



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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PHYSICS

9702/51

Paper 5 Planning, Analysis and Evaluation

October/November 2009

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use

1	
2	
Total	

This document consists of **8** printed pages.



- 1** The volume of air in a bottle affects its resonant frequency.

It is suggested that the resonant frequency f is related to the volume V by the equation

$$f^2 = \frac{k}{V}$$

where k is a constant.

Design a laboratory experiment to determine whether this equation is correct. You should draw a diagram showing the arrangement of your equipment. In your account you should pay particular attention to

- (a)** the procedure to be followed,
- (b)** the measurements to be taken,
- (c)** the control of variables,
- (d)** how to analyse the data,
- (e)** the safety precautions to be taken.

[15]

For
Examiner's
Use

Diagram

*For
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Use*

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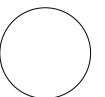
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- 2 An experiment is carried out to investigate how the resistance R of a thermistor varies with temperature T .

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Use

An ohmmeter is used to measure R . The equipment is set up as shown in Fig. 2.1.

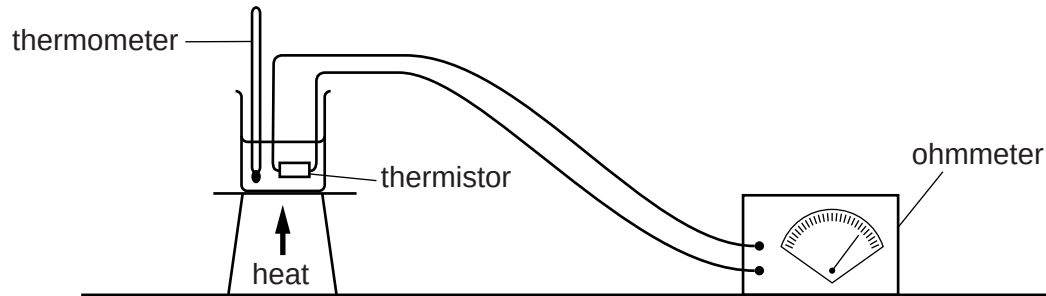


Fig. 2.1

Question 2 continues on page 6.

It is suggested that R and T are related by the equation

$$R = \frac{T^h}{g}$$

where g and h are constants.

- (a) A graph is plotted with $\lg R$ on the y -axis and $\lg T$ on the x -axis. Express the gradient and y -intercept in terms of g and h .

gradient = ...

y -intercept = ...

[1]

- (b) Values of T and R are given in Fig. 2.2.

T/K	R/Ω	$\lg (T/K)$	$\lg (R/\Omega)$
293	990 ± 10		
303	860 ± 10		
313	760 ± 10		
323	680 ± 10		
333	610 ± 10		

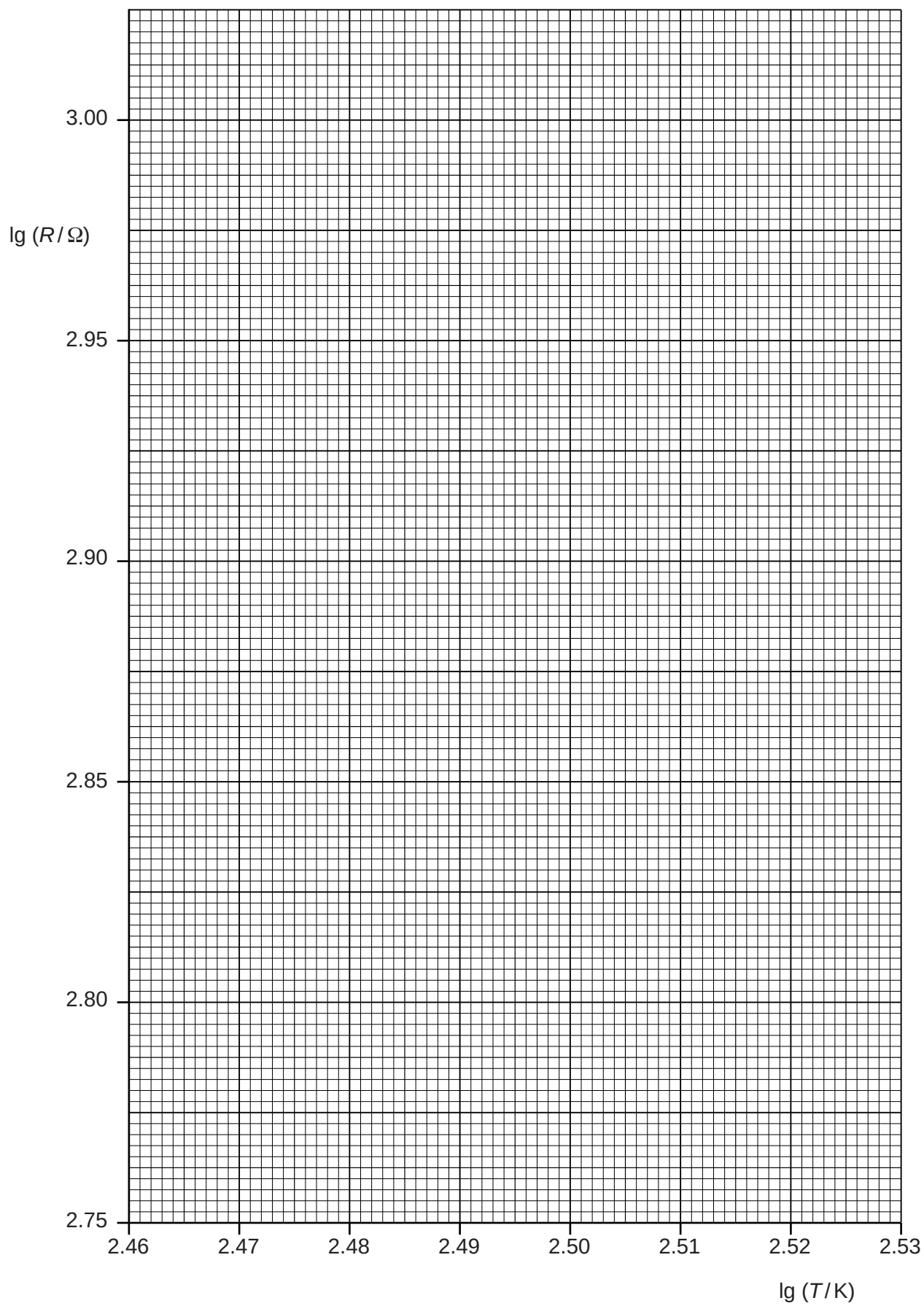
Fig. 2.2

Calculate and record values of $\lg (T/K)$ and $\lg (R/\Omega)$ in Fig. 2.2. Include the absolute errors in $\lg (R/\Omega)$. [3]

- (c) (i) Plot a graph of $\lg (R/\Omega)$ against $\lg (T/K)$. Include error bars for $\lg (R/\Omega)$. [2]
 (ii) Draw the line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]
 (iii) Determine the gradient of the line of best fit. Include the error in your answer.

gradient = ... [2]

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Use



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- (iv) Determine the y -intercept of the line of best fit. Include the error in your answer.

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y -intercept = ...[2]

- (d) Using your answers to (c)(iii) and (c)(iv), determine the values of g and h . Include the error in your values. You need not be concerned with the units of g and h .

g = ...

h = ...[3]



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PHYSICS

9702/52

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2

Total

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- 1 When a current passes through a wire, the wire becomes hot and expands.

This can be investigated in a laboratory by passing a current through a wire of diameter d and measuring the displacement y , as shown in Fig. 1.1.

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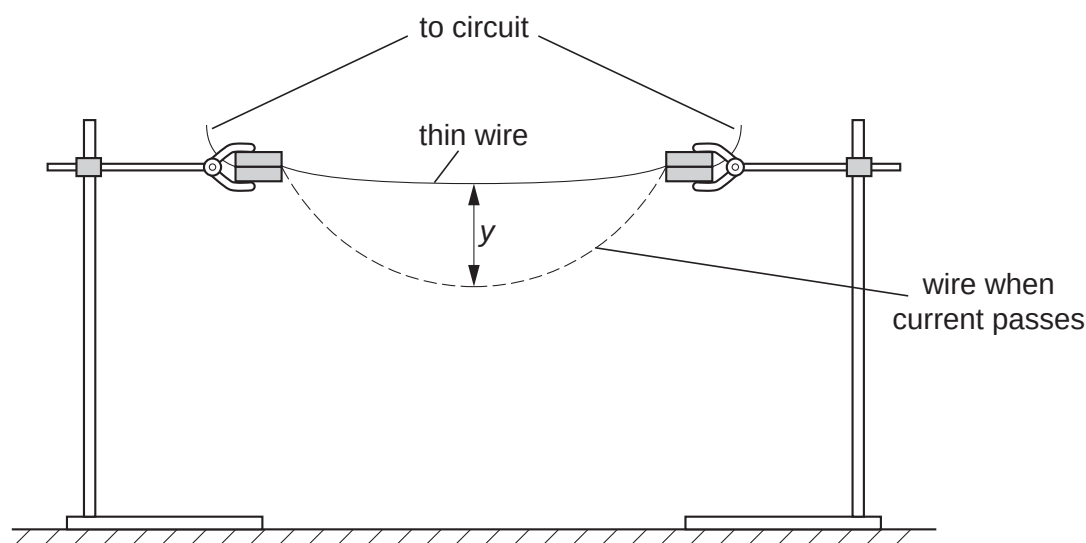


Fig. 1.1

It is suggested that the diameter d of the wire is related to y by the equation

$$y = pd^q$$

where p and q are constants.

Design a laboratory experiment to investigate the relationship between d and y , so as to determine a value for q . You should draw a diagram showing the arrangement of your equipment. In your account you should pay particular attention to

- (a) the procedure to be followed,
- (b) the measurements to be taken,
- (c) the control of variables,
- (d) the analysis of the data,
- (e) the safety precautions to be taken.

[15]

Diagram

*For
Examiner's
Use*

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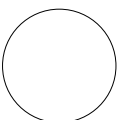
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- 2 An experiment is carried out to investigate how the time t for a steel ball to fall through air varies with the height h through which it falls.

For
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Use

The equipment is set up as shown in Fig. 2.1.

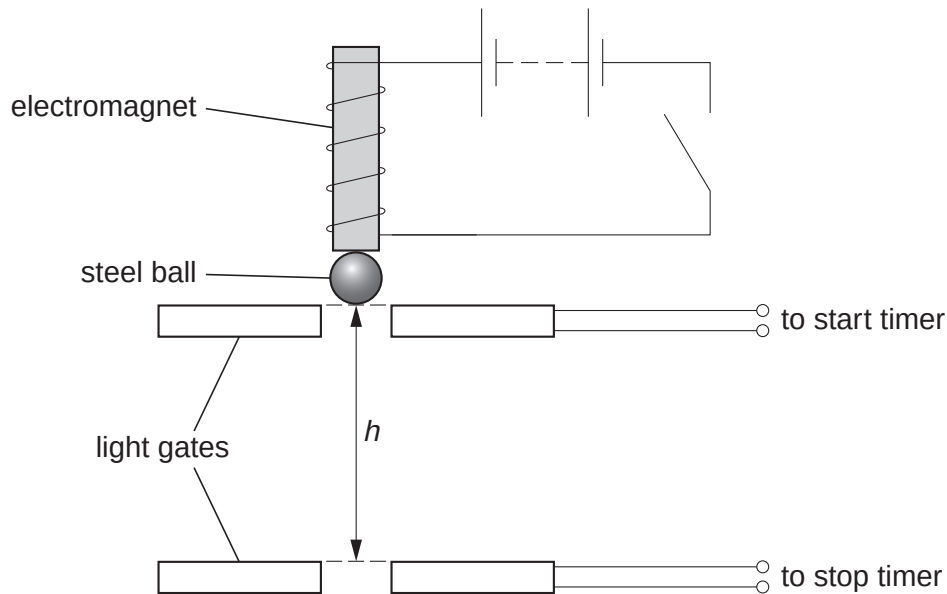


Fig. 2.1

An electromagnet is used to release the ball. As soon as the ball is released, it passes a light gate, which starts a timer. As the ball passes the lower light gate, the timer is stopped.

Question 2 continues on the next page.

It is suggested that t and h are related by the equation

$$h = \frac{1}{2}gt^2$$

where g is the acceleration of free fall.

- (a) A graph is plotted with t^2 on the y -axis and h on the x -axis. Express the gradient in terms of g .

gradient = ... [1]

- (b) Values of h and t are given in Fig. 2.2.

h/m	t/s	
0.60	0.35 ± 0.01	
0.75	0.39 ± 0.01	
0.90	0.43 ± 0.01	
1.00	0.45 ± 0.01	
1.15	0.49 ± 0.01	
1.30	0.52 ± 0.01	

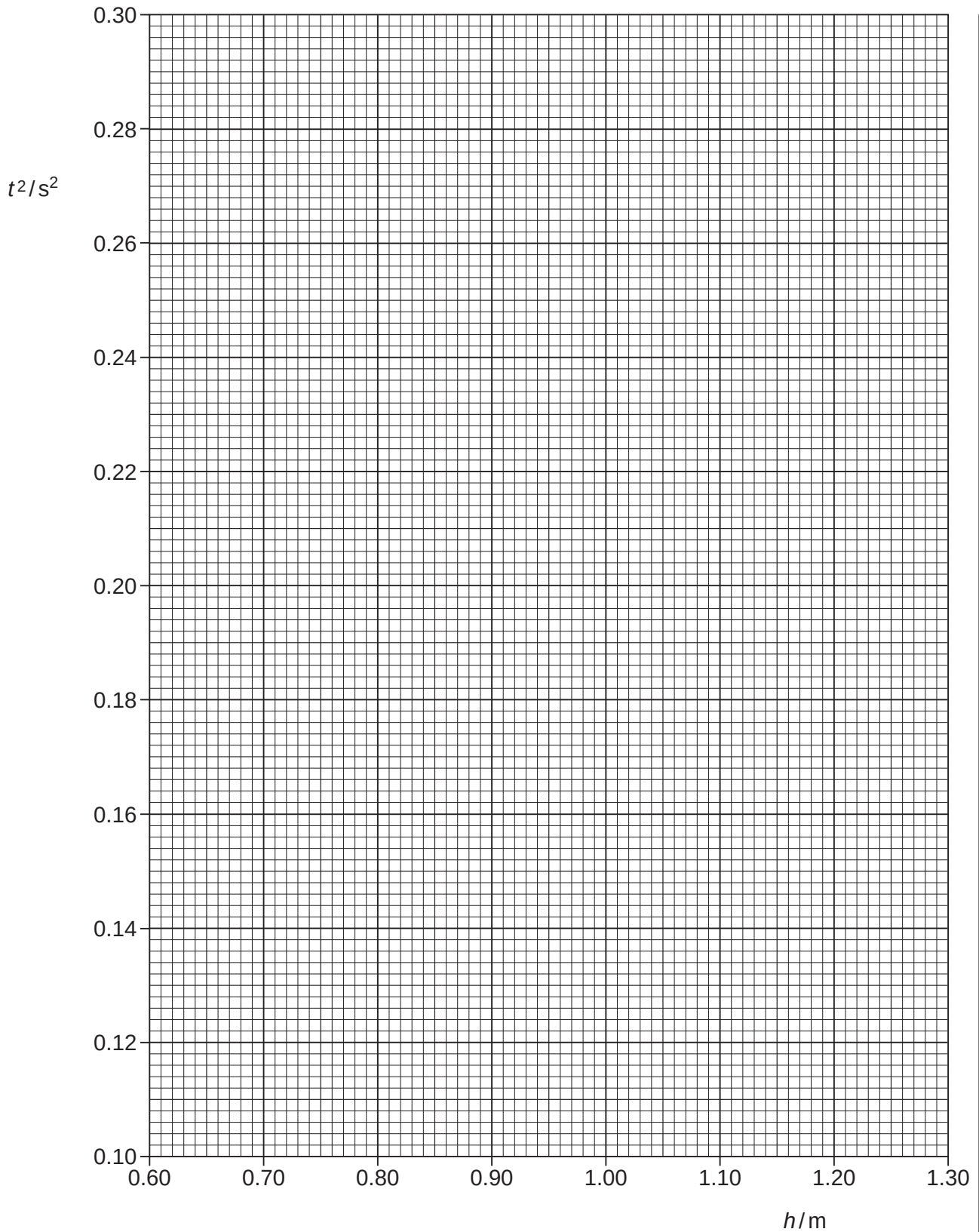
Fig. 2.2

Calculate and record values of t^2 in Fig. 2.2. Include the absolute uncertainties. [3]

- (c) (i) Plot a graph of t^2/s^2 against h/m . Include error bars for t^2 . [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]
- (iii) Determine the gradient of the line of best fit. Include the uncertainty in your answer.

gradient = ... [2]

For
Examiner's
Use



For
Examiner's
Use

- (d) Using your answer to (c)(iii), determine the value of g . Include the absolute uncertainty in your value and an appropriate unit.

For
Examiner's
Use

$$g = \dots\dots\dots [3]$$

- (e) The experiment is repeated from the top of a building.

- (i) The time taken for the steel ball to fall is 2.21 ± 0.01 s. Using your value of g , calculate the height b of the building.

$$b = \dots\dots\dots \text{ m } [1]$$

- (ii) Determine the percentage uncertainty in b .

$$\text{percentage uncertainty} = \dots\dots\dots \% [1]$$