Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Higher level
Paper 1B

28 April 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Session number

2 hours [Paper 1A and Paper 1B]

Instructions to students

- 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]**.

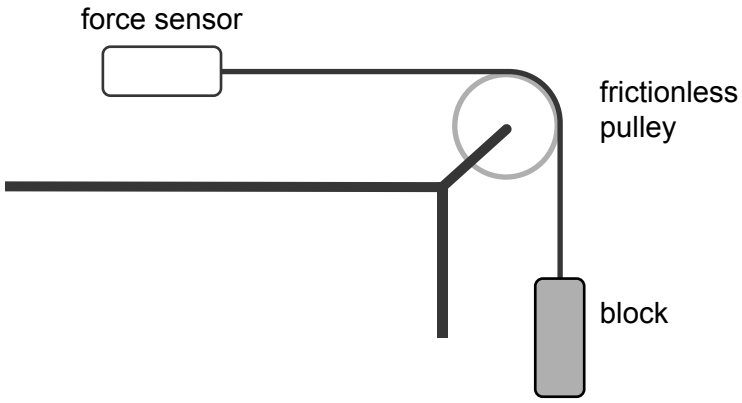
2226 – 4717

11 pages

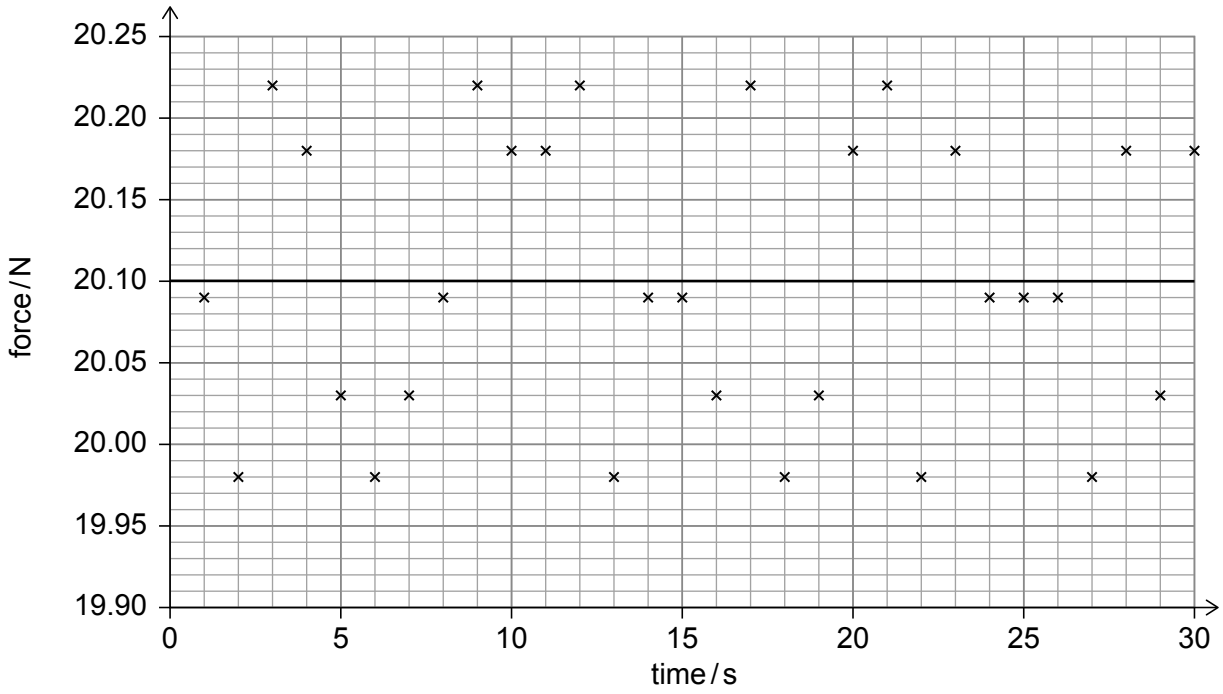
Answer **all** questions. Answers must be written within the answer boxes provided.

1. Two students measure the force needed to keep a block at rest.

Student A uses a frictionless pulley. The block is attached to one end of a string. The other end passes over the frictionless pulley to a force sensor.



Data are collected for 30 seconds. The graph shows the data and the line of best fit.



(This question continues on the following page)

(Question 1 continued)

(a) (i) State the average measured force. [1]

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(ii) Estimate the percentage uncertainty in the measured force. [2]

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(b) The students use a value of $g = 9.81\,\text{m}\,\text{s}^{-2}$ in their calculation. This value has percentage uncertainty of 0.4 %. Determine the mass of the block and its absolute uncertainty. State your answer to the appropriate number of significant figures. [3]

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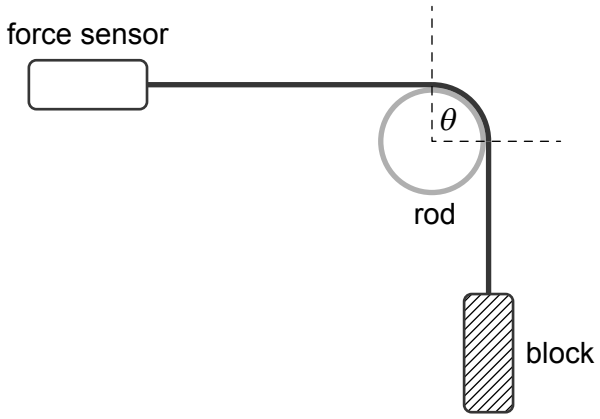
Answers written on this page
will not be marked.

(Question 1 continued)

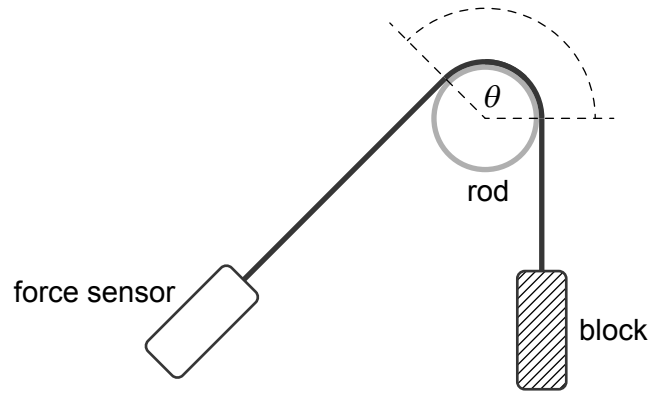
Student B designs an experiment using a fixed rod. In the experiment, the minimum force *F* needed to keep the block at rest is measured. The angle θ, subtended by the string in contact with the rod, is increased.

The position of the force sensor for $\theta = \frac{\pi}{2}$ rad is shown.



Angle θ is increased by moving the force sensor.

(c) Draw, on the diagram below, the position of the force sensor for the value $\theta = \pi$ rad. [1]



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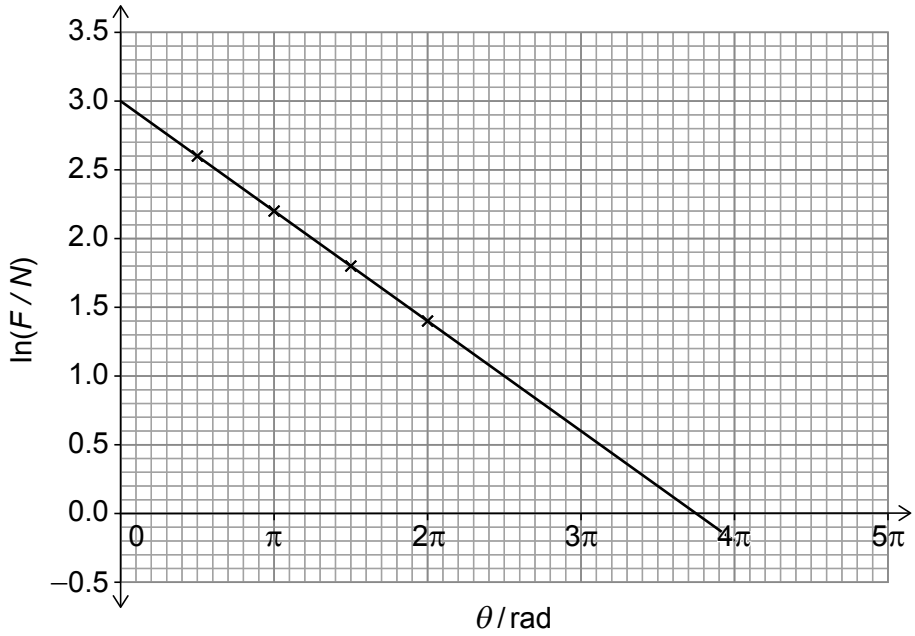
(Question 1 continued)

F and θ are related by

$$\ln(F) = \ln(mg) - k\theta$$

where m is the mass of the block and k is a constant.

Data were taken for four positions of the force sensor. The graph shows the variation of ln(F) with θ, and the line of best fit.



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(Question 1 continued)

(d) (i) State how the value of ln(*mg*) can be obtained from the graph. [1]

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(ii) Determine the value of *k*. [3]

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(e) Identify **two** control variables in this experiment. [2]

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will not be marked.

2. A group of students conducts an experiment to confirm the relationship between pressure P and volume V, for a constant mass M of air at a constant absolute temperature T. They use the equation $PV = \frac{M}{m_A} k_B T$ where m_A is the average mass of a molecule of the air.

(a) Outline why the equation suggests a directly proportional relationship between $\frac{1}{P}$ and V. [2]

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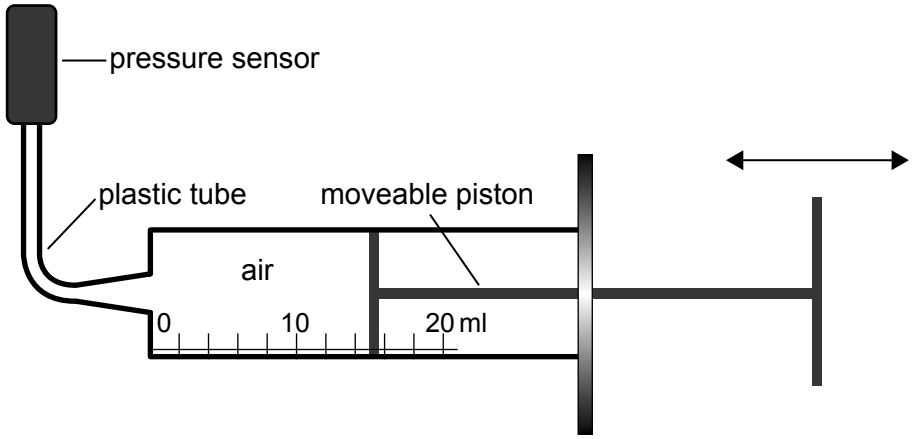
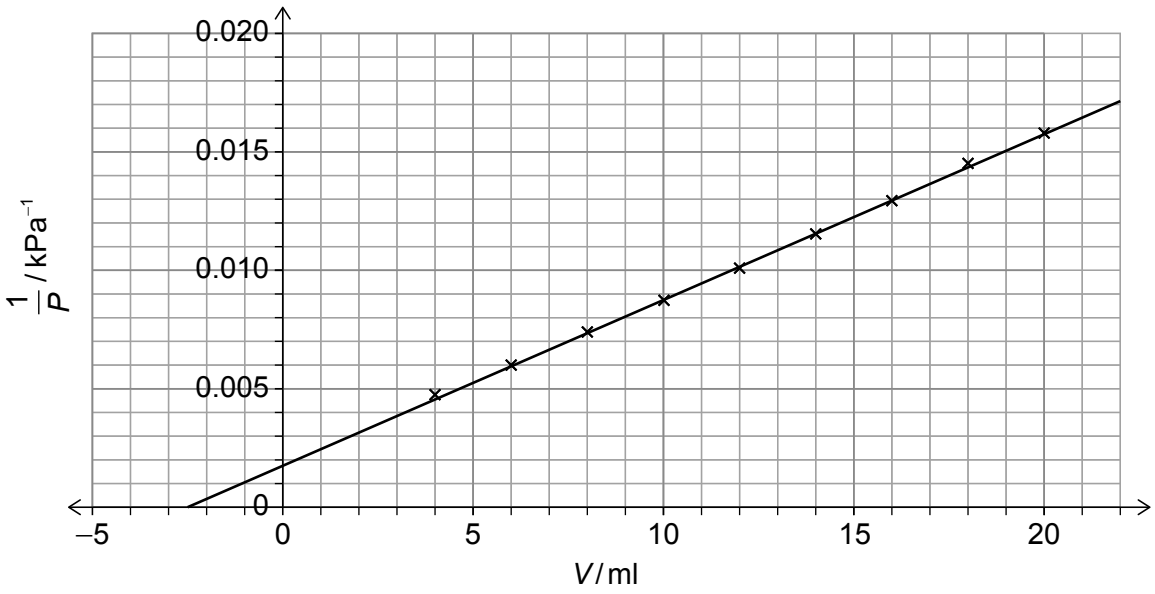
(Question 2 continued)

The students constructed an apparatus containing a plastic syringe and a pressure sensor, connected by a plastic tube.



The temperature inside the syringe is kept at room temperature. V is measured using the scale on the syringe.

The graph shows the variation with V of $\frac{1}{P}$ and the line of best fit.



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(Question 2 continued)

(b) The unit of the slope of the graph can be written as $kg^X \times m^Y \times s^2$

Determine the value of X and the value of Y. [2]

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(c) For $V = 20$ ml, show that the pressure measured is about 60 kPa. [1]

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The graph shows a systematic error.

(d) Identify

(i) the feature of the graph that shows a systematic error. [1]

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(ii) the source of the error in part (i). [1]

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