Name	Class	Index Number

JURONG PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination

PHYSICS **9749/04**
Higher 2

Paper 4 Practical

15 August 2024

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Give details of the practical shift and laboratory, where appropriate, in the boxes provided.

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.

Shift
Laboratory

For Examiner's Use	
1	/ 14
2	/ 8
3	/ 22
4	/ 11
Total	/ 55

This document consists of **16** printed pages and **4** blank pages.

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1 In this experiment, you will determine the resistivity of a metal.

(a) Set up the circuit as shown in Fig. 1.1, using the resistor of resistance $R = 68\ \Omega$.

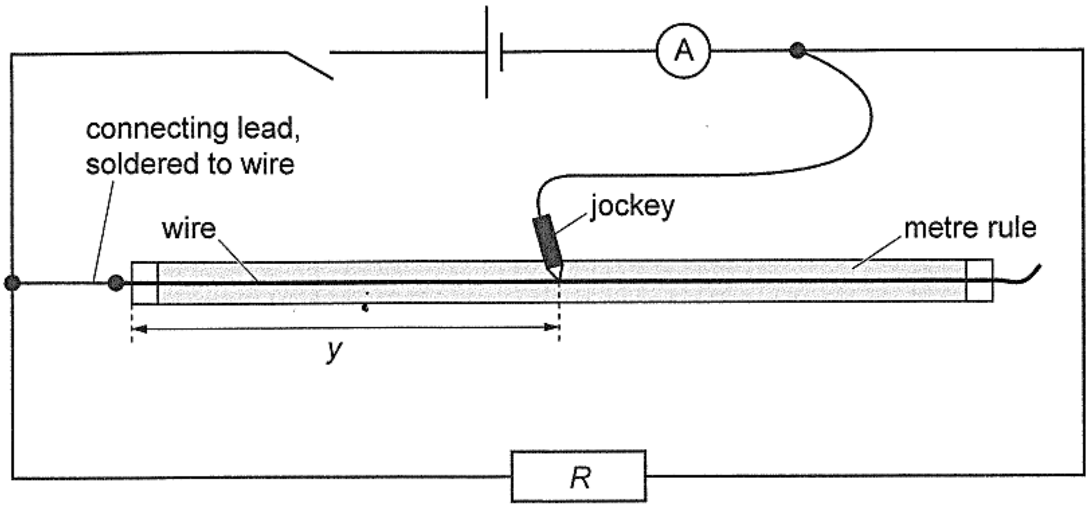

Fig. 1.1

Place the jockey on the wire about half-way along the metre rule. The distance between the end of the wire and the jockey is y, as shown in Fig. 1.1.

Close the switch.

Adjust the position of the jockey until the ammeter reading I is as close as possible to 121 mA.

Record R, I and y.

R = ...

I = ...

y = ...
[1]

Open the switch.

(b) Vary R and adjust y each time so that I is always as close as possible to 121 mA.

Present your results clearly.

[3]

(c) It is suggested that R and y are related by the expression:

$$\frac{R}{y}=\frac{QIR}{F}-Q$$

where I is your value from **(a)** and Q and F are constants.

Plot a suitable graph to determine values of Q and F.

Q = ...

F = ...
[8]

(d) Theory suggests that

$$Q = \frac{4\rho}{\pi d^2}$$

where d is the diameter of the wire and ρ is the resistivity of the metal.

Determine a value for ρ.

ρ = ... Ω m [2]

[Total: 14]

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2 In this experiment, you will investigate an oscillating system.

Two bobs A and B are supported by strings. The string supporting A has a mark at its midpoint.

Set up the apparatus as shown in Fig. 2.1

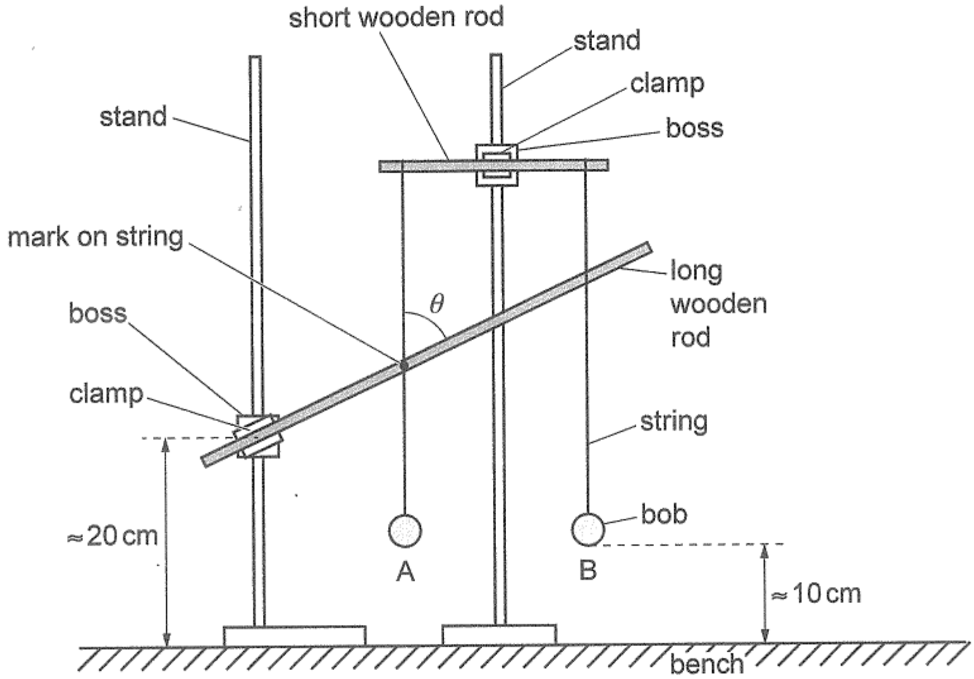

Fig. 2.1

(a) (i) The long wooden rod should pass between the stand and the strings.

The angle between the long wooden rod and the string supporting A is θ.

Adjust the position of the long wooden rod so that θ is approximately 60° and the rod is **behind** the mark on the string supporting A. The rod should be just touching both strings, with the strings hanging vertically.

Measure and record θ.

θ = ...° [1]

(ii) Pull A and B a short distance away from the long wooden rod. Keep the same separation between A and B.

Release A and B at the same time.

B first oscillates in phase with A, then out of phase, and then back in phase again. This takes n oscillations of B.

Determine n.

n = ... [2]

(b) It is suggested that:

$$n = k \tan\theta$$

where k is a constant.

Calculate k.

k = ... [2]

(c) Determine n and k for two more values of θ.

Tabulate your results.

[2]

(d) Explain why you would **not** select a value of $\theta = 90°$ in **(c)**.

....

....

....

....[1]

[Total: 8]

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3 A cantilever beam is a beam that is supported at one end only.

In this experiment, you will investigate how the following properties affect the behaviour of a cantilever beam:

- the length of the beam
- the load on the beam
- the cross-section of the beam
- the stiffness of materials from which the beam is made.

(a) Set up the metre rule on a flat surface such as a benchtop or a stool, as shown in Fig. 3.1.

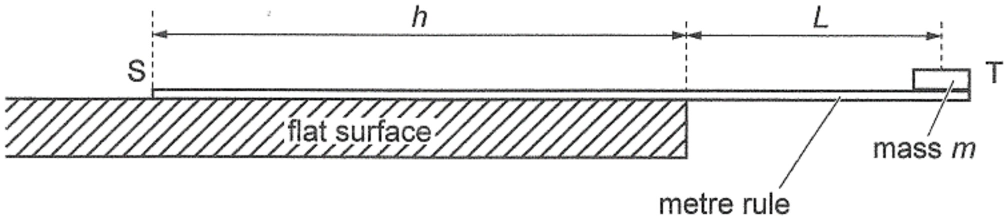


Fig. 3.1

The ends of the rule are S and T.

Use Blu-Tack to firmly attach a mass m, where m = 100 g, at T.

The distance between S and the edge of the surface is h.

The distance between the centre of mass m and the edge of the surface is L.

(i) Adjust the position of the rule so that S **just** lifts off the surface.

Measure and record h and L.

h = ...

L = ...
[1]

(ii) Calculate $\frac{h}{L}$.

$\frac{h}{L}$ = ...[1]

(iii) Estimate the percentage uncertainty in your value of $\frac{h}{L}$.

percentage uncertainty in $\frac{h}{L}$ = ...[2]

(b) Vary *m* and repeat **(a)(i)** and **(a)(ii).**

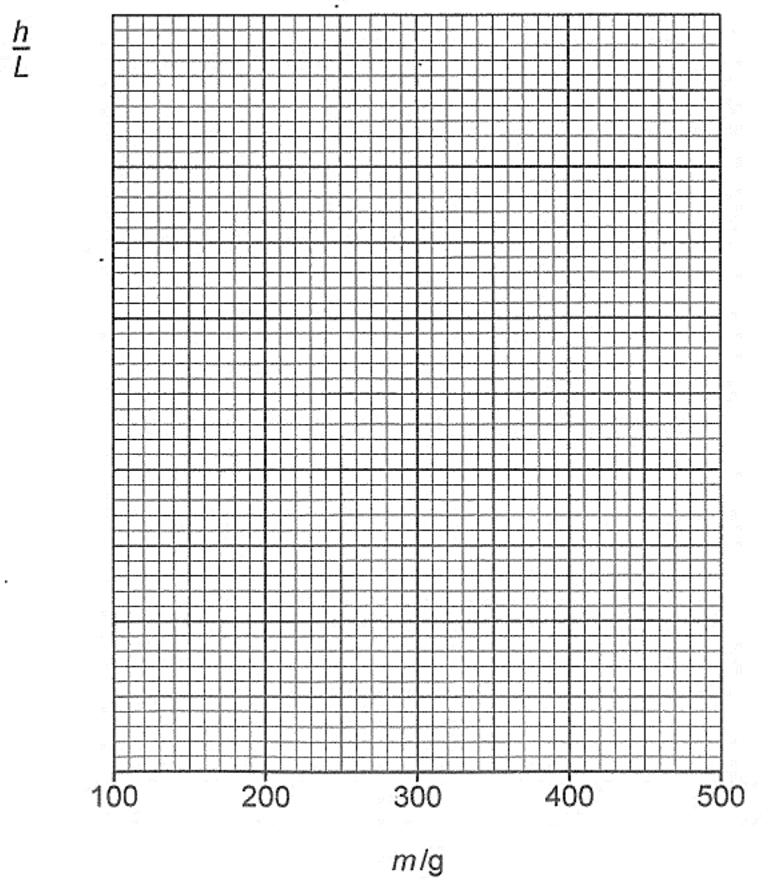
[2]

(c) It is suggested that h, L and m are related by the expression:

$$\frac{h}{L} = \frac{2m}{X} + 1$$

where X is the mass of the metre rule.

(i) Plot your results on the grid and draw the line of best fit.



[1]

(ii) Use your graph to determine a value for X.

X = ... g [1]

(d) Use a balance to determine the mass *X* of your metre rule.

X = ... g

Show whether your value in **(a)(iii)** explains the difference between your two values of *X*.

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....[1]

(e) You will now use a metal hacksaw blade as a cantilever beam.

When one end of the blade is fixed and the other end is loaded, the loaded end will move downwards, as shown in Fig. 3.2.

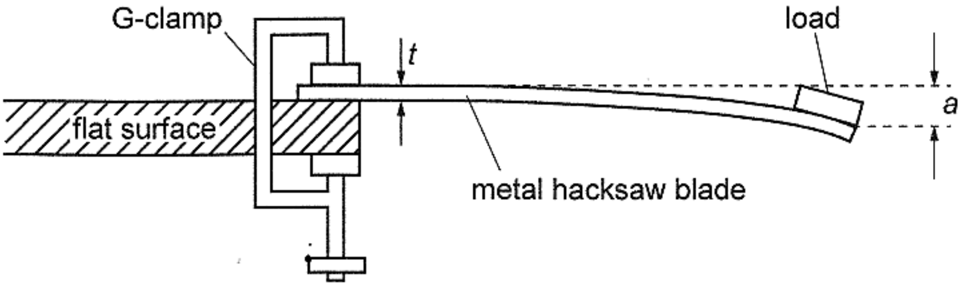

Fig. 3.2

The distance moved down is a, given by:

$$a = \frac{4MgL^3}{Yut^3}$$

where:

- M is the mass of the load
- L is the distance between the centre of the load and the edge of the surface
- u is the width of the blade
- t is the thickness of the blade
- Y is the stiffness of the metal
- g = 9.81 N kg^{-1}.

(i) Wearing safety goggles, set up the apparatus as shown in Fig. 3.2.

Use Blu-Tack to firmly attach a 100 g mass to the metal hacksaw blade.

Take measurements to determine a value for Y.

Y = ... GPa [4]

(ii) Suggest **one** significant source of uncertainty in this experiment.

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....

.... [1]

(iii) The value of *Y* for wood is 12 GPa.

Explain why it is **not** possible to perform this experiment using a wooden beam with the same dimensions as the metal hacksaw blade.

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....

....

.... [1]

(f) A diving board at a swimming pool has length *L*. A person of mass *M* jumps up and down on the end of the diving board.

The frequency of oscillation of the end of the diving board is *f*, given by:

$$f^2 = \frac{Z}{ML^3}$$

where *Z* is a constant.

The metal hacksaw blade can be used as a model diving board.

Plan an investigation to find *Z* for the blade.

Your answer should include a diagram, your experimental procedure and a precaution to improve the safety of the experiment.

Wearing safety goggles, use your apparatus to determine **two** values of *Z* for different values of *M* and *L*. Tabulate your results.

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[7]

[Total: 22]

4 A light dependent resistor (LDR) is a resistor whose resistance *R* varies with changing incident light intensity *I*. Light dependent resistor can also be referred to as photoconductor. The LDR has a resistance of 100 Ω when it is in bright light and a resistance of 1000 Ω when no light falls on it.

Some of the practical applications of the LDR are the burglar alarm system and the automatic switch for the street lamp.

It is suggested that the resistance *R* of the LDR is related to the intensity of the incident light *I* and the distance *d* from the light source by the relationship

$$R = k\, d^{\,p} I^{\,q}$$

where *k*, *p* and *q* are constants.

You are provided with a light dependent resistor, 12 V battery, voltmeter, ammeter, intensity meter and lamp with variable power supply.

Design an experiment to determine the values of *p* and *q*.

Draw a diagram to show the arrangement of your apparatus and you should pay particular attention to

(a) the equipment you would use,
(b) the procedure to be followed,
(c) the control of variables,
(d) any precautions that should be taken to improve the accuracy and safety of the experiment.

Diagram

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.... [11]

[Total: 11]

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