NATIONAL JUNIOR COLLEGE

SENIOR HIGH 2 PRELIMINARY EXAMINATION

Higher 2

CANDIDATE NAME	

SUBJECT CLASS		REGISTRATION NUMBER	

PHYSICS **9749/04**

Paper 4 Practical

26 Aug 2024
2 hours 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THE INSTRUCTION FIRST

Write your subject class, registration number and name 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 workings.
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	
2	
3	
4	
Total	

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1 In this experiment, you will determine the internal resistance of cell P.

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

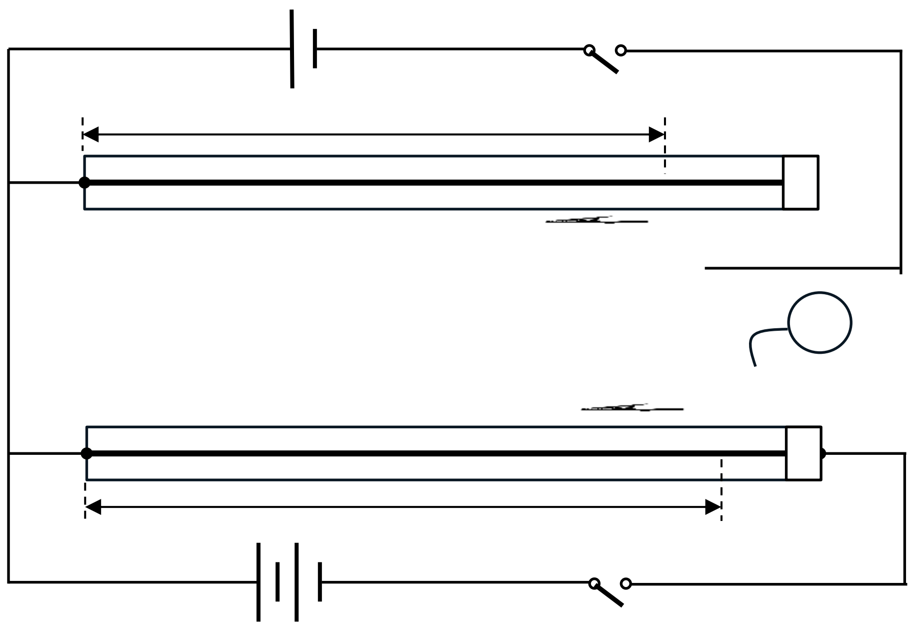
Take measurements to determine the resistance per unit length of each of the wires.

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 = ...
[1]

(b) Setup the circuit as shown in Fig. 1.1.



x

y

P

Q

K_1

K_2

A

A

B

Fig. 1.1

(i) Set x to 50 cm.

Close switch K_1 and K_2.

Adjust y until the ammeter reading is zero.

Measure and record x and y.

x = ...

y = ...
[2]

(ii) Open switch K_1 and K_2.

(c) Vary x and adjust y each time so that the ammeter reading is zero.
x must be more than 20 cm.

Present your results clearly.

[4]

(d) y and x are related by the expression:

$$\frac{1}{y} = a\frac{1}{x} + b$$

where a and b are constants.

Plot a suitable graph to determine a and b.

a = ...

b = ...

[7]

(e) Theory suggests that the internal resistance *r* of cell P is

$$r = \frac{a}{b} R_A$$

Determine *r*.

r = ……………………………………………….. [1]

[Total: 15]

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2 In this experiment, you will determine the spring constant of a spring.

(a) Measure and record the length L_0 of the unstretched spring, as shown in Fig. 2.1.

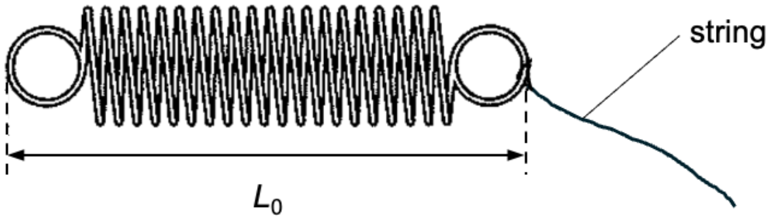
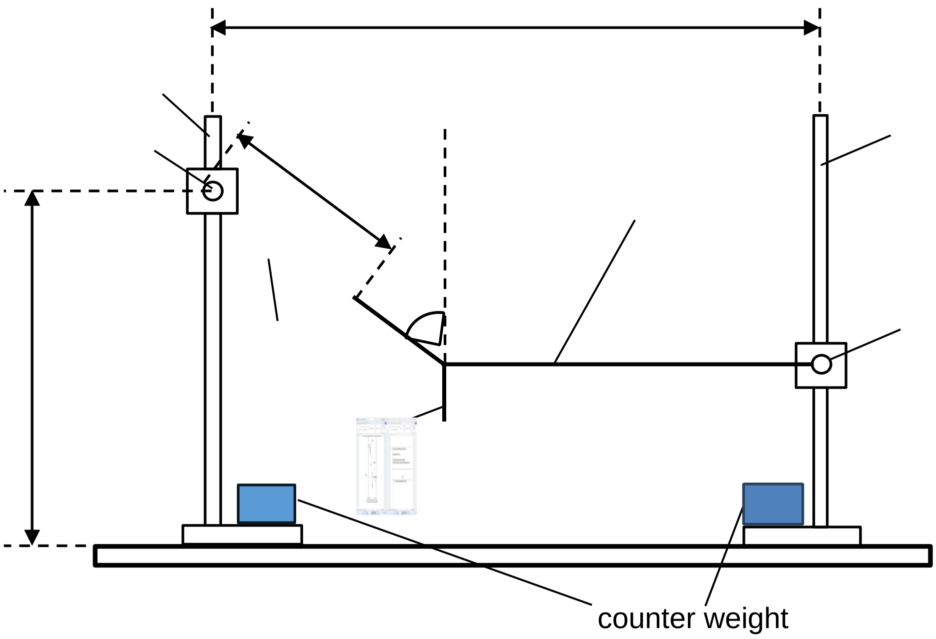


Fig. 2.1

L_0 = ... cm

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



rod of clamp

rod of clamp

m

retort stand

retort stand

red string

white string

P

Q

spring

θ

≈ 90 cm

≈ 75 cm

L

Fig. 2.2

Hang a mass m of 150 g from the red string.
The distance between the two retort stands is about 90 cm.
The end of the spring on the retort stand is about 75 cm from the bench.

Adjust the height of Q and/or slide the red string along the white string so that the section PQ is parallel to the bench.

(i) Record the value of mass *m.*

m = ………………………………………………… g

(ii) Measure and record the length L of the spring and the angle θ.

L = ……………………………………………… cm

θ = ……………………………………………………
[2]

(c) Theory suggests that

$$cos\ cos\ \theta\ = \frac{mg}{ke}$$

where k is the spring constant of the spring, e is the extension of the spring and g = 9.81 m s^{-2}.

Determine k.

k = ……………………………………….. N m^{-1} [2]

(d) If you were to repeat this experiment using other masses, describe how you will conduct the experiment and the graph that you would plot to determine k.

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

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.... [3]

[Total: 7]

3 In this experiment, you will investigate the movement of a loaded wire.

(a) **(i)** Take the **shorter** of the two wires.

(ii) Measure and record the diameter d of the wire.

d = ... [2]

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

percentage uncertainty of d = ... [1]

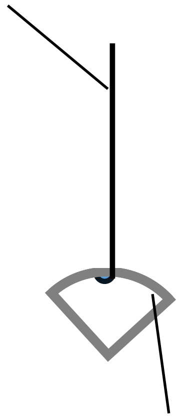
(iv) Calculate the cross-sectional area A of the wire using

$$A = \frac{\pi d^2}{4}$$

A = ... [1]

(b) **(i)** Secure the hook of the mass hanger to one end of the wire by wrapping the wire around the hook and vertical wire several times as shown in Fig. 3.1.

Leave at least 25 cm of excess wire.

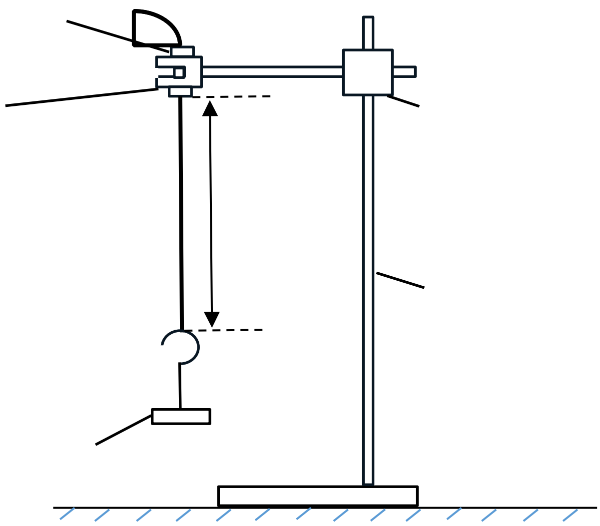


vertical wire

hook of mass hanger

Fig. 3.1

(ii) Set up the apparatus as shown in Fig. 3.2.
The total mass hanging from the end of the wire is 100 g.
The length *L* should be approximately 15 cm.



bench

vertical wire

mass

boss

clamp

split cork

stand

L

Fig. 3.2

(iii) Measure and record *L*.

L = ...

(iv) Twist the mass through approximately 180°.

Release the mass. The mass will oscillate as shown in Fig. 3.3.

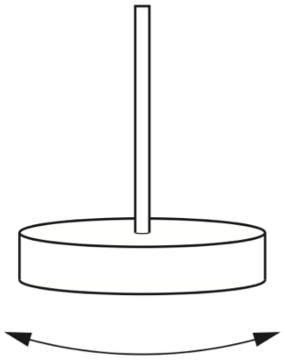


Fig. 3.3

Take measurements to determine the period *T* of the oscillations.

T = ... [2]

(v) Estimate the percentage uncertainty in your value of *T*.

percentage uncertainty of *T* = ... [1]

(c) **(i)** Take the **longer** wire. Repeat **(a)(ii)** and **(a)(iv)**.

d = ...

A = ...
[2]

(ii) Secure the hook of the mass hanger to one end of the wire as shown in Fig. 3.1 and leaving about 60 cm of excess wire.

The total mass hanging from the end of the wire is 100 g.

Repeat **(b)(iii)** and **(b)(iv)** for a value of L of approximately 50 cm.

L = ...

T = …………………………………………….
[1]

DO NOT dismantle the apparatus.

(d) It is suggested that the relationship between T, L and A is

$$T = k\frac{\sqrt{L}}{A}$$

where k is a constant.

(i) Using your data, calculate two values of k.

first value of k = …………………………………………….

second value of k = …………………………………………….
[1]

(ii) State whether or not the results of your experiment support the suggested relationship. Justify your conclusion by referring to your values in **(a)(iii)** and **(b)(v)**.

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

(e) The oscillations in **(b)** and **(c)** is known as torsional oscillations. Another way to set the wire and mass system into oscillations is to allow it to swing from side-to-side, as shown in Fig. 3.4.

Fig. 3.4

(i) Set the **longer** wire in **(c)** into the swinging oscillations shown in Fig. 3.4.
Take measurements to determine the period T_S of the swinging oscillations.

T_S = ……………………………………………

(ii) The torsional oscillations of the wire is dependent on the mass *m* of the load hung from the end of the wire.

Vary *m* and find values of *T* of the **torsional oscillations of the shorter wire** at the length *L* you used in **(b)(iii)**. Present your results clearly.

Use your results to estimate a value of *m* that allows the period *T* to be equal to T_S.

m = ...
[3]

(f) It is suggested that the period of the torsional oscillations of the wire is directly proportional to the radius *r* of the mass hung from the end of the wire.

Explain how you would investigate this relationship.

Your account should include:

- your experimental procedure
- control of variables
- how you would use your results to show direct proportionality
- why you might have difficulties using mass with very small radii and very large radii.

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.... [5]

[Total: 21]

4 A student is investigating how the intensity of the reflection of sound from a wooden panel depends on the thickness of foam attached to the panel and the frequency of the sound, as shown in Fig. 4.1.

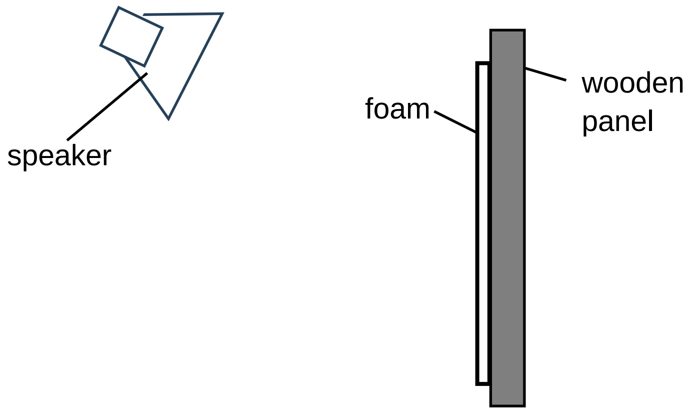

Fig 4.1 (Top View)

It is suggested that the intensity I of the reflected sound is related to the thickness t of the foam and frequency f of the sound by the relationship

$$I = At^x f^y$$

where A, x and y are constants.

You are provided with identical pieces of foam.

Design an experiment to determine the values of x and y.

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

(a) the equipment you would use,
(b) the procedure to be followed,
(c) how interference is reduced,
(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
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[Total: 12]

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