Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Higher level
Paper 1B

5 November 2025

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

Candidate session number

2 hours [Paper 1A and Paper 1B]

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]**.

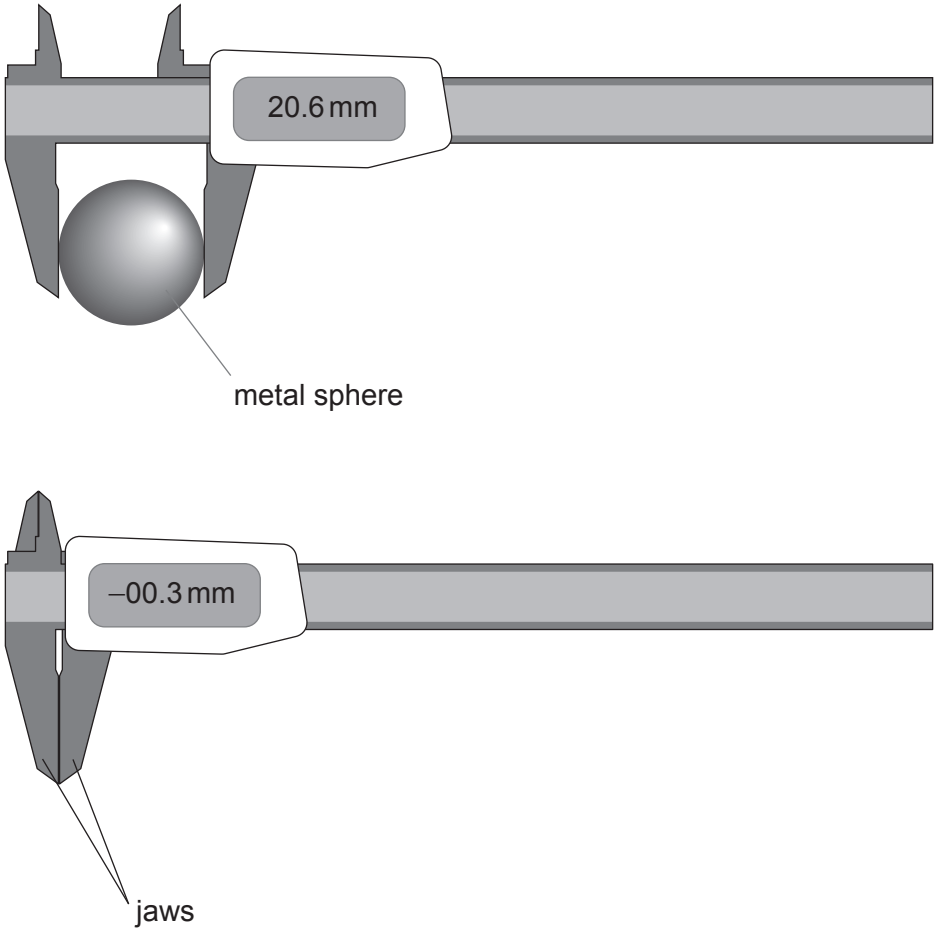
8825–6708

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

1. The density of a metal sphere is determined using a digital caliper and a mass balance.

The digital caliper is used to measure the diameter *D* of the sphere by placing the sphere in the jaws of the digital caliper. This reading is shown.

The sphere is then removed and another reading is taken immediately afterwards with the jaws closed.



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(Question 1 continued)

(a) (i) Calculate D. [1]

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(ii) The manufacturer of the digital caliper states that the uncertainty in the device reading is $\pm 0.1\,\text{mm}$.

Calculate the percentage uncertainty in D. [1]

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(b) State **one** way in which the procedure for the measurement of D can be improved using the same digital caliper. [1]

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(c) The mass M of the sphere is $(54.0 \pm 0.2)\,\text{g}$.

The density of the sphere ρ is calculated to be $11.3 \times 10^3\,\text{kg m}^{-3}$, using $\rho = \dfrac{6M}{\pi D^3}$.

(i) Calculate the percentage uncertainty in ρ. [2]

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(ii) State the value of ρ, including the absolute uncertainty of ρ. [1]

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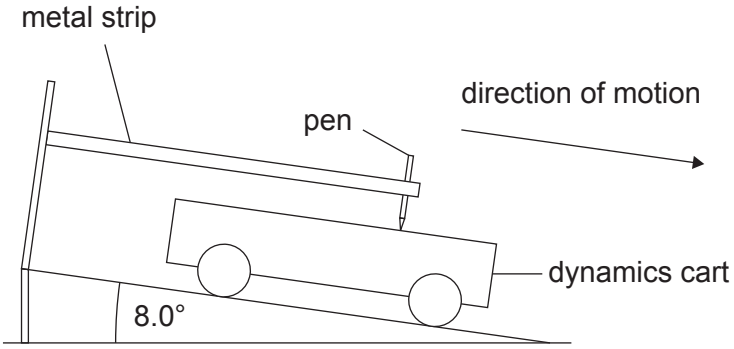
Answers written on this page
will not be marked.

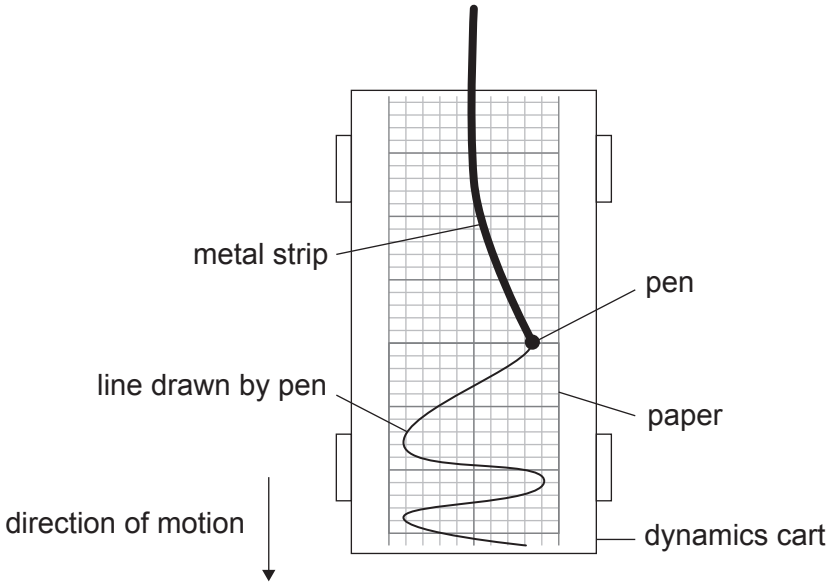
2. The acceleration of a dynamics cart is measured as the cart rolls from rest down an inclined ramp.

A flexible metal strip is attached to the ramp. The metal strip performs simple harmonic oscillations.

A pen is attached to the metal strip and makes marks on paper that is fixed to the top surface of the cart.



Side view



View from above

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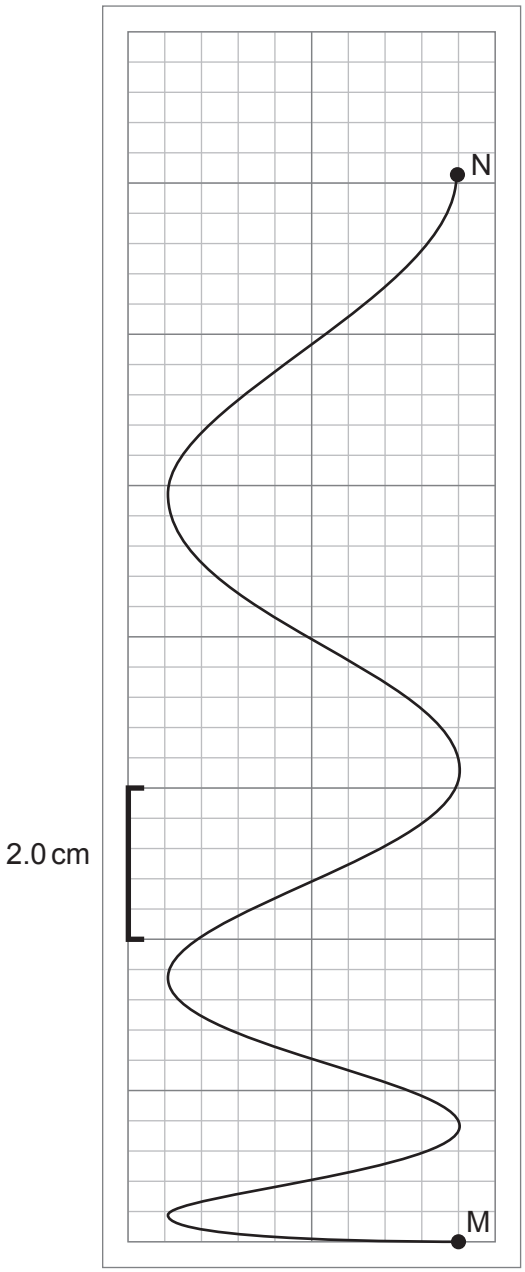
(Question 2 continued)

The pen is displaced from its equilibrium position. The pen and the cart are then released at the same time.

As the cart accelerates down the ramp, the pen oscillates from side to side. The frequency of oscillation of the pen is 6.3 Hz.

The pen moves from point M to point N on the paper. The paper is shown with a grid, and the scale of the grid is marked on the diagram.

Air resistance is negligible in this experiment.



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(Question 2 continued)

(a) Calculate the time the pen takes to move from M to N. [2]

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(b) Determine the acceleration of the cart. State an appropriate unit for your answer. [3]

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(c) The ramp is inclined at an angle of 8.0° to the horizontal.

(i) Discuss how your value for the acceleration of the cart in (b) compares with the component of *g* that acts down the ramp. [1]

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(ii) Explain why the two values in (c)(i) are different. [1]

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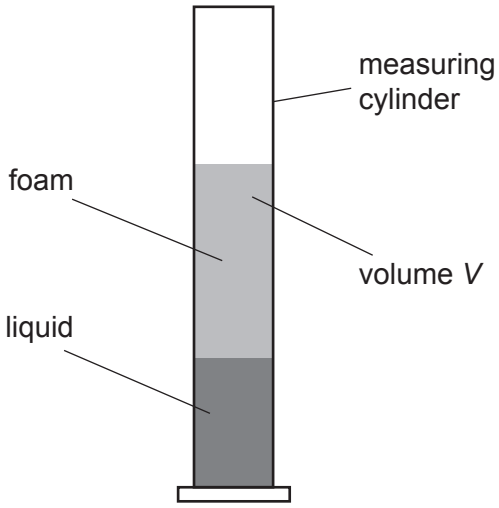
3. A foam forms above a liquid when the liquid is stirred or poured.

A student investigates the change in volume of a foam with time.

At time $t = 0$, the liquid is poured quickly into a measuring cylinder and a foam forms above the liquid. The student waits one minute for the foam to settle and then records the volume V of the foam and the time t.

The student repeats the measurement every minute.



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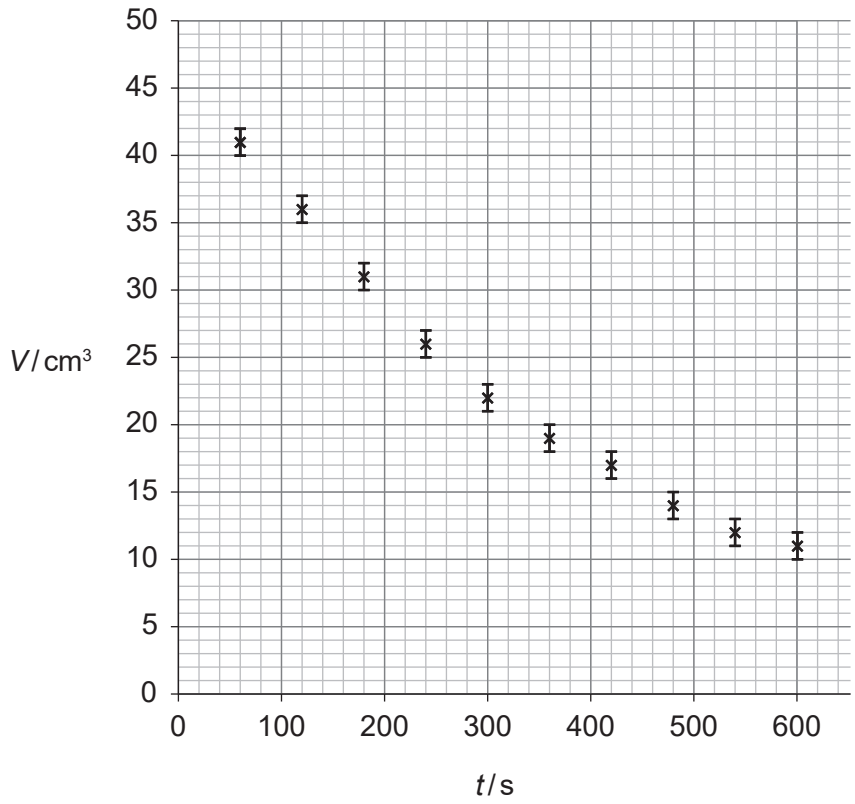
(Question 3 continued)

The student plots the data to show how V varies with t. Error bars are given for values of V; errors in t are negligible.



(a) (i) Draw the best-fit line for these data on the graph, extrapolating your line to the V-axis. [1]

(ii) Estimate the initial volume of the foam. [1]

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(Question 3 continued)

(b) The student suggests that the foam experiment can model radioactive decay.

For this to be true, the *V*–*t* graph must have similar properties to those of a graph of corrected count rate against time for the decay of a radioactive nuclide.

(i) Explain how data from the *V*–*t* graph can be tested to decide whether the foam experiment can model radioactive decay. [1]

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(ii) Show, using data from the *V*–*t* graph and your test from (b)(i), that the student's suggestion is correct. [2]

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(c) The student decides to stop the experiment when the volume of the foam has decreased by $\frac{7}{8}^{\text{th}}$ of its original volume.

Predict the time at which the student will stop the experiment. [2]

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