IB Demystified

Examiners · Moderators · Mentors

Physics

Standard Level

Paper 1B — Mock Examination

Mock Exam 1

Calculator required

Time allowed: **40 minutes**

Maximum mark: **20 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Topic emphasis: experimental techniques, uncertainties and errors, graphical analysis and data processing

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told 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 this paper is **[20 marks]**.

Where necessary, take the magnitude of the gravitational field strength at the Earth's surface to be $g = 9.81\,\text{N}\,\text{kg}^{-1}$. Values of all other constants are given in the data booklet.

Graphs must be drawn in pencil. Show all of your working: marks are available for correct method even when the final answer is incorrect.

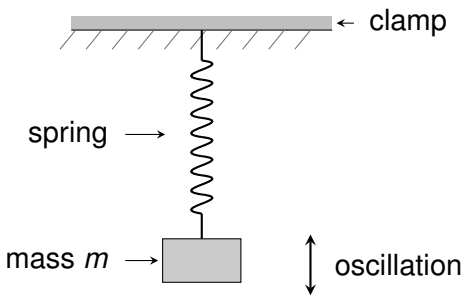
Marks awarded	
Question 1	. . . . . / 11
Question 2	. . . . . / 9
Total	. . . . . / 20

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

1. A student investigates how the period of oscillation of a mass suspended from a vertical spring depends on the mass.

A spring is clamped at its upper end. A mass m is attached to the lower end of the spring. The mass is pulled down a short distance and released so that it oscillates vertically.

The student measures the time t_{20} for 20 complete oscillations using a digital stopwatch. The uncertainty in t_{20} is ± 0.2 s for every measurement.



(a) Explain why the student measures the time for 20 oscillations instead of the time for one oscillation. **[1]**

.....

.....

(b) For $m = 0.100$ kg the student records $t_{20} = (8.7 \pm 0.2)$ s.

Show that the period of oscillation of this mass is (0.435 ± 0.010) s. **[1]**

.....

.....

(This question continues on the following page)

(Question 1 continued)

The student repeats the measurement for a range of masses. The results are shown in the table.

m / kg	t_{20} / s	T / s	T^2 / s^2	$\triangle(T^2)$ / s^2
0.100	8.7	0.435	0.189	0.009
0.200	11.8	0.590	0.348	0.012
0.300	14.2	0.710	0.504	0.014
0.400	16.3	0.815	0.664	0.016
0.500	18.1	0.905		

(c) Complete the table for $m = 0.500$ kg. **[2]**

.....

.....

.....

(d) The theory of the oscillation predicts that

$$T^2 = \frac{4\pi^2}{k}(m + m_0),$$

where k is the spring constant of the spring and m_0 is a constant.

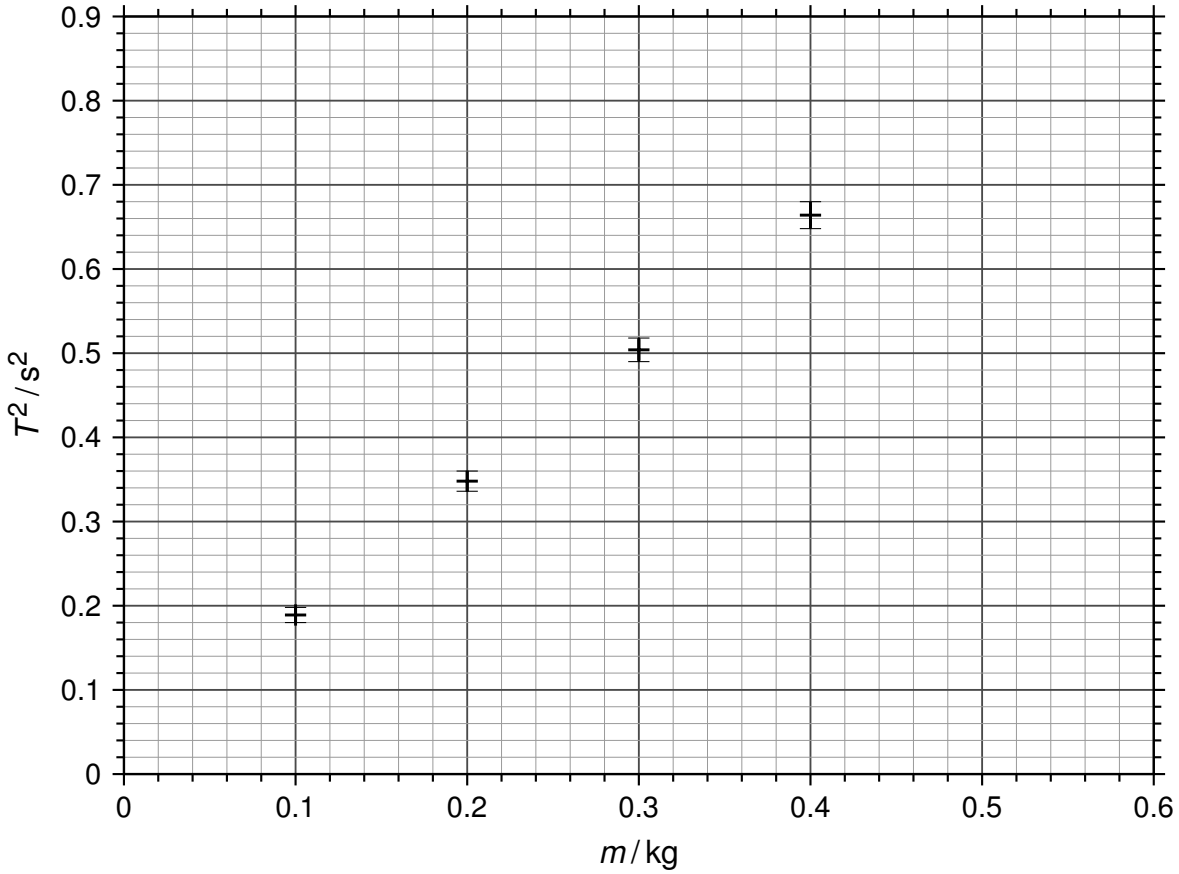
The first four data points have been plotted on the graph on the following page. Error bars for T^2 are shown; the uncertainty in m is negligible.

(i) Plot the data point for $m = 0.500$ kg on the graph, including its error bar. **[1]**

(ii) Draw the line of best fit for these data, extrapolating your line to the T^2-axis. **[1]**

(This question continues on the following page)

(Question 1 continued)



(e) Determine, using your line of best fit, the spring constant k of the spring. State an appropriate unit for your answer. **[3]**

.....

.....

.....

.....

.....

(This question continues on the following page)

(Question 1 continued)

(f) Your line of best fit does not pass through the origin.

(i) Determine m_0 using your graph. **[1]**

.....

.....

.....

(ii) Suggest a physical reason for the non-zero value of m_0. **[1]**

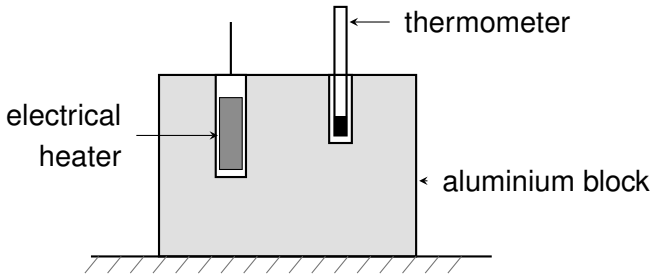
.....

.....

2. A student determines the specific heat capacity of aluminium.

An electrical heater is placed inside a solid aluminium block of mass 0.80 kg. A thermometer is placed in a second hole in the block. The block rests on the bench and is not insulated.

The heater is switched on at time $t = 0$ and the temperature θ of the block is recorded every 100 s.



(a) The readings on the meters connected to the heater are

$$V = (12.0 \pm 0.1)\,\text{V} \qquad \text{and} \qquad I = (4.20 \pm 0.05)\,\text{A}.$$

Calculate the power of the heater and its percentage uncertainty. **[2]**

.....

.....

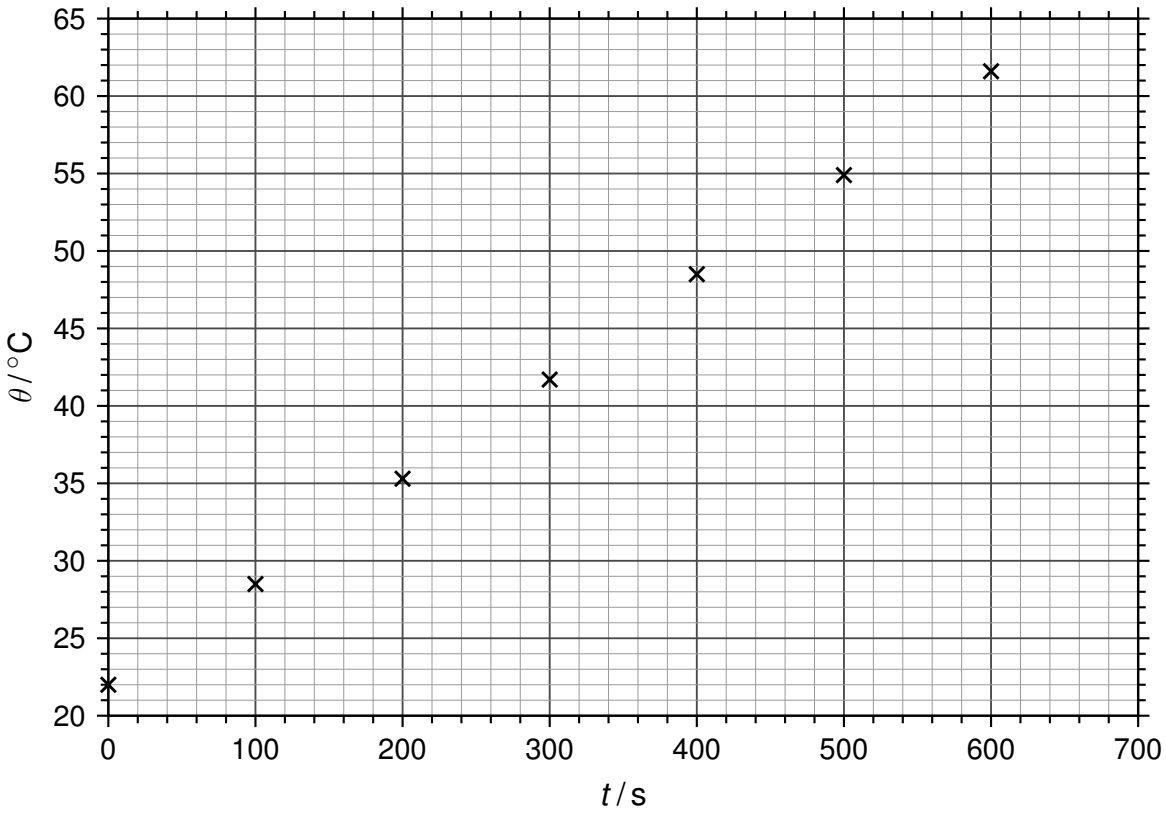
.....

.....

(This question continues on the following page)

(Question 2 continued)

The student plots the recorded data.



(b) Draw the line of best fit for these data and determine its gradient. State an appropriate unit for your answer. **[2]**

.....

.....

.....

.....

(c) Determine the specific heat capacity of aluminium obtained in this experiment. **[2]**

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 2 continued)

(d) The accepted value of the specific heat capacity of aluminium is 900 J kg^{-1} K^{-1}.

Comment on the accuracy of the student's result. **[1]**

.....

.....

(e) Explain how thermal energy transferred from the block to the surroundings affects the value of the specific heat capacity obtained in (c). **[1]**

.....

.....

.....

(f) Suggest one improvement to the experiment, other than repeating the readings, that would increase the accuracy of the result. **[1]**

.....

.....

.....

End of examination.

Total: **20 marks**