EUNOIA JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATIONS 2023
General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME

CIVICS GROUP	2	2	-			REGISTRATION NUMBER		

PHYSICS

9749/04

Paper 4 Practical

August 2023

2 hours 30 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number in the spaces at the top of this page.
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	**21**
2	**14**
3	**9**
4	**11**
Total	**55**

This document consists of **20** printed pages.

1 In this experiment, you will investigate how the motion of a paper strip depends on its dimensions.

(a) **(i)** Cut a strip of paper about 26 cm long from the graph paper (labelled **PP1**) provided.

(ii) Set up the strip of paper as shown in Fig. 1.1.

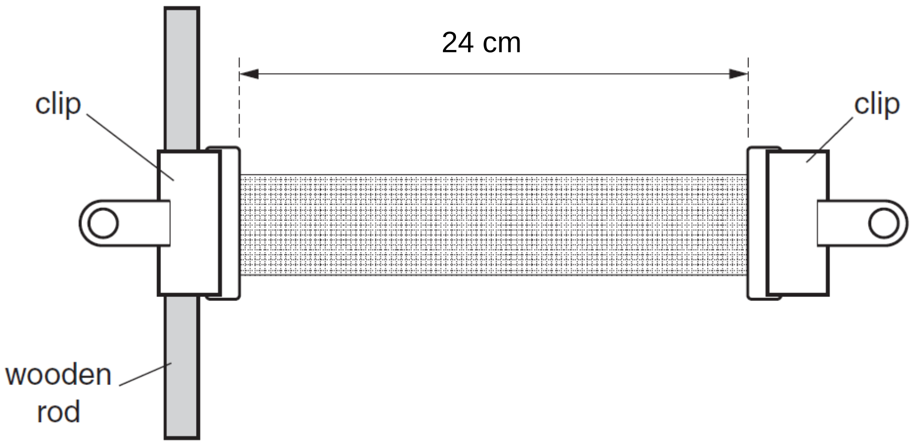


Fig. 1.1

(iii) Measure and record the width *w* of the paper strip, as shown in Fig. 1.2.

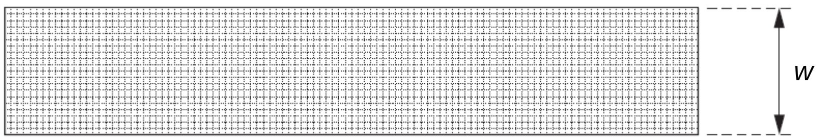


Fig. 1.2

w = ………………………….. [1]

(b) **(i)** Set up the apparatus with the top clip supported on the nail, as shown in Fig. 1.3.

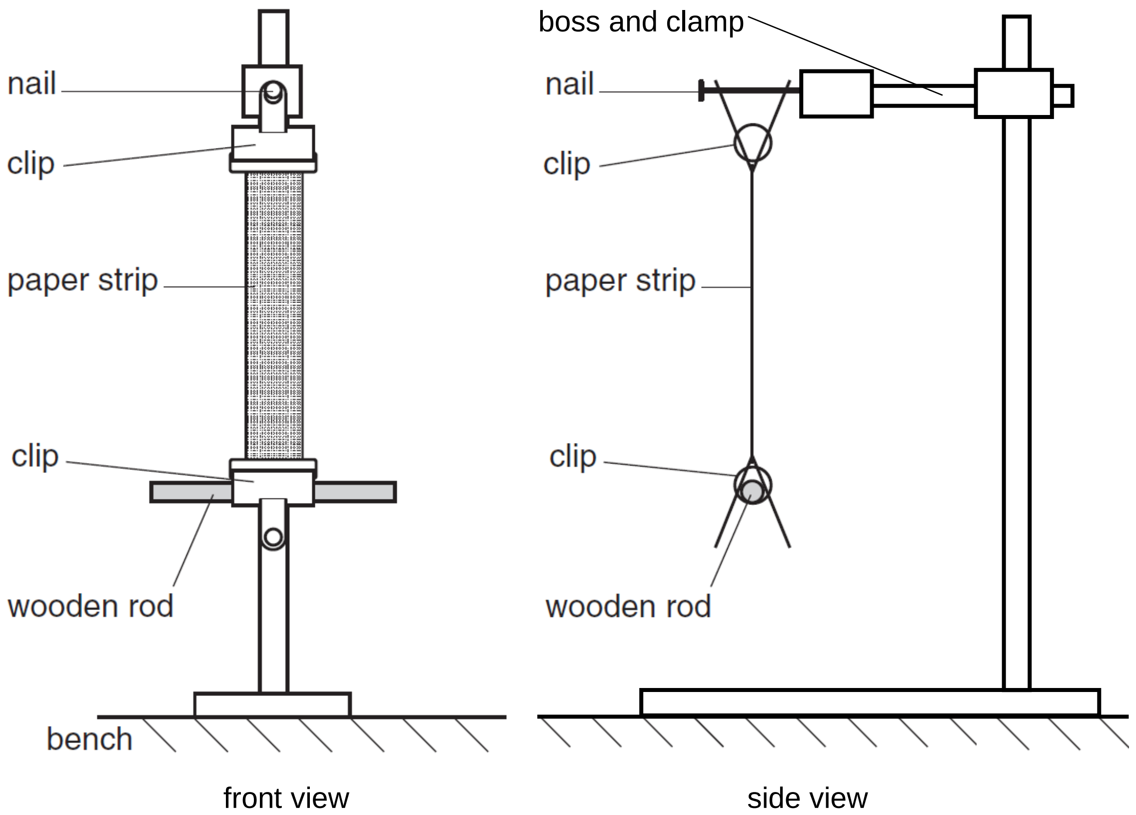


Fig. 1.3

(ii) Twist the wooden rod through an angle of approximately 90° in a horizontal plane and release the rod.

Determine the period of oscillation of the wooden rod, *T*.

T = ... [2]

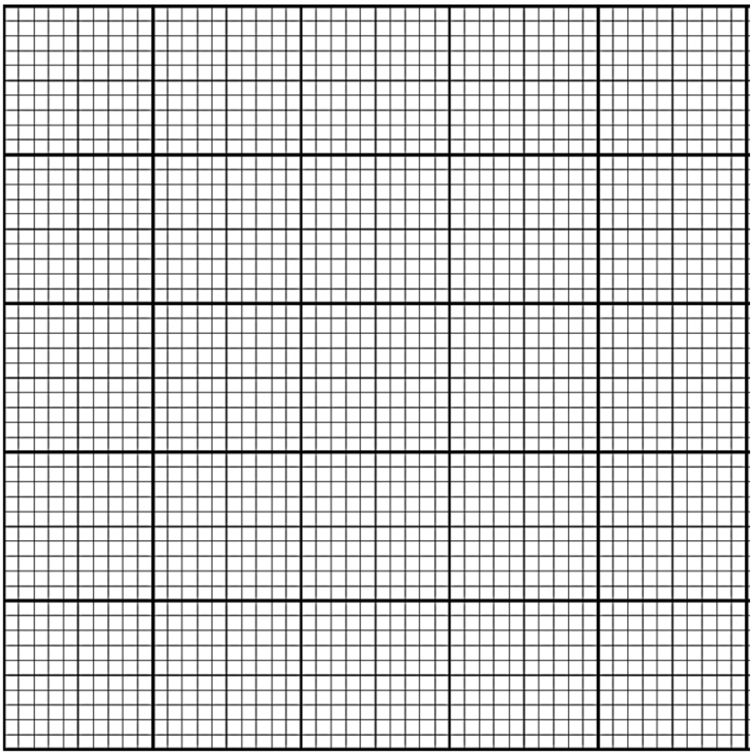
(c) **(i)** State, with a reason, the largest value of *w* you would use in this experiment.

………………………………………………………………………………………………………

……………………………………………………………………………………………….… [1]

(ii) Vary *w* and repeat steps **(a)** and **(b).**
Present your results clearly. [3]

(d) (i) Plot values of T against $\frac{1}{w}$ on the grid below and draw a best fit straight line. [2]



(ii) Identify one point which you have plotted in **(d)(i)** where the measured period T is the furthest from its expected value according to the best fit straight line.

Calculate the difference between the measured value and the expected value of T for this point.

difference = ………………………… [1]

(iii) Based on your plot in **(d)(i)** and your answer in **(d)(ii)**, comment on whether your results support the following relationship.

$$Tw = \text{constant}$$

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………………………………………………………………………………………….… [2]

(e) It is further suggested that the period *T* of the oscillations depends on the thickness *c* of the paper.

(i) You have been provided with three additional strips of paper (labelled **PP2**, **PP3**, **PP4**) with different thicknesses.

Make appropriate measurements to investigate the relationship between *T* and *c*. Present your results clearly, including relevant data from **(c)(ii)**. [3]

(ii) Plot values of T against c on the grid below and draw a line of best fit. [2]

(iii) Comment on the relationship between T and c.

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…………………………………………………………………………………………….… [1]

(f) The behaviour of the oscillating system also depends on the length l of the wooden rod.

It is suggested that the period T is directly proportional to the square of the length l^2 of the wooden rod.

Explain how you would investigate this relationship. Your account should include:

- your experimental procedure
- control of variables
- how you would use your results to verify if the relationship is valid

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.... [3]

[Total: 21]

Question 2 starts on the next page

2 In this experiment, you will investigate how the current in a circuit changes as the resistance of the circuit is changed.

(a) (i) Measure and record the e.m.f. *E* of the d.c. power supply.

E = ... [1]

(ii) Set up the apparatus as shown in Fig. 2.1.

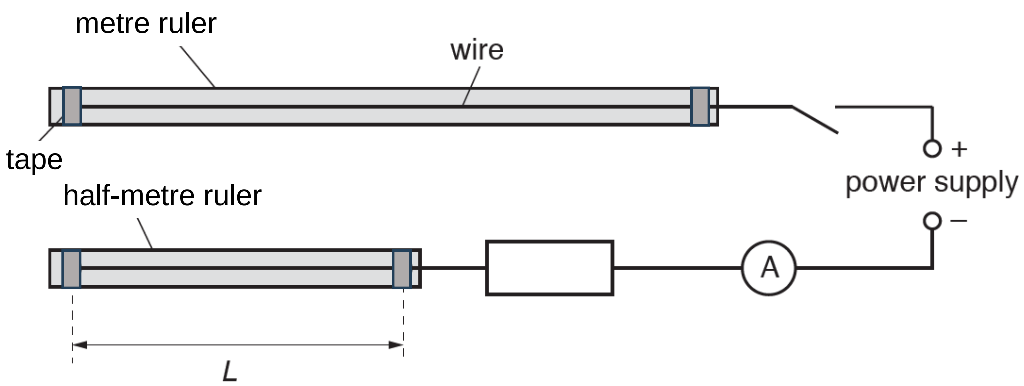

Fig. 2.1

(iii) Measure and record the length *L* of the shorter wire.

L = ... [1]

(b) (i) Complete the circuit as shown in Fig. 2.2.

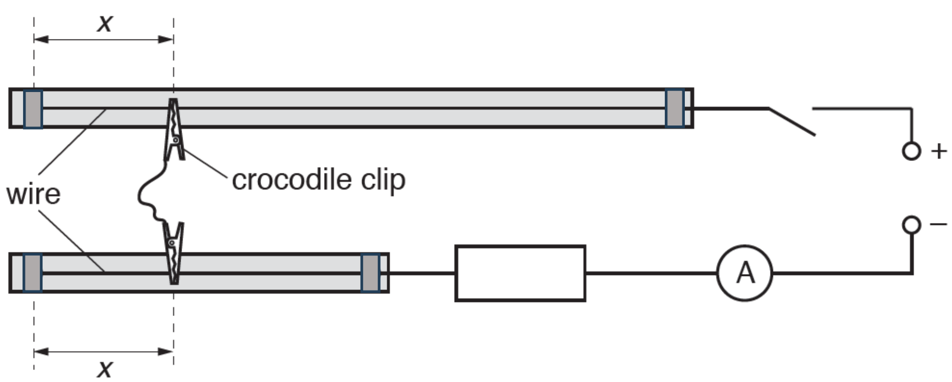

Fig. 2.2

Each crocodile clip should be attached to a wire at the same distance *x* from the end of the wire, as shown in Fig. 2.2.

(ii) Measure and record the distance x.

x = ...

(iii) Close the switch.

(iv) Record the ammeter reading I .

I = ... [1]

(v) Open the switch.

(c) Vary *x* and repeat **(b)**. Record your readings in the space below. [4]

(d) It is suggested that the relationship between I and *x* is

$$\frac{1}{I} = -Px + Q$$

where *P* and *Q* are constants.

By plotting a suitable graph, determine the values of *P* and *Q*.

P = ...

Q = ...

[6]

(e) Theory suggests that

$$Q = \frac{R}{E} + \frac{3PL}{2}$$

where *R* is the resistance of the resistor.

Using your results, determine the value of *R*.

R = ………………………….. Ω [1]

[Total: 14]

3 In this experiment, you will investigate the maximum angle of tilt of a bottle when it contains different amounts of water.

You are provided with two sealed bottles of identical size containing water inside. One bottle is almost fully filled (labelled **A**) and the other is filled to about quarter-full (labelled **B**).

(a) Measure the diameter *d* of the bottle using the vernier callipers.

d = ... [1]

(b) Take the bottle labelled **A**.

(i) Measure the height *h* as shown in Fig. 3.1, using a half-metre ruler.

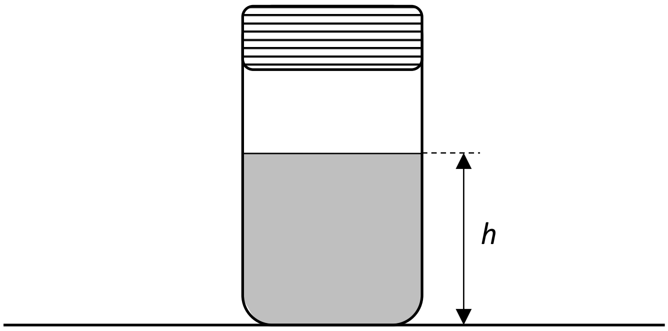

Fig. 3.1

h = ... [1]

(ii) The angle of tilt θ of the bottle is the angle it makes with the horizontal when it is about to topple, as shown in Fig. 3.2.

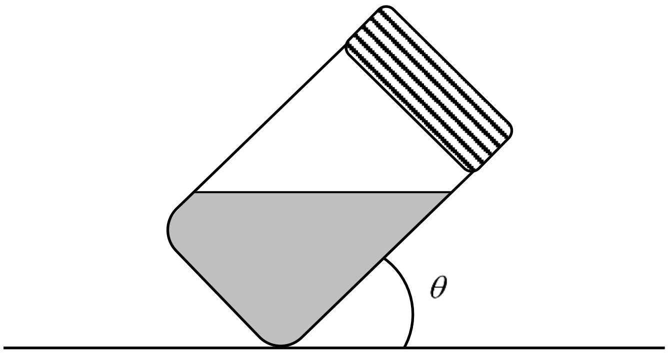

Fig. 3.2

Making sure that the lid is secure, tilt the bottle as shown, until it is about to topple, and measure θ.

θ = …………………………….. [1]

(iii) Estimate the percentage uncertainty in θ.

percentage uncertainty in θ = …………………………….. [1]

(iv) Use your values in **(a)** and **(b)(i)**, calculate the volume V of the water in the bottle.

V = ………………………………. [1]

(c) By using bottle **B**, repeat **(b)(i)** and **(b)(ii).**

h = ………………………………

θ = …….………………………..

[2]

(d) It is suggested that $\sqrt{h}$ is inversely proportional to $\cos\theta$. Explain whether the results of your experiment support this idea.

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[Total: 9]

4 An aluminium ring is placed on a coil with the rod of a metal retort stand passing through their centres, as shown in Fig. 4.1.

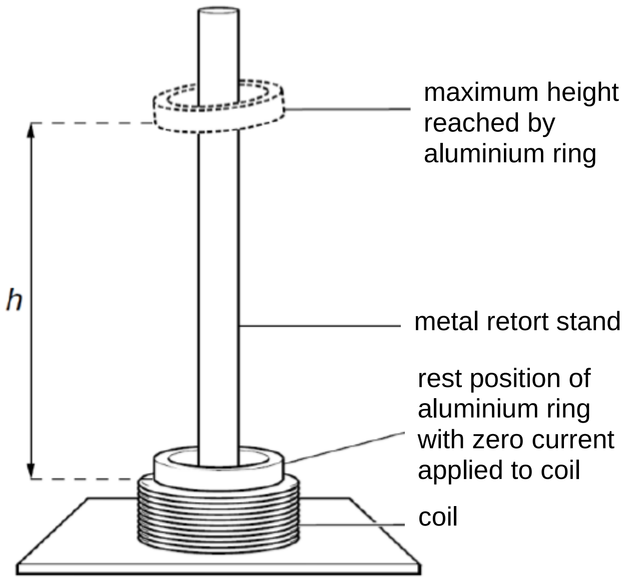

Fig. 4.1

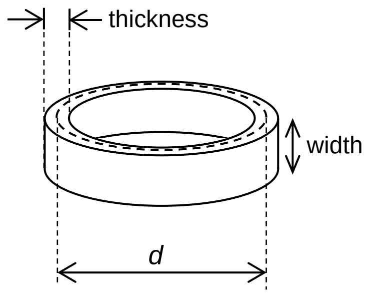

Fig. 4.2

There is initially no current through the coil and the ring remains at rest just on top of the coil. When a direct current passes through the coil, the ring jumps up to a maximum height h before falling back down to its initial rest position.

It is suggested that the maximum height h the ring attains is related to the diameter d of the ring and the magnetic flux density B at the ends of the coil with current passing through the coil.

$$h = kd^m B^n$$

where k, m and n are constants.

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

You are provided with rings of equal thickness and width but different diameters. The dimensions are drawn in Fig. 4.2.

Draw a diagram to show the arrangement of your equipment. Pay particular attention to

- the equipment you would use
- the procedure to be followed
- the control of variables
- any precautions that should be taken with your experiment.

Diagram

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[11]