OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

PHYSICS A 2826/03/TEST

Practical Test (Part B)

Thursday **23 MAY 2002** 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** 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.

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

This question paper consists of 10 printed pages and 2 blank pages.

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It is recommended that you spend about 1 hour on this question.

1 It is important for electrical engineers to know how components in a circuit will behave under different conditions, for example, at high temperatures. In this experiment you will investigate how the current through a silicon diode is related to the potential difference across it when the diode is maintained at a constant temperature of about 80 °C.

(a) Set up the circuit shown in Fig. 1.1. Ensure that the positive terminal of the diode is connected to the positive terminal of the cell. Initially the switch S should be open.

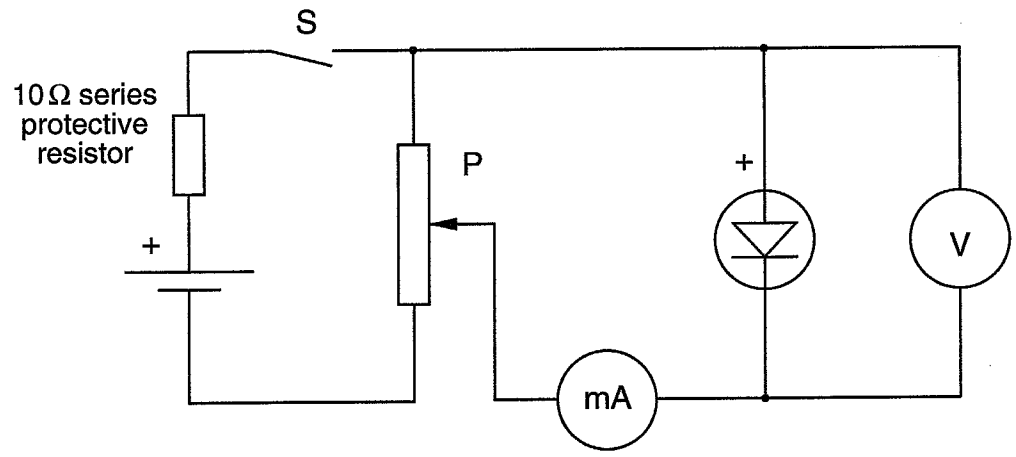

Fig. 1.1

(b) Immerse the diode in the water. Heat the water to about 80 °C, ensuring that all connecting wires are kept well away from the source of heating. Maintain this temperature (±2 °C) for the rest of the experiment.

(c) **(i)** Adjust the potential divider P to about the halfway position and close switch S.

(ii) Measure and record the potential difference V and the current I.

(iii) Change the setting of the potential divider and repeat **(ii)** until you have six sets of readings of V and I for values of I in the range 0 to 50 mA.

Include values of ln (I/mA) in your table of results.

(iv) Suggest one method of improving the way in which a constant temperature may be maintained during the time when readings are being taken.

(d) The current I in the diode is related to the potential difference V by the expression

$$I = I_0 e^{\left(\frac{KV}{T}\right)}$$

where I_0 and K are constants and T is the temperature measured in kelvin.

(i) Plot a graph of ln (I/mA) (y-axis) against V (x-axis) and draw the best fit line.

(ii) Determine the gradient and y-intercept of the line.

(iii) Use your answers from **(ii)** to find values for K and I_0.

Include appropriate units with your values.

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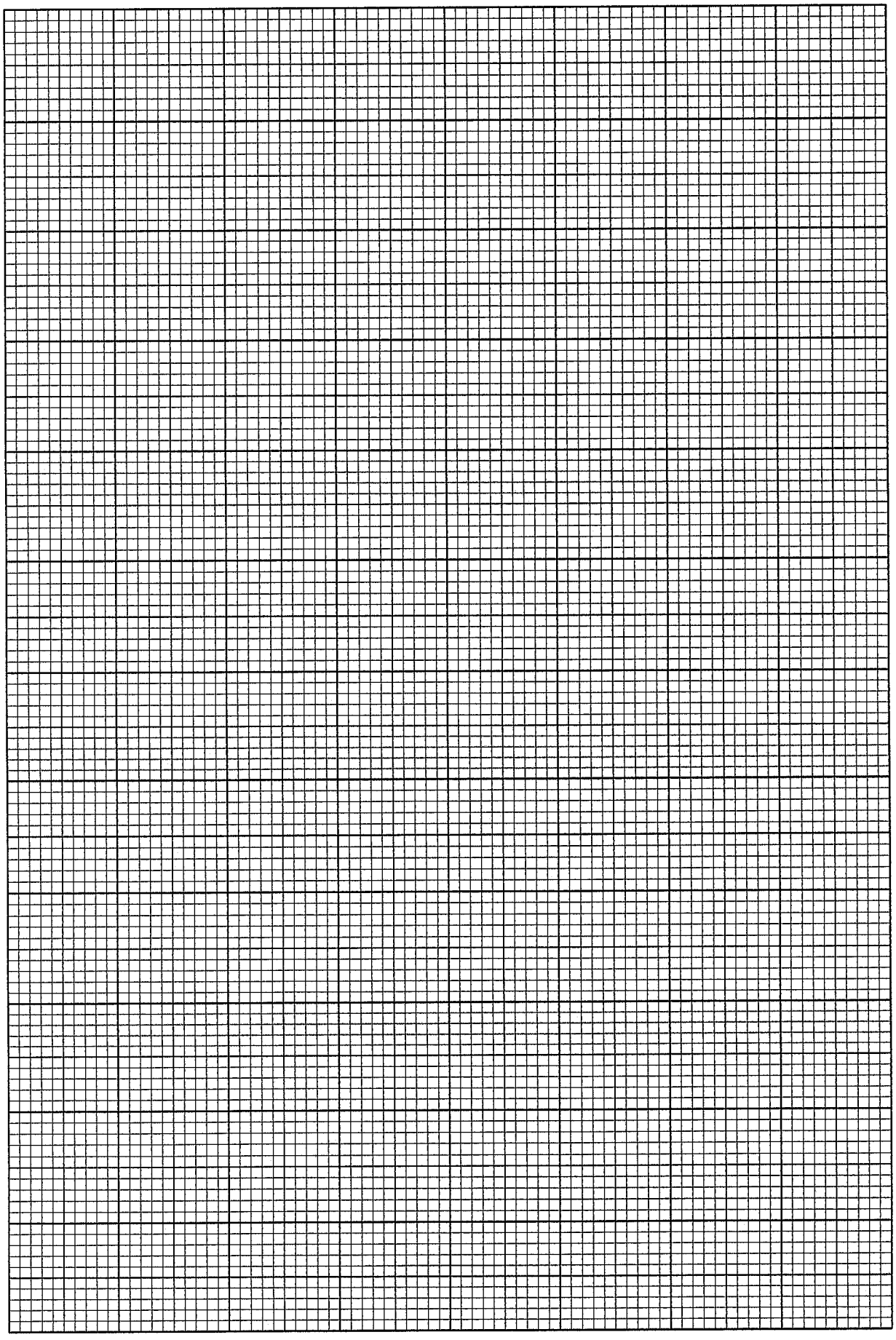
Measurements and calculations



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

Approximately half of this time should be spent on the evaluation exercise in part (f).

2 In this experiment you will investigate how the average rate of change of potential energy of a falling mass depends on air resistance. The apparatus is shown in Fig. 2.1.

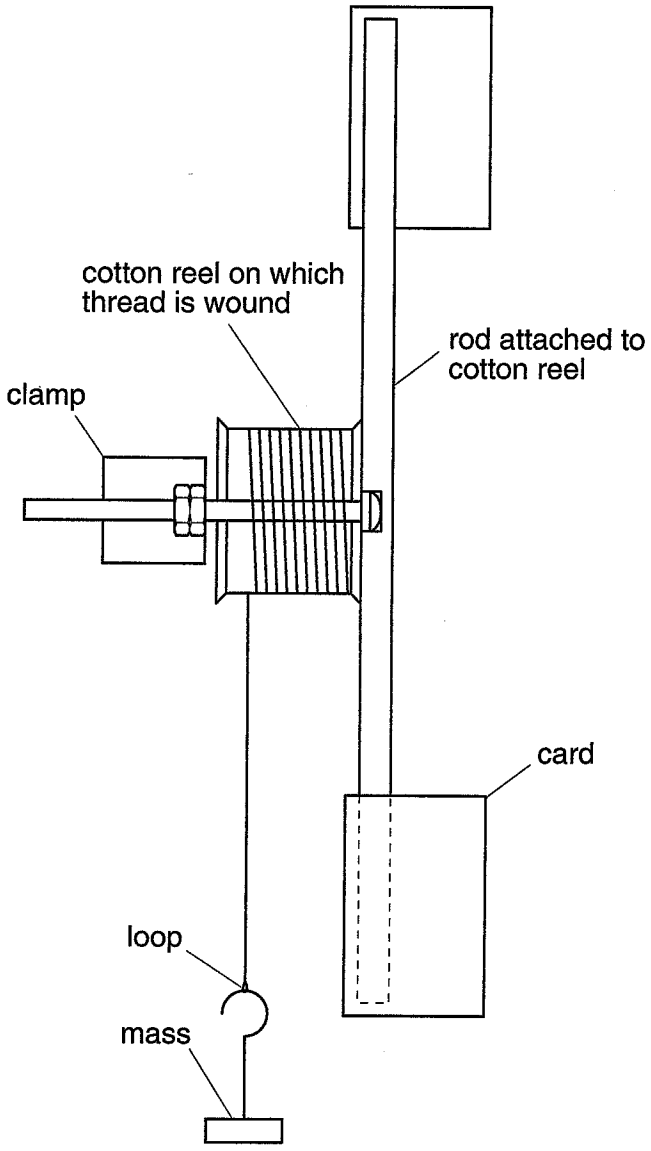


Fig. 2.1

(a) (i) Determine the area A of one of the cards. The cards are attached to the rod by double-sided sticky tape. You may detach them if you wish.

A = ... cm^2

(ii) Attach the mass to the loop and turn the rod to raise the mass.

(iii) Release the mass gently and observe that the rod rotates as the mass falls. Make sure that the cards do not hit the thread.

(b) (i) Position two markers A and B below the mass as shown in Fig. 2.2.

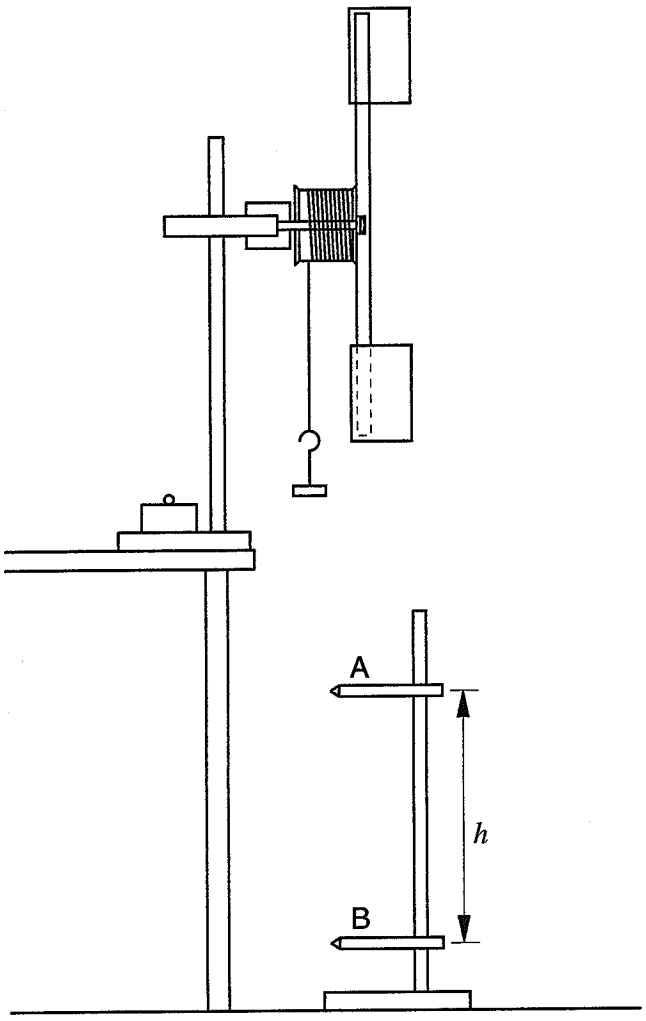


Fig. 2.2

(ii) Measure the distance *h* between the two markers.

h ..... m

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(c) **(i)** Position the mass some distance above marker A. Release the mass and measure the time t taken for it to fall between the two markers.

t = ... s

(ii) Repeat **(c)** **(i)** once.

Hence estimate the percentage uncertainty in the time t.

(iii) Calculate the average rate of change of potential energy of the falling mass as it moves between A and B. The mass of the mass holder is 0.050 kg. The acceleration of free fall $g = 9.8\,\text{m s}^{-2}$.
(Note: $\Delta E_p = mgh$)

(d) **(i)** Remove the cards from the rod. Attach the smaller pair of cards which are each of area $A/2$.

(ii) Repeat **(c)** **(i)** and **(c)** **(iii)**.

(e) For the mass falling at terminal velocity in this experiment it is suggested that the average rate of change of potential energy is inversely proportional to the card area. Do the results of your experiment support this suggestion? Justify your answer.

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(f) Evaluation exercise.

(In this part question two marks are awarded for quality of written communication).

Write an evaluation of the procedure which you have followed to investigate how the average rate of change of potential energy of the falling mass is related to card area. You should include some of the limitations of your procedure and suggest ways in which the experiment may be improved, giving reasons for your suggestions.

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