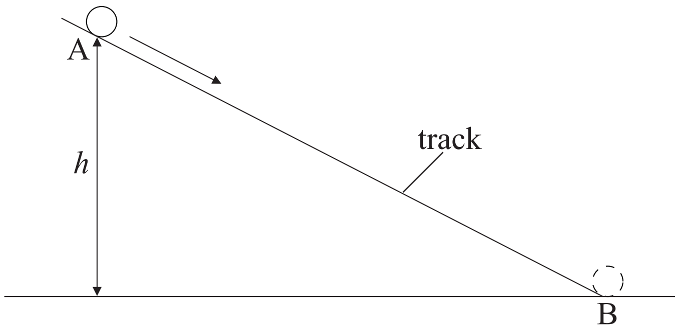
SECTION A

*Answer **all** questions. Write your answers in the boxes provided.*

A1. Data analysis question.

A small sphere rolls down a track of constant length AB. The sphere is released from rest at A. The time t that the sphere takes to roll from A to B is measured for different values of height h.



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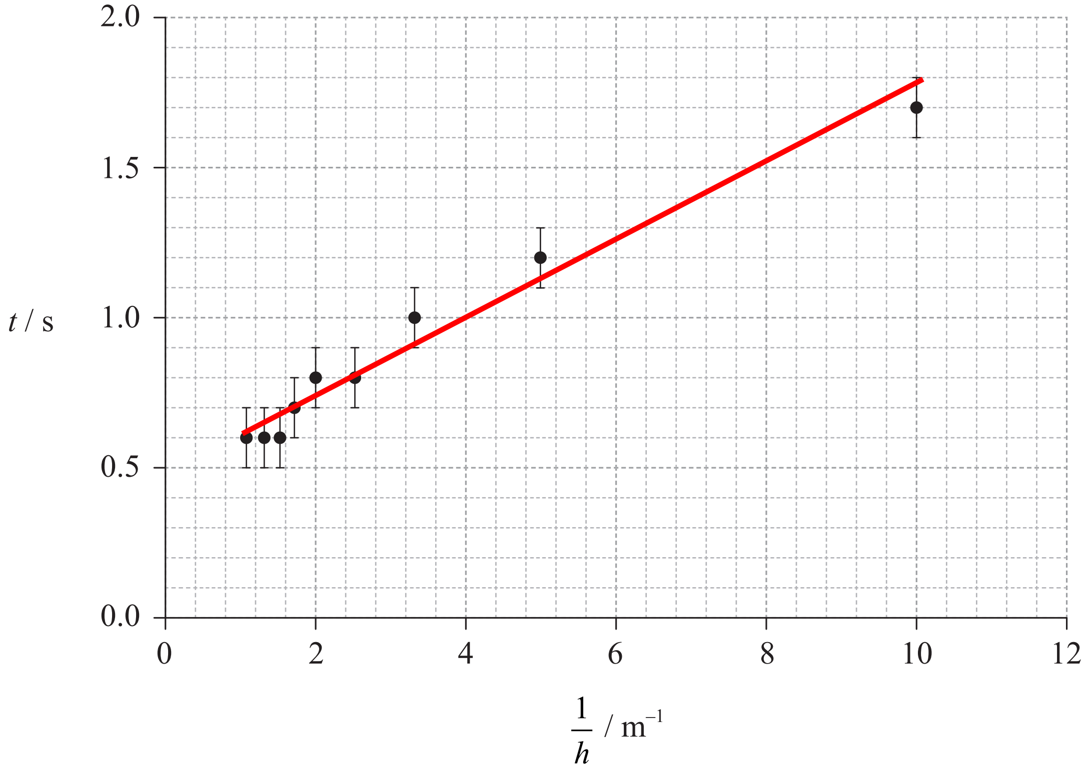
(Question A1 continued)

A student suggests that t is proportional to $\frac{1}{h}$. To test this hypothesis a graph of t against $\frac{1}{h}$ is plotted as shown on the axes below. The uncertainty in t is shown and the uncertainty in $\frac{1}{h}$ is negligible.



(a) (i) Draw the straight line that best fits the data. *[1]*

(ii) State why the data do not support the hypothesis. *[1]*

The best fit line cannot pass through the origin of the graph. Thus t is not proportional to 1/h.

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(Question A1 continued)

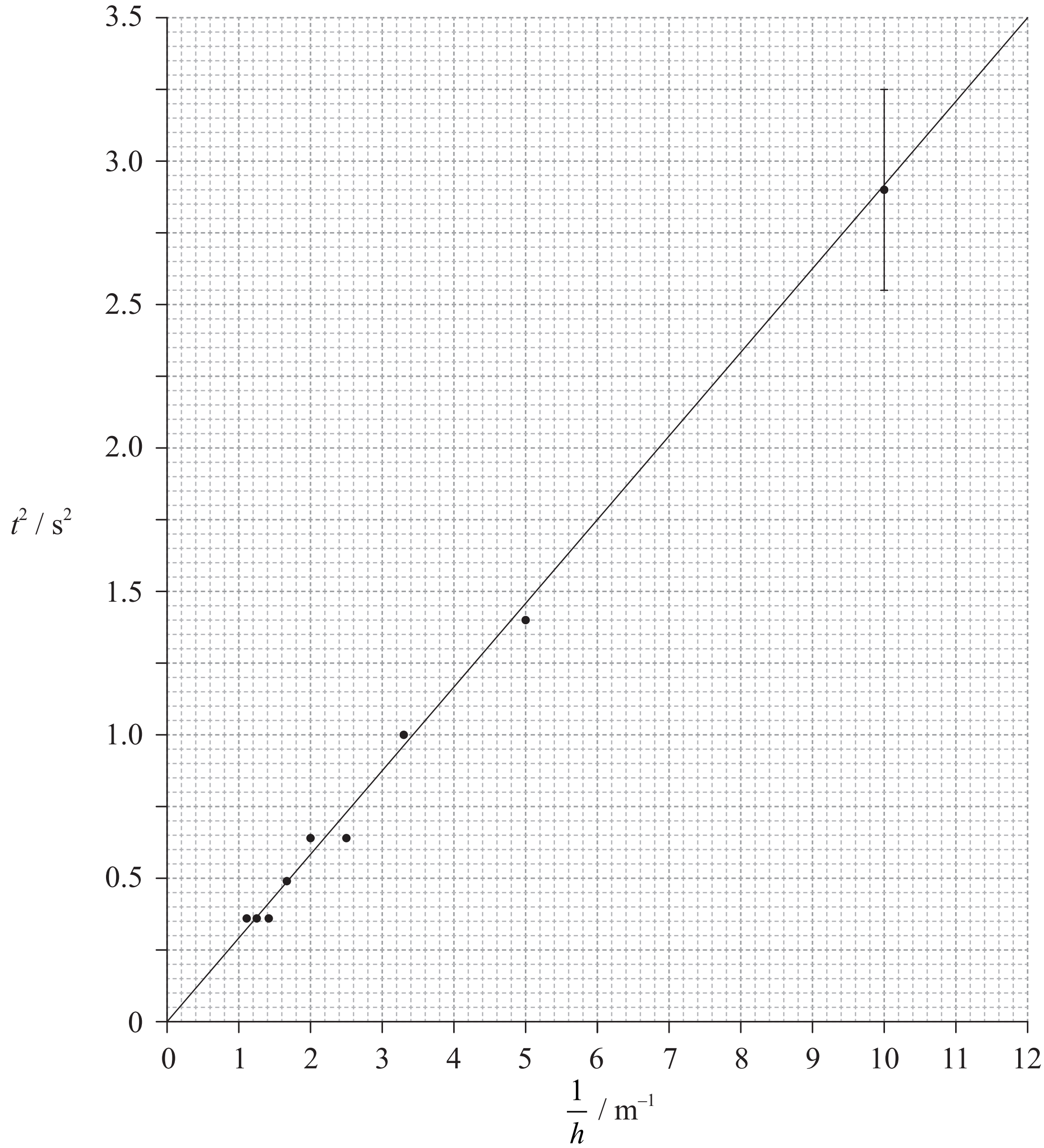
(b) Another student suggests that the relationship between t and h is of the form

$$t = k\sqrt{\frac{1}{h}}$$

where k is a constant.

To test whether or not the data support this relationship, a graph of t^2 against $\frac{1}{h}$ is plotted as shown below.

The best-fit line takes into account the uncertainties for all data points.



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(Question A1 continued)

The uncertainty in t^2 for the data point where $\frac{1}{h} = 10.0\,\text{m}^{-1}$ is shown as an error bar on the graph.

(i) State the value of the uncertainty in t^2 for $\frac{1}{h} = 10.0\,\text{m}^{-1}$. *[1]*

From the graph $\Delta t^2 = 7\text{x}0.05 = 0.35\ \text{s}^2$

(ii) Calculate the uncertainty in t^2 when $t = 0.8 \pm 0.1\,\text{s}$. Give your answer to an appropriate number of significant digits. *[4]*

$\Delta t^2/t^2 = 2 \times \Delta t/t = 2 \times 0.1/0.8 = 0.25$ Thus $\Delta t^2 = t^2 \times 0.25 = 0.8^2\text{x}\ 0.25 = 0.16 = 0.2\ \text{s}^2$

(iii) Use the graph to determine the value of k. Do not calculate its uncertainty. *[3]*

Gradient = 2.9 / 10 = 0.29 $\text{s}^2 \cdot \text{m}$

From the relation $t^2 = k^2 . (1/h)$. Thus $k^2 = 0.29 \Rightarrow k = 0.5385 = 0.54$

(iv) State the unit of k. *[1]*

$\text{m}^{1/2}.\text{s}$

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