



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Advanced Level

CANDIDATE  
NAME

CENTRE  
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	
<b>Total</b>	

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]

**Diagram**

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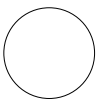
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A series of 25 horizontal dotted lines spanning the width of the page, intended for handwritten answers.

Five vertically stacked rectangular boxes, likely for marking or grading purposes.



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

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

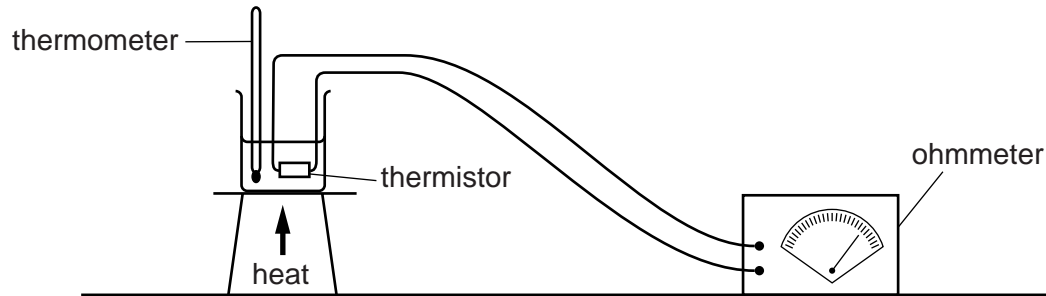


Fig. 2.1

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.

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

**Fig. 2.2**

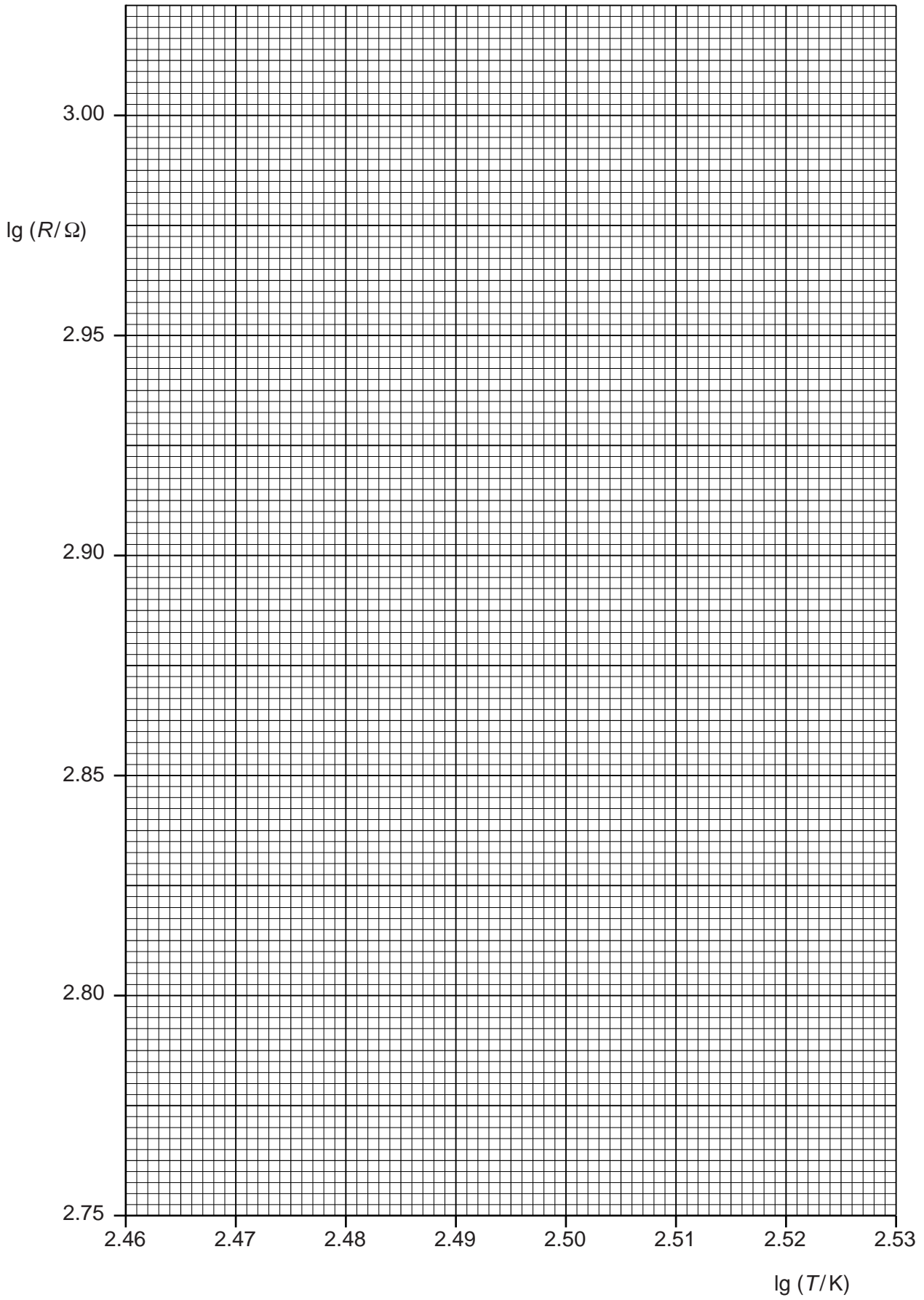
Calculate and record values of  $\lg (T/K)$  and  $\lg (R/\Omega)$  in Fig. 2.2. Include the absolute errors in  $\lg (R/\Omega)$ . [3]

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

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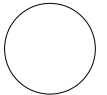
$y$ -intercept = .....[2]

- (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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