OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

PHYSICS A 2826/03/TEST

Practical Test (Part B)

Thursday **22 MAY 2003** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic Calculator
Candidate's Plan (Part A of the Practical Test)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces on the question paper.

INFORMATION FOR CANDIDATES

- In this part of the Practical Test you will be assessed on the Experimental and Investigative Skills:
  Skill I Implementing
  Skill A Analysing evidence and drawing conclusions
  Skill E Evaluating
- You are advised to spend the first few minutes reading through the whole paper before starting to answer any questions.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- You will be awarded marks for the quality of written communication where this is indicated in the question.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
Planning	**16**	
1	**28**	
2	**16**	
TOTAL	**60**	

This question paper consists of 12 printed pages.

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It is recommended that you spend about one hour on this question.

1 A thermistor is a device which is made of a semiconducting material. The resistance of a particular type of thermistor falls when its temperature is raised. This is because the extra kinetic energy of the atoms enables more electrons to move from atom to atom in the material. In this experiment you will be required to investigate how the resistance of a thermistor varies with its temperature and use the results of your experiment to find a value for the energy E which must be given to an electron to enable it to move from atom to atom.

(a) Construct the circuit shown in Fig. 1.1.

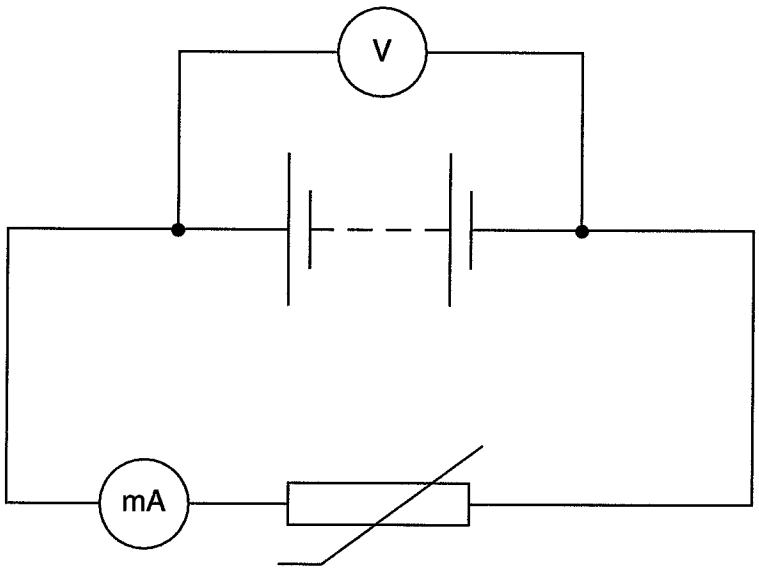

Fig. 1.1

(b) (i) Immerse the thermistor in a beaker of water. Measure and record the current I, potential difference V and temperature θ.

I = ... mA

V = ... V

θ = ... °C

(ii) Estimate the percentage uncertainty in this value of I.

% uncertainty in I = ...

(c) (i) Arrange the apparatus so that the water may be heated. Use the stand and clamp to ensure that the wires connected to the thermistor are kept well away from the source of heating.

(ii) Raise the temperature of the water by about 10 °C.

[Turn over

For Examiner's Use

(iii) Measure and record the new values of I, V and θ. Repeat **(ii)** until you have a total of **six** sets of readings for I, V and θ where $15\,°C \leq \theta \leq 85\,°C$. Include in your table of results values of the resistance R of the thermistor, and the thermodynamic temperature T, where $T = \theta + 273$. Also tabulate all the values of $\ln(R/\Omega)$ and T^{-1}.

(d) **(i)** Plot a graph of $\ln(R/\Omega)$ (y-axis) against T^{-1} (x-axis).

(ii) Determine the gradient of the line of best fit.

gradient = ...

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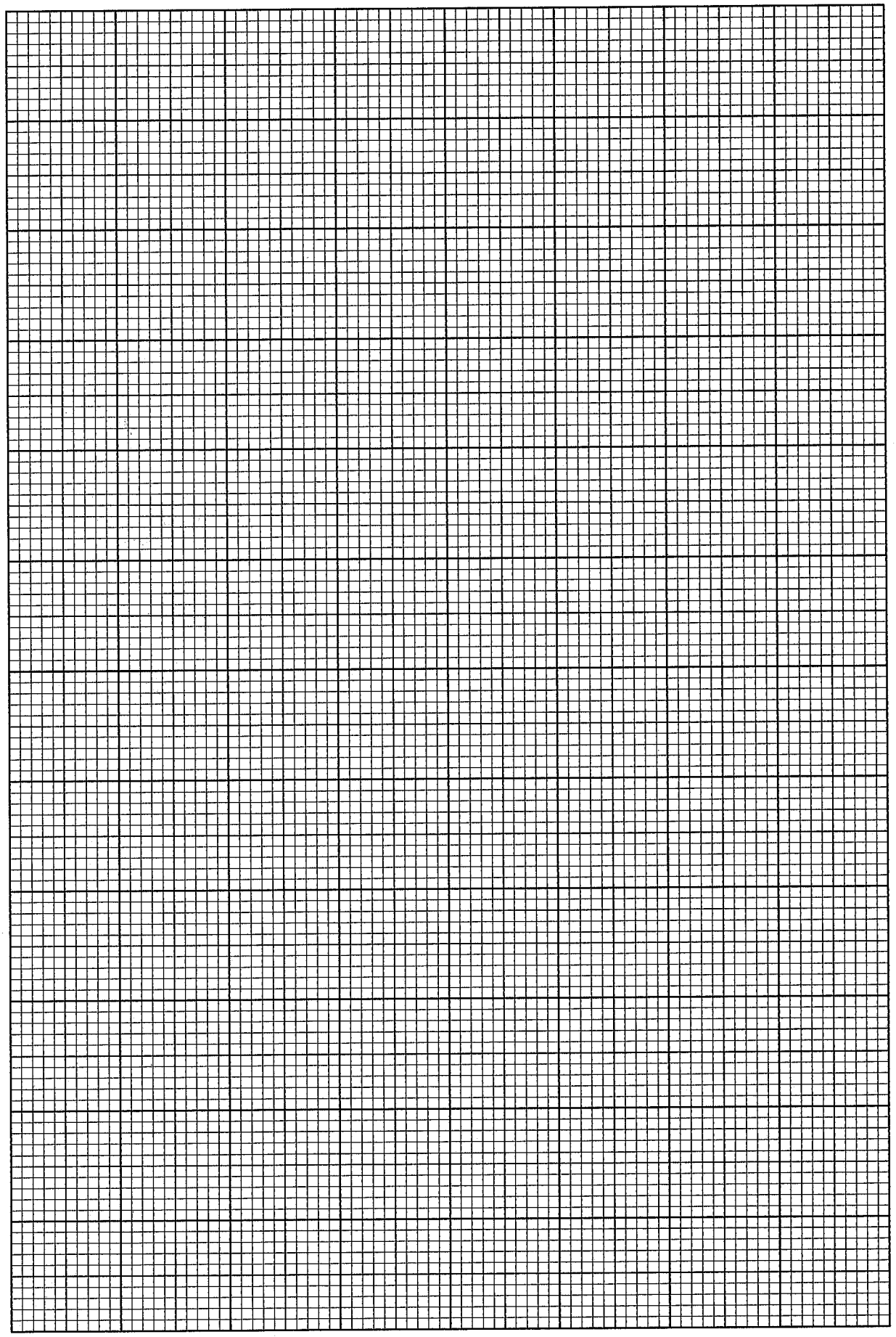

For Examiner's Use

(iii) State the precautions taken to ensure that the temperature had stabilised before the readings were taken.

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(e) The formula which relates R and T is

$$R = Ae^{\frac{E}{kT}}$$

where A is a constant, E is the energy required to move an electron from atom to atom and the constant k has the value 1.38×10^{-23} J K^{-1}.

Use your answer from **(d) (ii)** and the value of k to determine a value for E.

E = ... J

For Examiner's Use

It is recommended that you spend about 30 minutes on this question.

2 In this question you will investigate how the period of torsional oscillation in a horizontal plane depends on the radius of the disc. A thin copper wire passes through the middle of the disc. You should not disturb the wire from this position during the experiment.

The radius of the disc is 10.0 cm.

(a) Clamp the wire between two wooden blocks so that the disc is suspended in a horizontal plane 50.0 cm below the blocks as shown in Fig. 2.1.

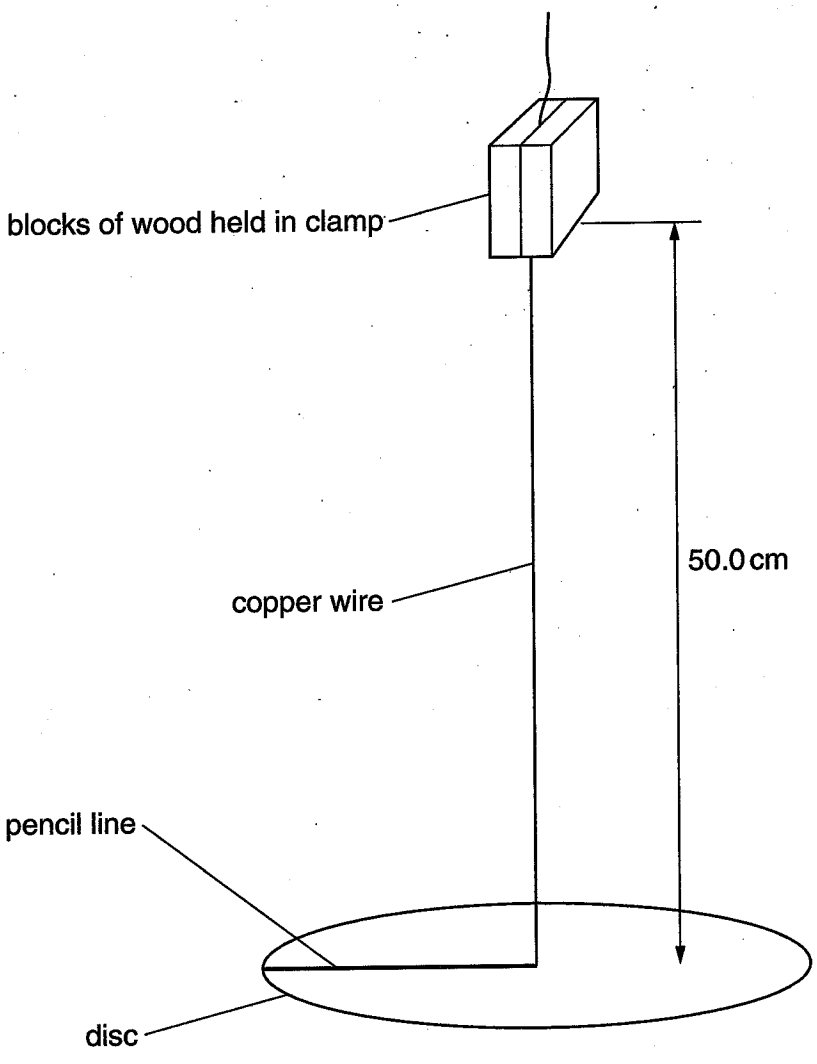

Fig. 2.1

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(b) (i) Gently rotate the disc as shown in Fig. 2.2 through an angle < 90° so that the wire is twisted. Release the disc so that it performs torsional oscillations in a horizontal plane.

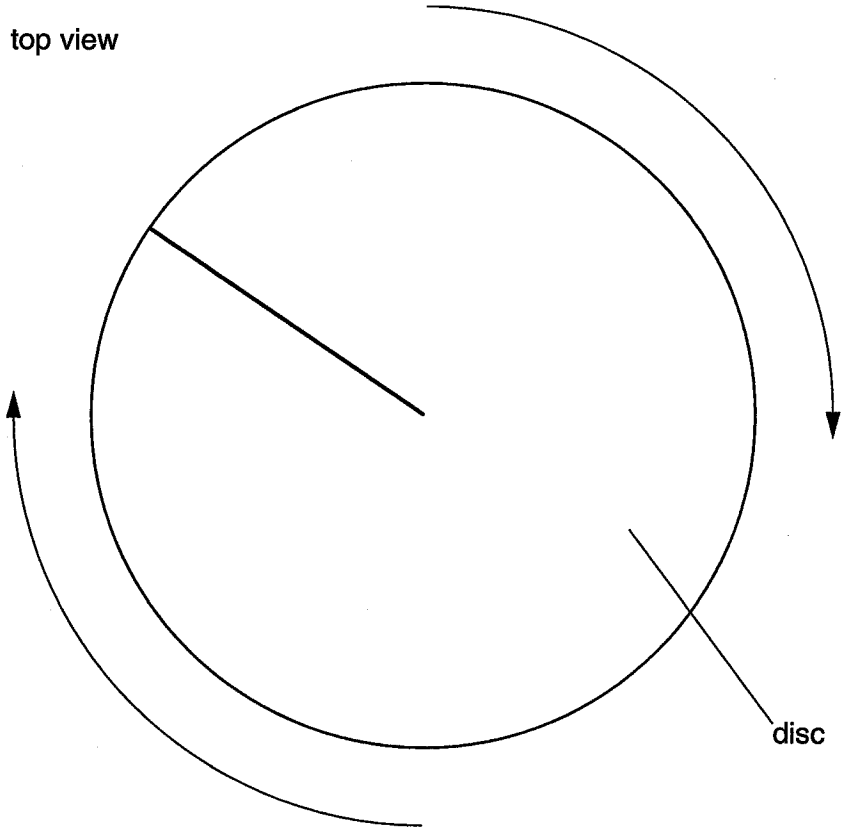

Fig. 2.2

(ii) Make and record measurements to determine the period T of these oscillations.

T = ... s

For Examiner's Use

(c) State **one** way in which you could improve the accuracy of this measurement, other than by repeating the measurement.

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(d) Justify the number of significant figures which you have given for T.

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(e) **(i)** Unclamp the wire from the blocks.

(ii) Cut out a disc of radius 5.0 cm using scissors. The circumference of this disc has been drawn on the card.

(iii) Reclamp the wire between the blocks as in part **(a)**.

(f) Repeat part **(b)** recording your results in the space below.

T = ... s

[Turn over

(g) Do the results of your experiment support the suggestion that T is directly proportional to r^2? Justify your answer.

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For Examiner's Use

In this question, two marks are available for the quality of written communication.

(h) Write an evaluation of the procedure which you have followed. You should include some of the limitations of the procedure and suggest ways in which the experiment may be improved, giving reasons for your suggestions.

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For Examiner's Use

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Quality of Written Communication