UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3258365976

PHYSICS **5054/31**

Paper 3 Practical Test **May/June 2011**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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 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.
For each of the questions in Section A, you will be allowed to work with the apparatus for a maximum of 20 minutes. For the question in Section B, you will be allowed to work with the apparatus for a maximum of 1 hour.

You are expected to record all your observations as soon as these observations are made.
You may lose marks if you do not show your working or if you do not use appropriate units.
An account of the method of carrying out the experiments is **not** required.

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.

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1	
2	
3	
4	
Total	

This document consists of **10** printed pages and **2** blank pages.

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Section A

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Answer **all** questions in this section.

1 *In this experiment, you will determine the mass of a metre rule using the principle of moments.*

You have been provided with

- a metre rule with a hole at the 1.0 cm mark,
- a knife-edge to act as a pivot in **(a)**,
- a rod held in a boss to act as a pivot in **(b)**,
- a pulley wheel held in a clamp and stand,
- a length of string with two loops,
- a mass and hook, labelled S,
- a card showing *m*, the mass of S,
- a half-metre rule,
- a set square.

(a) Balance the metre rule on the knife-edge and record the distance *d* of the centre of mass of the metre rule from the 0.0 cm mark on the rule.

d = ... [1]

(b) Set up the apparatus shown in Fig. 1.1.

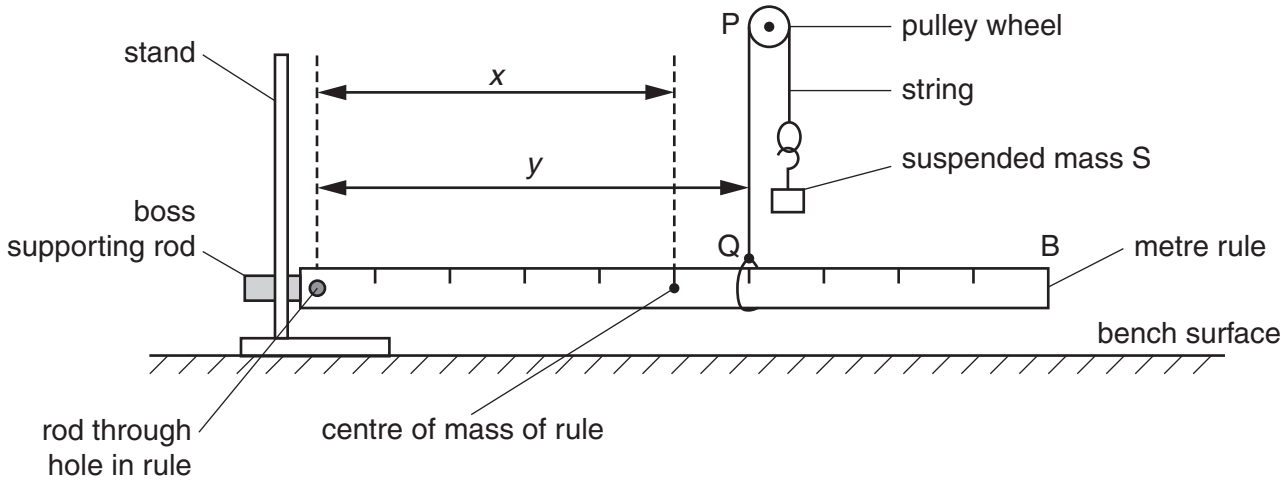


Fig. 1.1

Pass the rod through the hole at the 1.0 cm mark on the rule. Place the loop at one end of the string over the rule at the 60.0 cm mark on the rule. Place the string over the pulley and suspend the mass S from the loop at the other end of the string using the hook. Initially, end B of the metre rule rests on the bench.

Move the loop along the metre rule towards end B. Keep the length PQ of the string vertical by moving the pulley horizontally. Eventually end B of the metre rule rises off the bench.

Adjust the positions of the loop and the pulley to make the rule horizontal and the string PQ vertical.

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(c) Explain how you made sure that the string PQ is vertical. You may add to Fig. 1.1 if you wish.

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.....

.....

.....

.....[1]

(d) Measure and record

(i) the distance x from the centre of the rod to the centre of mass of the metre rule,

x = ...

(ii) the distance y from the centre of the rod to the position of the string on the metre rule.

y = ...
[2]

(e) Calculate the mass M of the rule using the relationship

$$M = \frac{m\,y}{x}$$

where m is the mass of S, and is written on the card.

M = ... [1]

[Total: 5]

2 *In this experiment, you will determine the time for one oscillation of a simple pendulum.*

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You have been provided with

- a simple pendulum,
- a metre rule,
- a stopwatch,
- a pin in a cork.

(a) The apparatus shown in Fig. 2.1 has been set up for you.

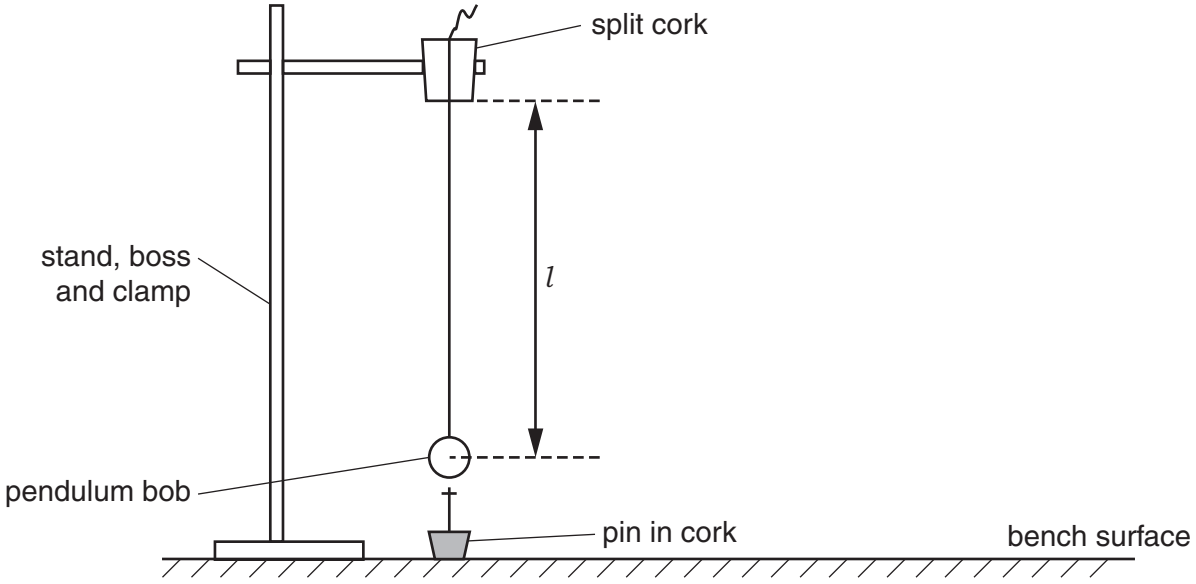


Fig. 2.1

Measure the length l of the simple pendulum from the base of the split cork to the centre of the pendulum bob.

l = ... [1]

(b) Place the pin so that it marks the central position of the pendulum bob when it is stationary, as shown in Fig. 2.1. When the pendulum bob is pulled to the side and released, it moves from side to side. One complete oscillation of the pendulum bob is from O to A to B and back to O, as shown in Fig. 2.2.

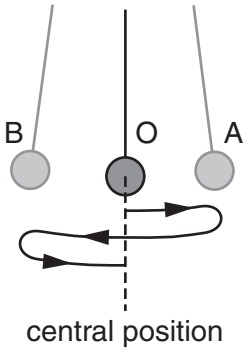


Fig. 2.2

(i) The time for 20 complete oscillations of the bob is t. Take measurements to determine an accurate value of t.

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t = ...

(ii) Calculate the time T for one oscillation.

T = ...
[2]

(c) Calculate a value for the acceleration of free fall g, using the relationship

$$g = \frac{4\pi^2 l}{T^2}.$$

Give a unit for your answer.

g = ... [2]

[Total: 5]

3 *In this experiment, you will measure the critical angle for light in a transparent block.*

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You have been provided with

- a semi-circular transparent block,
- an illuminated slit,
- a protractor.

(a) (i) On Fig. 3.2 on page 7 of your question paper, draw a normal to the line XY at the point M, towards the bottom of the page. The length of the normal should be greater than the radius of the semi-circular block.

(ii) To the left of the normal draw a line at an angle of incidence of 60° to the normal. Label this line L. This line should also be longer than the radius of the block.

[1]

(b) Place the semi-circular block on Fig. 3.2 of your question paper with the straight edge along line XY and with the centre of the straight edge at M. This is shown in Fig. 3.1. Arrange the light source and slit so that a ray of light passes along the line L.

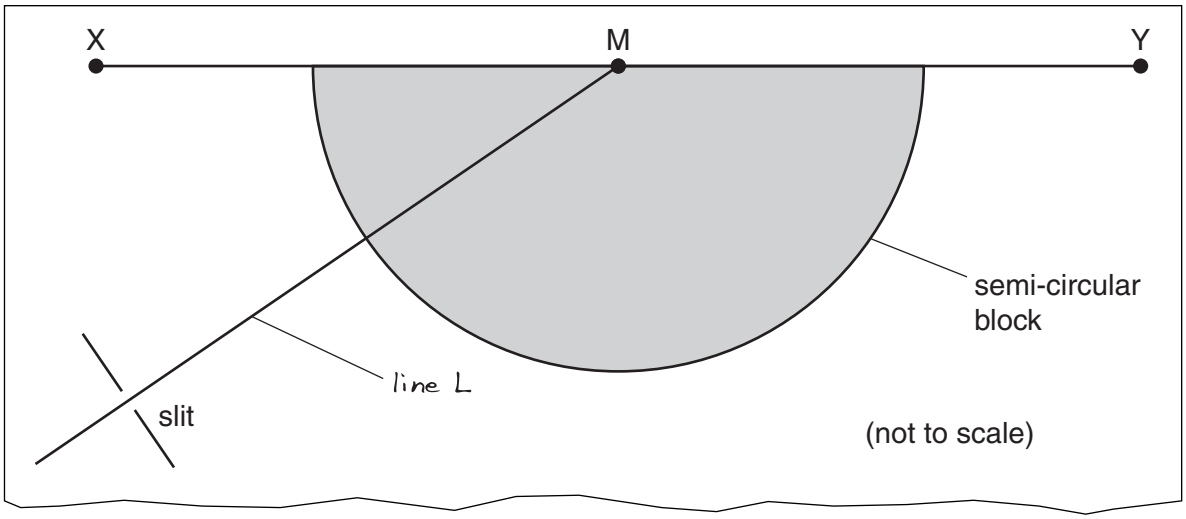


Fig. 3.1 (not to scale)

Draw around the semi-circular edge of the block.

(i) Mark and label two points, P_1 and P_2, on the ray that leaves the block.

(ii) Remove the block. Draw a line connecting P_1 and P_2 and extend this line to meet XY.

(iii) Measure the angle of reflection.

angle =.....

[2]



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Fig. 3.2

(c) Replace the block in its marked position on Fig. 3.2, with the light ray passing along the line L. Change the angle of incidence until light leaves the block at M as close as possible to the direction MY.

(i) Mark and label two points P_3 and P_4 on **the incident ray**.

(ii) Remove the block. Draw a line connecting points P_3 and P_4 and extend this line to meet XY.

(iii) The new angle of incidence of the ray of light is approximately equal to the critical angle for light in the transparent block. Measure this angle of incidence.

angle = ...
[2]

[Total: 5]

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Section B

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4 *In this experiment, you will investigate the power transferred by a light-emitting diode (LED).*

You have been provided with an incomplete circuit consisting of

- a power supply,
- an ammeter,
- a voltmeter,
- an LED,
- a resistor labelled 'X',
- a switch.

You have also been provided with three resistors labelled with the values of their resistances and some additional connecting leads.

(a) (i) Connect the 68 Ω resistor between points A and B.

(ii) In the space below, draw a circuit diagram of the completed circuit.

[2]

(b) Close the switch and record the potential difference V across the LED and the current I in the circuit. Open the switch.

V = ...

I = ...

[2]

(c) Calculate the power P transferred by the LED using the relationship

$$P = I\,V.$$

P = ... [1]

(d) Replace the 68 Ω resistor first with the 180 Ω resistor and then with the 330 Ω resistor. Then use all possible **series** combinations of the 68 Ω, 180 Ω and 330 Ω resistors. In each case repeat **(b)** and **(c)**.

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Record your results in a table in the space below. Include the results from **(b)** and **(c)** in the table. Include a column for the values of the resistors used in the gap between A and B.

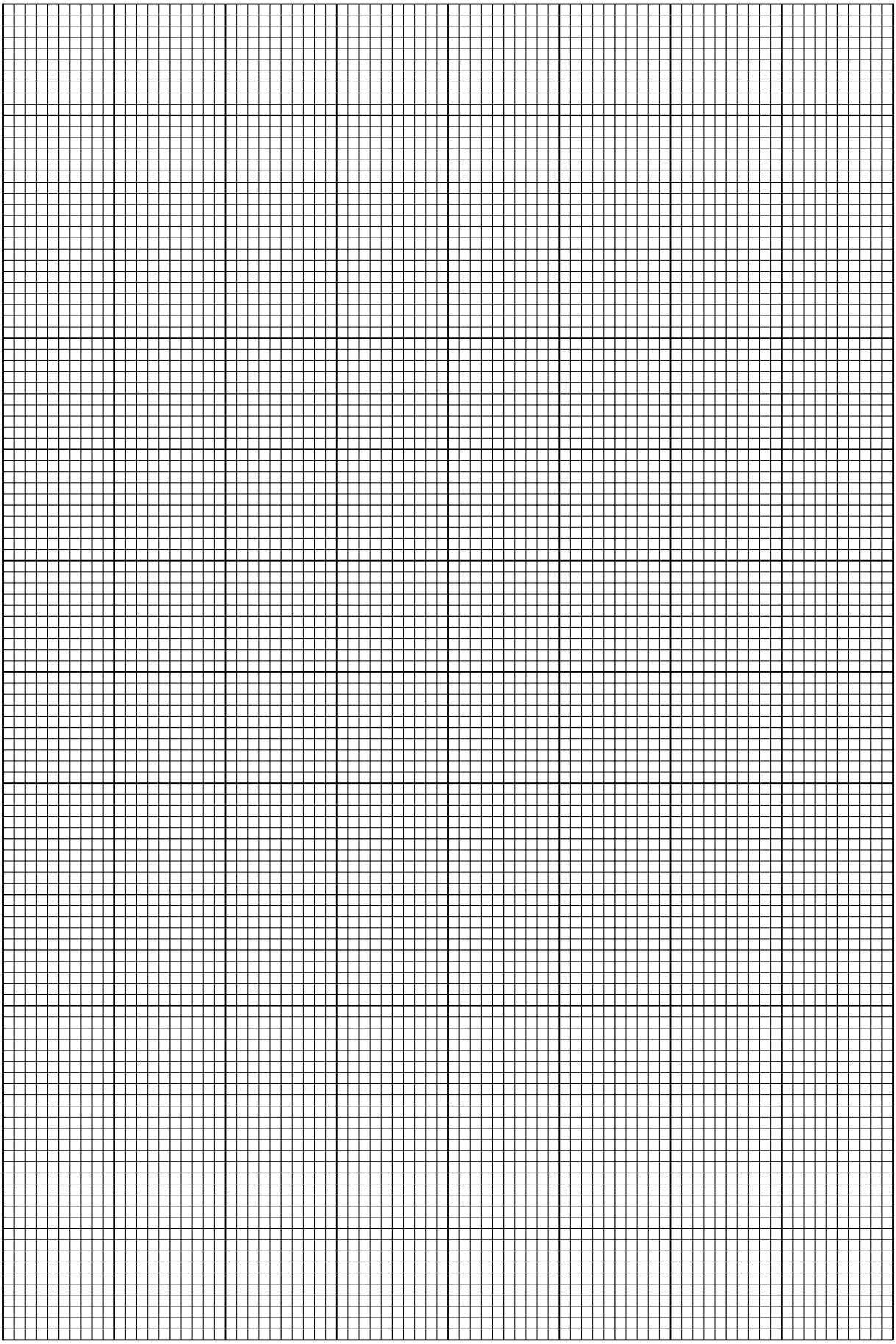
[5]

(e) Using the grid opposite, plot a graph of P/mW against I/mA. Draw the line of best fit. [4]

(f) Determine the power transferred by the LED when the current in it is 10 mA.

power = ... [1]

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[Total: 15]

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