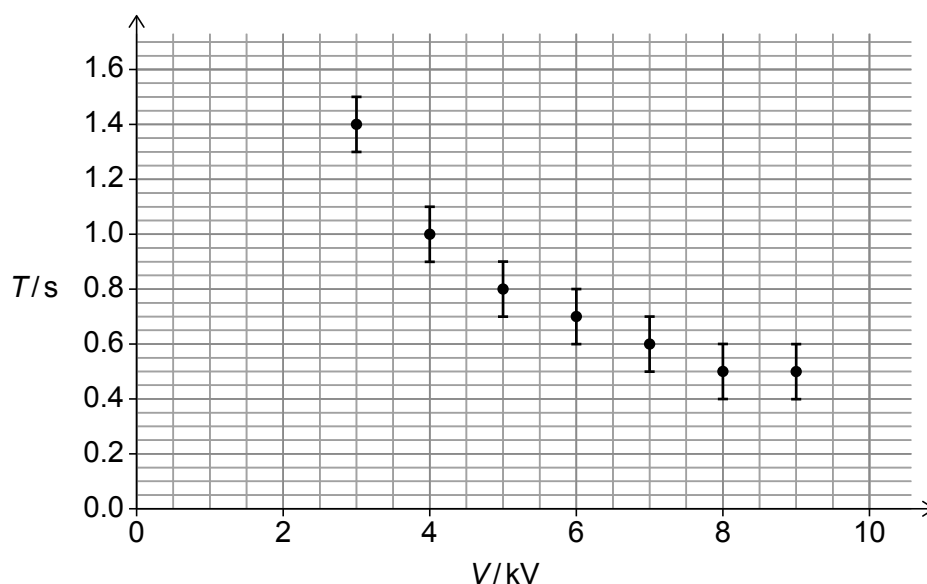
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The graph shows the variation of T with V . The uncertainty in V is not plotted.



- (iii) Outline why it is unlikely that the relationship between T and V is linear.

[1]

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- (iv) Calculate the largest fractional uncertainty in T for these data.

[2]

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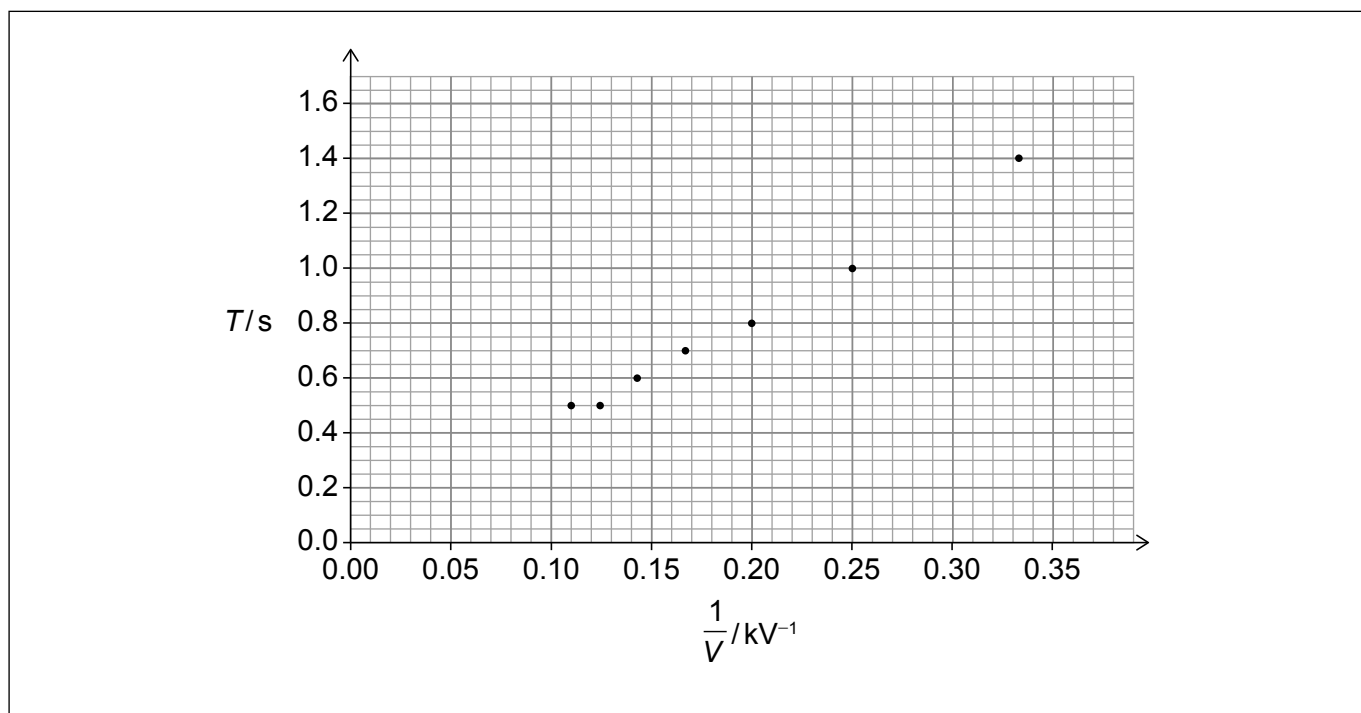
(Question 1 continued)

- (b) The students suggest the following theoretical relationship between T and V :

$$T = \frac{A}{V}$$

where A is a constant.

To verify the relationship, the variation of T with $\frac{1}{V}$ is plotted.



- (i) Determine A by drawing the line of best fit.

[3]

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(Question 1 continued)

(ii) State the units of A .

[1]

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(iii) The theoretical relationship assumes that the ball is only affected by the electric force.

Suggest why, in order to test the relationship, the length of the string should be much greater than the distance between the plates.

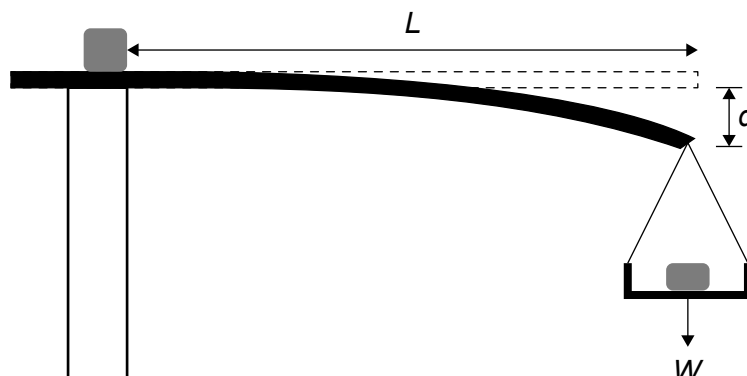
[2]

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2. A group of students investigate the bending of a plastic ruler that is clamped horizontally at one end. A weight W attached to the other end causes the ruler to bend. The weight is contained in a scale pan.

The students fix the length L of the ruler and vary W . For each value of W , the group measures the deflection d of the end of the ruler to which the weight is attached.



- (a) The group obtains the following repeated readings for d for **one** value of W .

Reading	1	2	3	4	5	6
d / cm	2.7	2.9	3.6	2.7	2.8	2.9

The group divides into two subgroups, A and B, to analyse the data.

Group A quotes the mean value of d as 2.93 cm.

Group B quotes the mean value of d as 2.8 cm.

Discuss the values that the groups have quoted.

[2]

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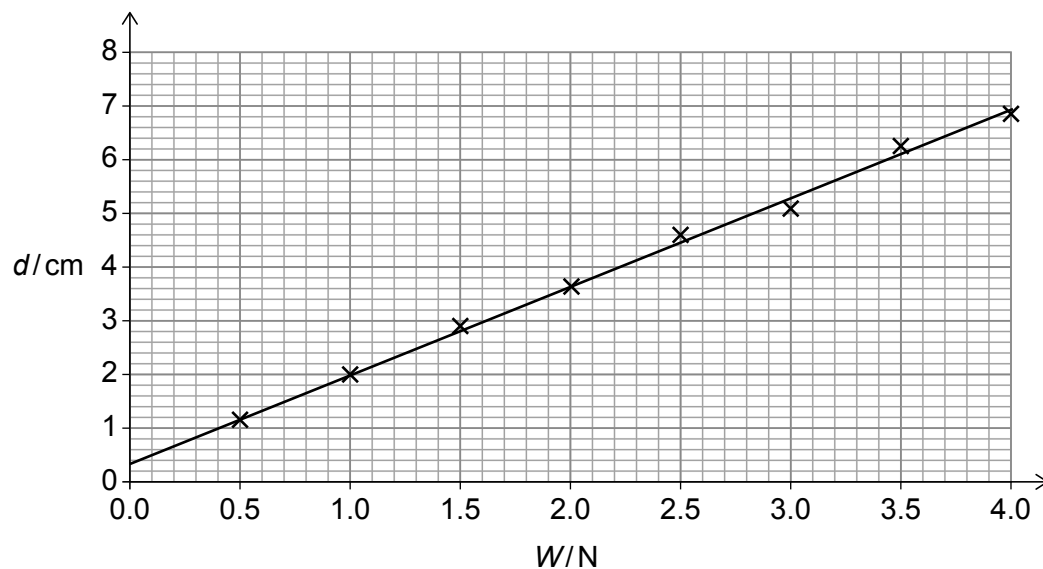
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(Question 2 continued)

(b) The variation of d with W is shown.



Outline **one** experimental reason why the graph does not go through the origin.

[1]

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(c) Theory predicts that

$$d \propto \frac{W^x L^y}{EI}$$

where E and I are constants. The fundamental units of I are m^4 and those of E are $\text{kg m}^{-1} \text{s}^{-2}$.

Calculate x and y .

[2]

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(Question 2 continued)

- (d) The ruler has cross-sectional area $A = a \times b$, where $a = (28 \pm 1)$ mm and $b = (3.00 \pm 0.05)$ mm.

- (i) Suggest an appropriate measuring instrument for determining b . [1]

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- (ii) Calculate the percentage uncertainty in the value of A . [2]

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