Name	Class	Index Number

JURONG PIONEER JUNIOR COLLEGE

JC2 Preliminary Examination 2021

PHYSICS **9749/04**
Higher 2 **19 August 2021**

Paper 4 Practical **2 hours 30 minutes**

Candidates answer on the Question Paper.

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.

You will be allowed a maximum of one hour to work with the apparatus for Questions 1 and 2, and a maximum of one hour for Question 3. You are advised to spend approximately 30 minutes on Question 4.

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	/ 16
2	/ 6
3	/ 21
4	/ 12
Total	/ 55

This document consists of **17** printed pages.

1 In this experiment, you will investigate the current in an electrical circuit.

(a) (i) You have been provided with two metre rules A and B, each with a resistance wire attached.

Take measurements to determine the resistance per unit length of each of the wires.

The resistance per unit length of the wire attached to rule A is R_A.

The resistance per unit length of the wire attached to rule B is R_B.

R_A = ...

R_B = ...
[2]

(ii) Measure and record the diameter d of the wire attached to rule A.

d = ... [1]

(iii) Determine the resistivity ρ of the wire attached to rule A.

ρ = ... [1]

(b) Set up the circuit as shown in Fig. 1.1.

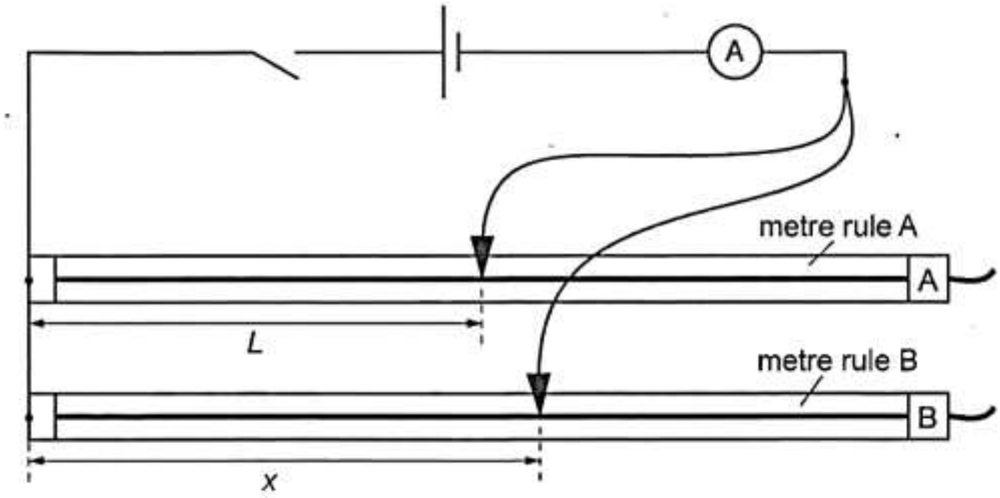

Fig 1.1

L should be approximately half the length of the rule and *x* should be **greater** than *L.*

Close the switch.

Measure and record *L, x* and the ammeter reading *I.*

L = ...

x = ...

I = ...
[2]

(c) Vary *x* and repeat **(b)**, keeping *L* constant throughout.

[3]

(d) It is suggested that I and x are related by the expression

$$I = \frac{E}{R_A L} + \frac{E}{R_B x}$$

where E is the electromotive force (e.m.f.) of the cell.

Plot a suitable graph to determine a value for E.

E = ... V [6]

(e) Without taking further readings, sketch a line on your graph grid to show the results you would expect if the experiment was repeated with x measured on metre rule A and the same L in **1(b)** measured on metre rule B.

Label this line W. [1]

[Total: 16]

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

(a) Place the wooden strip on the pivot, as shown in Fig. 2.1.

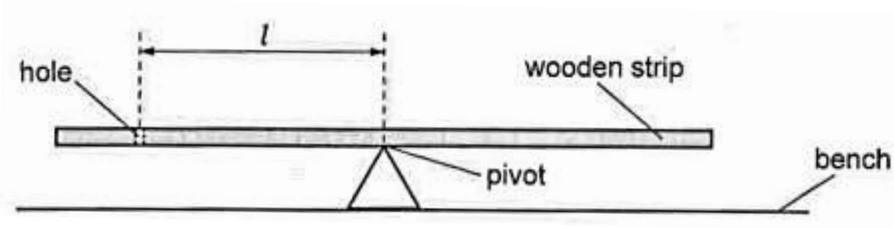

Fig. 2.1

Adjust the position of the wooden strip on the pivot until it balances. The distance between the centre of the hole in the wooden strip and the pivot is l.

Without marking the wooden strip, measure and record l.

l = ... [1]

(b) Set up the apparatus as shown in Fig. 2.2.

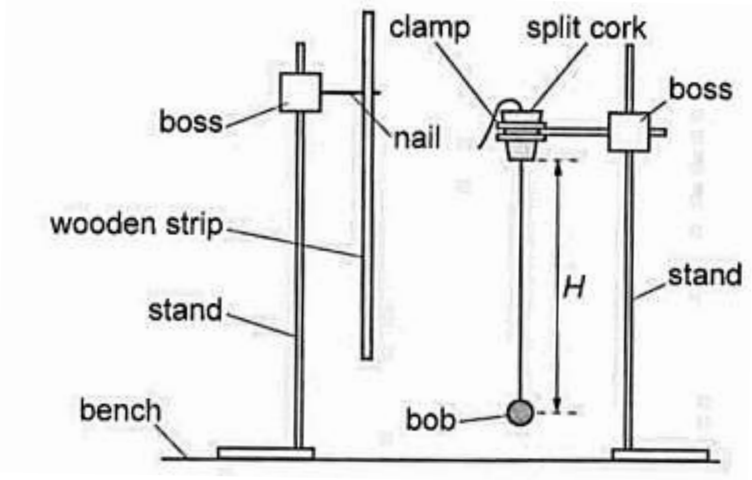

Fig. 2.2

The distance between the bottom of the split cork and the centre of the bob is *H*.

Adjust the string in the split cork until *H* is approximately 40 cm.

Displace the bob and the bottom of the wooden strip towards you through a short distance.

Release the bob and the strip at the same time. The oscillations of the bob and the strip will be out of phase.

Adjust *H* so that the oscillations of the bob and the strip remain in phase for several cycles after release.

Measure and record H.

H = ... [1]

(c) The quantities l and H are related by the equation

$$b = \sqrt{l(H - l)}$$

where b is a constant.

(i) Calculate b.

b = ... m [2]

(ii) If you were to repeat this experiment using a similar wooden strip with several holes at different positions along its length, describe the graph that you would plot to determine b.

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[Total: 6]

3 In this experiment, you will investigate the behaviour of an oscillating system.

You have been provided with two lengths of copper wire, two spheres of modelling clay and a rubber band.

(a) (i) Bend the **longer** wire at its mide-point so that the two arms of the wire form an angle θ, as shown in Fig. 3.1. Adjust the arms so that θ is approximately 40º.

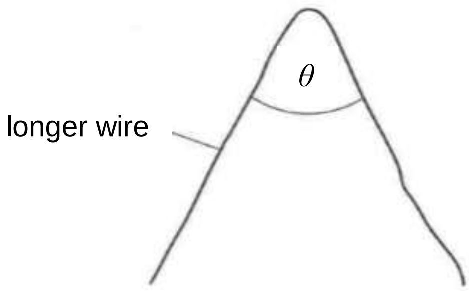

Fig. 3.1

(ii) Measure and record θ.

θ = ... º [1]

(iii) Estimate the percentage uncertainty in your value of θ.

percentage uncertainty in θ = ... [1]

(iv) Calculate sin(θ/2).

sin(θ/2) = ... [1]

(b) (i) Place the modelling clay spheres on the ends of the wire and set up the apparatus as shown in Fig. 3.2.

The distance *C* is the distance between the top of the wire and the bottom of the sphere on each side of the bent wire.

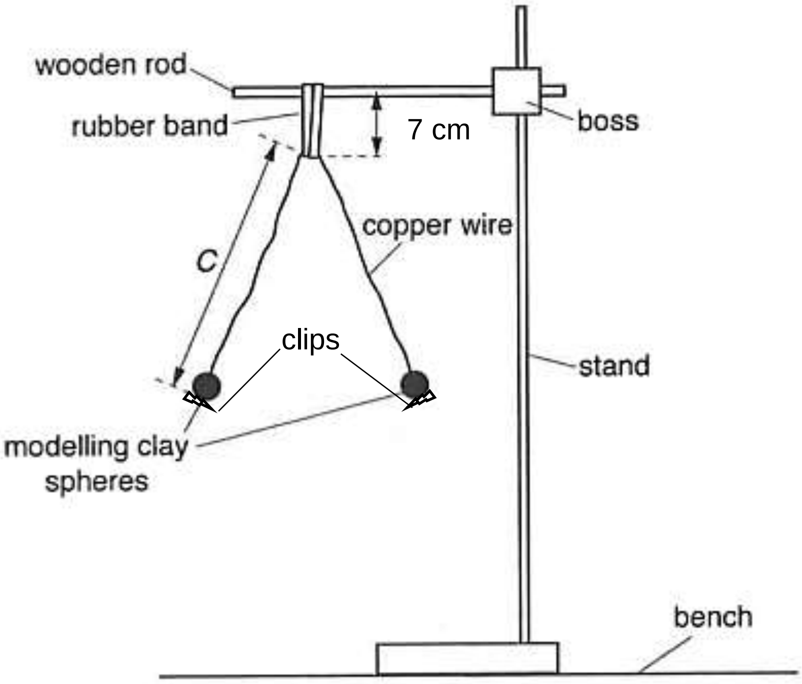

Fig. 3.2

Loop the rubber band **twice** over the wooden rod. The distance between the rod and the bottom of the band should be approximately 7 cm.

(ii) Determine *C* and estimate the percentage uncertainty in your value of *C*.

C = ...

percentage uncertainty in *C* = ...
[3]

(iii) Move one of the spheres so that the wire turns through approximately 90° about a vertical axis. Release the sphere.

The wire will oscillate about a vertical axis.

Determine the period T of these oscillations.

T = ... s [1]

(c) Increase θ and repeat **(a)(ii)**, **(a)(iv)** and **(b)(iii)**.

θ = ... °

$\sin(\theta/2)$ = ...

T = ... s
[2]

(d) It is suggested that

$$T = kC\sin(\theta / 2)\sqrt{m}$$

where *k* is a constant and *m* is the mass of each sphere, with a value of 50.0 g.

(i) Use your values from **(a)(iv)**, **(b)(ii)**, **(b)(iii)** and **(c)** to determine two values of *k*.

Give your values of *k* to an appropriate number of significant figures.

first value for *k* = ...

second value for *k* = ...
[1]

(ii) State whether the results of your experiment support the suggested relationship in **(d)**.

Justify your conclusion by referring to your values in **(a)(iii)** and **(b)(ii)**.

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.... [1]

(e) (i) You will now determine two more values of k using:

- the **shorter** wire with the spheres on the ends of the wire, as shown in Fig. 3.3
- the **longer** wire with the spheres placed along the wires, as shown in Fig. 3.4.

The value of C and θ must be the **same** in both cases and θ must be approximately 40^o as in **(a)(i)**.

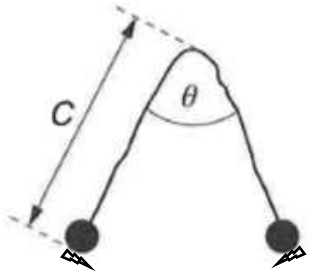

Fig. 3.3

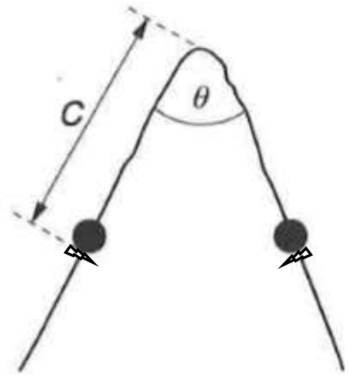

Fig. 3.4

Tabulate your results.

[3]

(ii) Comment on your values of k in **(d)(i)** and **(e)(i)**.

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.... [2]

(f) The behaviour of the oscillating system depends on the properties of the rubber band.

It is suggested that the period T is inversely proportional to the number n of loops in the rubber band.

(i) Explain how you would investigate this relationship using the same apparatus.

Your account should include:

- your experimental procedure
- control of variables
- how you would use your results to show inverse proportionality
- why you might not have enough results to reach a valid conclusion.

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.... [4]

(ii) Suggest a change to the shape of the rubber band that will improve your procedure in **(f)(i)**.

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.... [1]

[Total: 21]

4 A student is investigating the transmittance of light by glass.

Transmittance τ of glass may be expressed as

$$\tau = \frac{\text{intensity of transmitted light}}{\text{intensity of incident light}}$$

It is suggested that the transmittance of light is related to the wavelength λ of light and thickness t of glass by the relationship

$$\tau = k\ \lambda^n\ t^m$$

where k, n and m are constants.

Design an experiment to determine the values of n and m.

You have been given a few identical rectangular glass blocks and a few laser sources with unknown wavelengths.

Draw a diagram to show the arrangement of your apparatus. You should pay particular attention to

(a) the equipment you would use

(b) the procedure to be followed

(c) how the wavelength of the laser and the thickness of the block are determined

(d) the control of variables

(e) any precautions that should be taken to improve the accuracy and safety of the experiment.

Diagram

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[12]

[Total: 12]