IB Demystified

Examiners • Moderators • Mentors

Physics

Higher Level

Paper 1B — Mock Examination

Mock Exam 1

Time allowed: **40 minutes**
Maximum mark: **20 marks**
Calculator: **required**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Topics tested: measurement and uncertainties, error propagation, graph analysis, and linearizing data using logarithms.

Instructions to candidates

- Write your session number on the cover page.
- Do not open this paper until you are told to start.
- Answer **all** questions.
- Write your answers inside the boxes provided.
- You need a calculator.
- You need a clean copy of the **physics data booklet**.
- The maximum mark for this paper is **20 marks**.

How your answers are marked

- Marks are given for correct working as well as for the correct final answer, so show every step.
- Give numerical answers to a sensible number of significant figures.
- Include the unit whenever a question asks for one.
- Take $g = 9.81\ \text{N kg}^{-1}$. All other constants are in the data booklet.

Question	Marks available	Marks awarded
1	8	
2	7	
3	5	
Total	**20**	

1. A student measures the resistivity ρ of the metal used to make a uniform wire.

The student uses a micrometer screw gauge to measure the diameter d of the wire at five different points along the wire. The five readings are shown in the table.

Reading	1	2	3	4	5
d / mm	0.412	0.410	0.415	0.413	0.410

The student also measures the length L and the resistance R of the same wire:

$$L = (1.250 \pm 0.002)\ \text{m}, \qquad R = (2.86 \pm 0.04)\ \Omega.$$

The resistivity of the metal is given by

$$\rho = \frac{\pi R d^2}{4L}.$$

(a) Determine the mean value of d and its absolute uncertainty. **[2]**

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(b) Calculate the percentage uncertainty in d. **[1]**

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(c) Calculate ρ. **[2]**

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(Question 1 continued)

(d) Calculate the percentage uncertainty in ρ. **[1]**

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(e) State the value of ρ together with its absolute uncertainty. **[1]**

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(f) The student wants a smaller percentage uncertainty in ρ but cannot change any of the apparatus. State **one** way to do this. **[1]**

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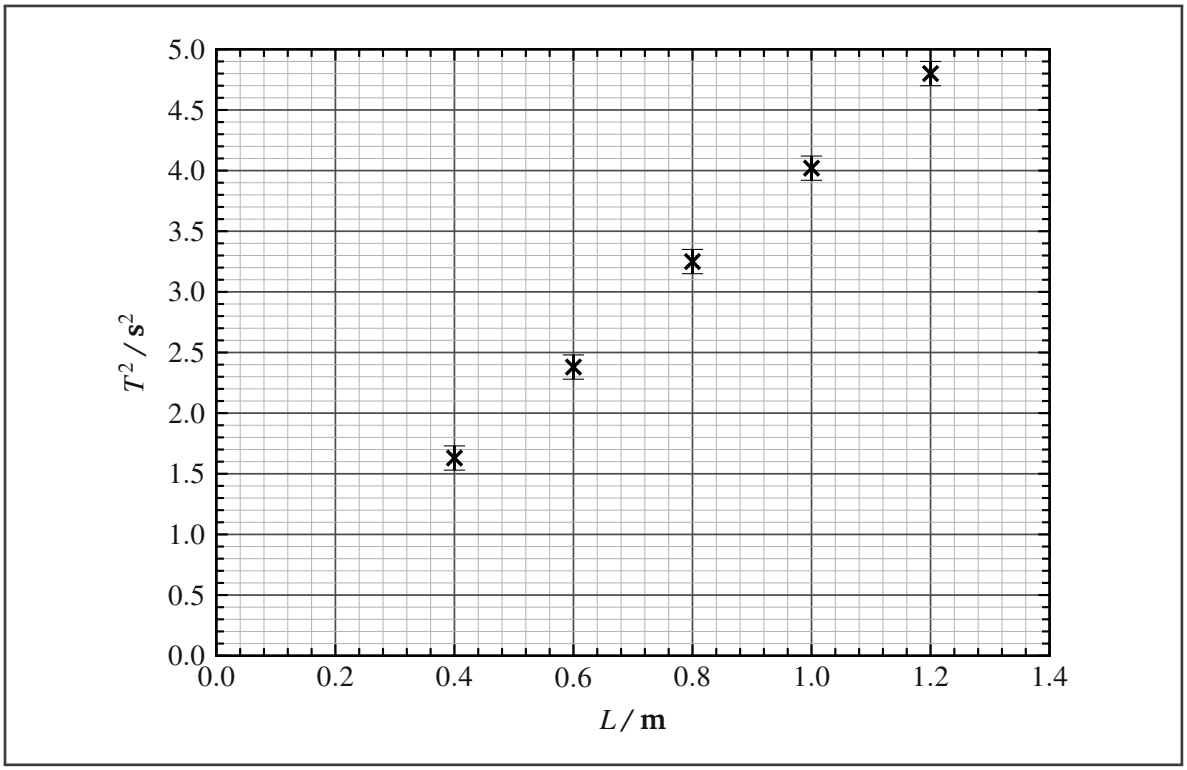
2. A student uses a simple pendulum to measure the acceleration of free fall g.

For each length L of the pendulum, the student times 20 complete oscillations and uses this to calculate the period T. The student then plots T^2 against L.

The error bars show the uncertainty in T^2. The uncertainty in L is too small to show.

For small oscillations, theory predicts

$$T = 2\pi\sqrt{\frac{L}{g}}.$$



(a) Draw the best-fit line for these data on the graph. **[1]**

(b) Determine the gradient of your best-fit line. Include a unit. **[2]**

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(This question continues on the following page)

(Question 2 continued)

(c) Use your gradient to calculate a value for g. **[1]**

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(d) On the graph, draw the steepest line and the shallowest line that still pass through all the error bars. Use these two lines to find the absolute uncertainty in your value of g. **[2]**

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(e) The best-fit line does not pass through the origin. State what this tells you about the experiment. **[1]**

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3. A student investigates how the fundamental frequency f of a stretched string depends on the tension F in the string. The length of the string and its mass per unit length are kept constant.

The student assumes that

$$f = kF^n,$$

where k and n are constants.

The table shows the student's results and the processed data.

F / N	f / Hz	$\log(F/\text{N})$	$\log(f/\text{Hz})$
2.0	29.8	0.30	1.47
4.0	41.5	0.60	1.62
6.0	51.6		
8.0	58.8	0.90	1.77
10.0	66.3	1.00	1.82
12.0	72.1	1.08	1.86

(a) Show that a graph of $\log f$ against $\log F$ should be a straight line. State what the gradient and the vertical intercept of this line represent. **[1]**

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(b) Complete the table by filling in the two missing values for $F = 6.0\,\text{N}$. **[2]**

(c) The student plots the graph. A graphic display calculator gives the line of best fit as $y = 0.496x + 1.323$. Determine n, and state whether the data support the prediction that f is proportional to $\sqrt{F}$. **[1]**

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(Question 3 continued)

(d) Determine the value of k. Include a unit. **[1]**

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End of examination

Total: 20 marks