HWA CHONG INSTITUTION
C2 Preliminary Examination
Higher 2

A

CANDIDATE NAME		**CT GROUP**	**23S**
TUTOR NAME			

PHYSICS

9749/04

Paper 4 Practical

22 August 2024

2 hours 30 mins

Candidates answer on the Question Paper.

No Additional Materials are required.

INSTRUCTIONS TO CANDIDATES

Write your name, CT group and tutor's name in the boxes 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.

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, submit sets A, B and C separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
1	**/ 12**
2	**/ 9**
3	**/ 22**
4	**/ 12**
Total	**/ 55**

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1 In this experiment, you will investigate the period of torsional oscillations of a suspended disc with loaded mass.

(a) Set up the apparatus as shown in Fig. 1.1.

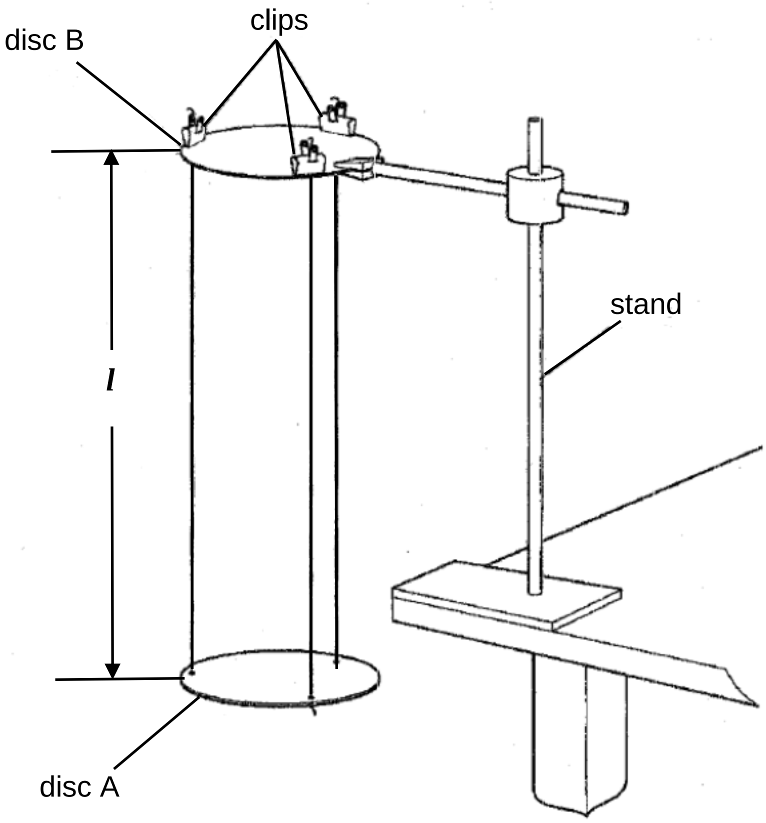

Fig. 1.1

Disc A and disc B have three small holes spaced at regular intervals near the edge. Pieces of string have been threaded through the holes.

Clamp disc B horizontally using two small blocks of wood. Use the clips on disc B to adjust the length l of each string until l is about 100 cm.

Place a 50 g mass in the centre of disc A.

(b) (i) Gently rotate disc A through a small angular displacement and release it so that the disc performs torsional oscillations of period *T* in a horizontal plane as shown in Fig. 1.2.

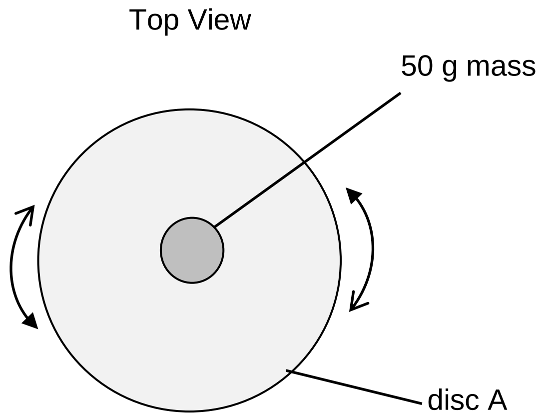

Fig. 1.2

Determine and record *T*.

T = ……………………………………………………..
[2]

(ii) Repeat **(b)(i)** for different values of mass *m*, by stacking the slotted masses on top of each other, until you have five sets of readings of *T* and *m*.

Present your results clearly.

[4]

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(c) It is suggested that T and m are related by the expression:

$$T = km^n$$

where k and n are constants.

Plot a suitable graph to determine the values of k and n.

k = ……………………………………………

n = ……………………………………………
[6]

[Total: 12]

2 In this experiment, you will investigate the energy stored in a stretched rubber band.

(a) **(i)** Place the rubber band on the bench so that it is taut without being stretched, as shown in Fig. 2.1.

The length of the rubber band is L_0.

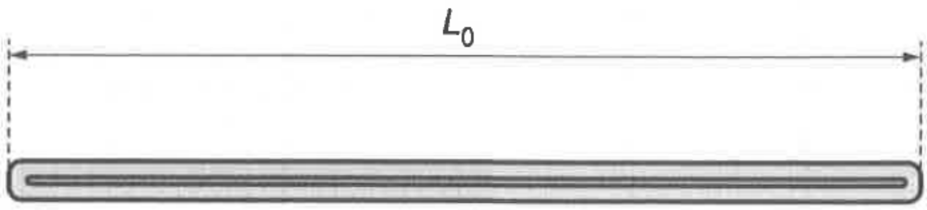


Fig. 2.1

Measure and record L_0 for your rubber band.

L_0 = ... [1]

(ii) Use the dimensions given on the card to calculate the volume V of the rubber band.

V = ... [1]

(b) **(i)** Set up the apparatus as shown in Fig. 2.2 with the mass hanger suspended from the rubber band.

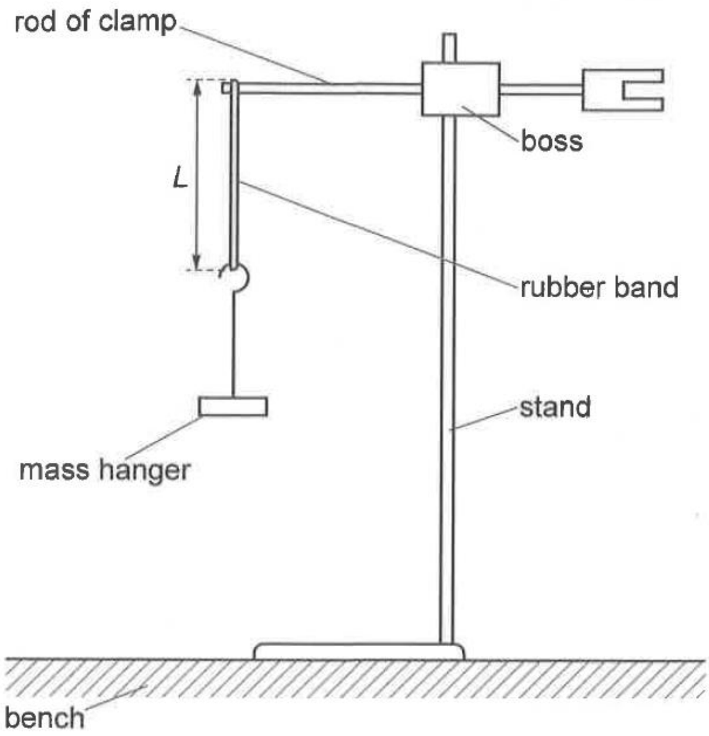


Fig. 2.2

The extended length of the rubber band is L.

Calculate the extension e of the rubber band where:

$$e = L - L_0.$$

Record your answer in metres.

e = ... m

The force F acting on the rubber band is given by:

$$F = mg$$

Where m is the mass, in kg, suspended from the rubber band and g = 9.81 N kg^{-1}.

Calculate and record F.

F = ... N

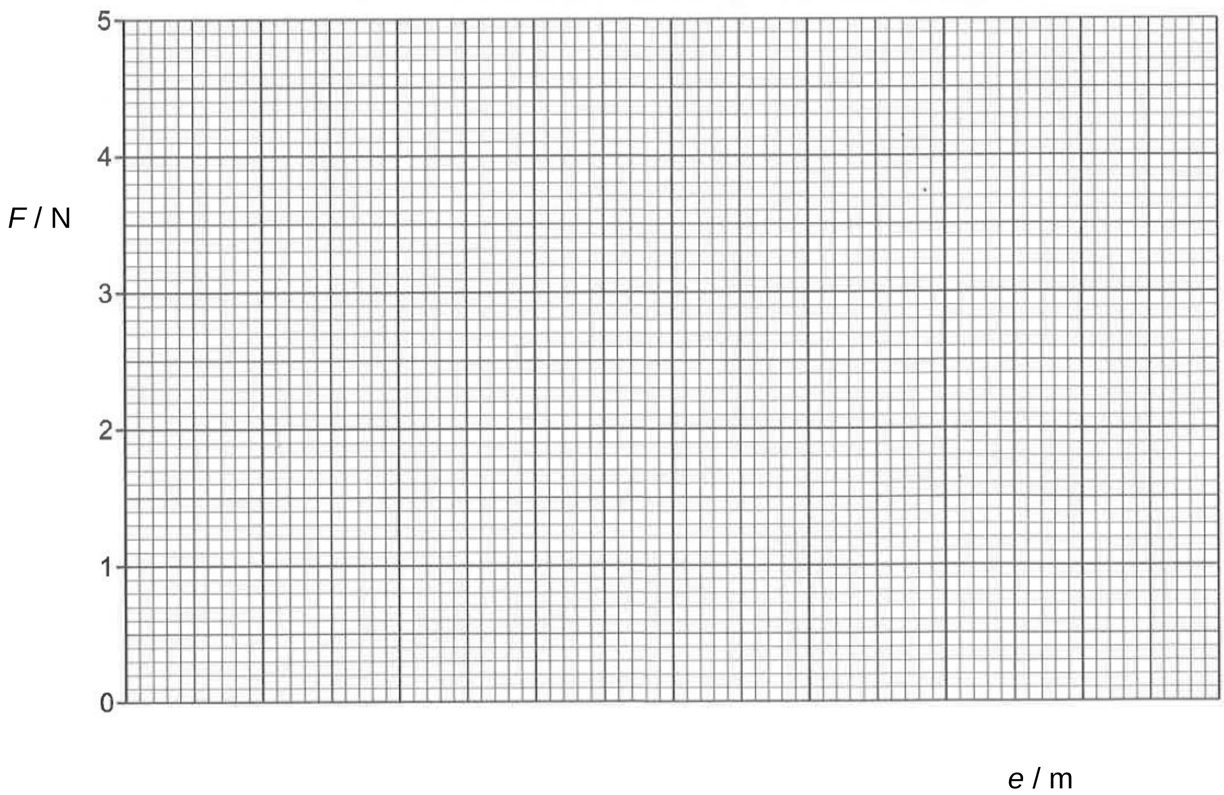
[1]

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

Present your results clearly.

[3]

(iii) Plot your results on the grid below.



[1]

(iv) The area under the graph represents the approximate energy stored by the rubber band.

Estimate this energy when its extended length $L = 2L_0$.

energy stored = ... J [1]

(v) Calculate the energy stored per unit volume, in J m^{-3}, in the rubber band when its extended length $L = 2L_0$.

energy stored per unit volume = ... J m^{-3} [1]

[Total: 9]

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B

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PHYSICS

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3 This experiment investigates the properties of a coil of wire.

(a) You have been provided with two cardboard tubes with wire wrapped around them.
The diameter of the tube labelled Y is D_Y, as shown in Fig. 3.1.
The diameter of the wire is d_Y.

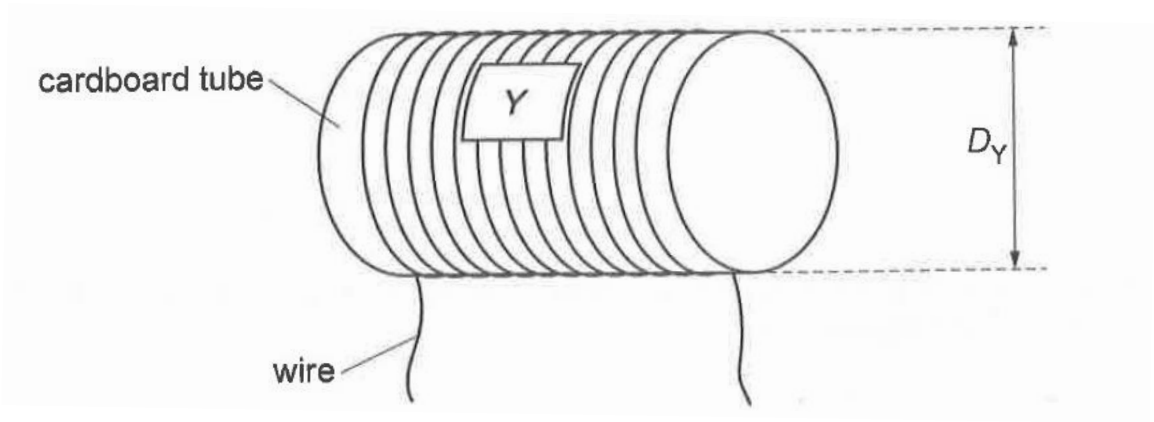

Fig. 3.1

Measure and record D_Y and d_Y.

D_Y = ……………………………………………..... cm

d_Y = …………………………………………… mm
[2]

(b) **(i)** The total length of wire is L_Y.

Estimate and record your value for L_Y.

Show your working.

L_Y = ……………………………………………..... cm [2]

(ii) Estimate the percentage uncertainty in your value of L_Y.

percentage uncertainty in L_Y = ... [1]

(c) Connect the circuit shown in Fig. 3.2 where resistor R has a resistance *R* of 15 Ω.

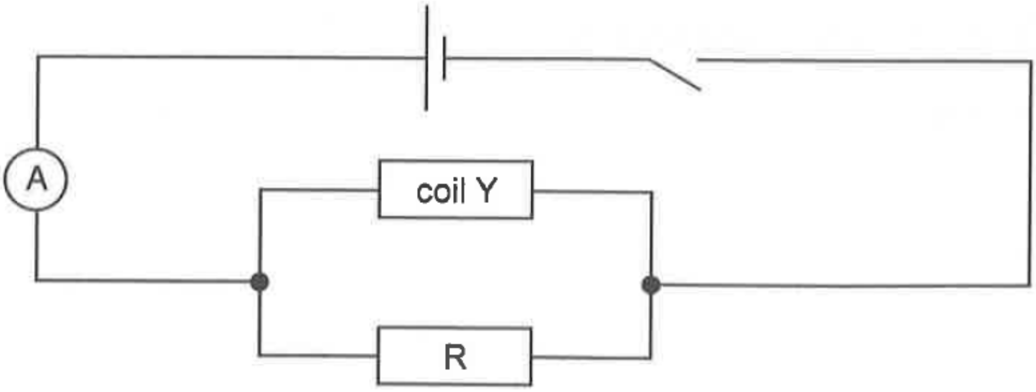

Fig. 3.2

Close the switch.

Note and record *R* and the ammeter reading I.

R = ... Ω

I = ... A

[1]

Open the switch.

(d) Vary *R* and repeat **(c)**.

Present your results clearly.

[3]

(e) Plot your results on Fig. 3.3 and label this line Y.

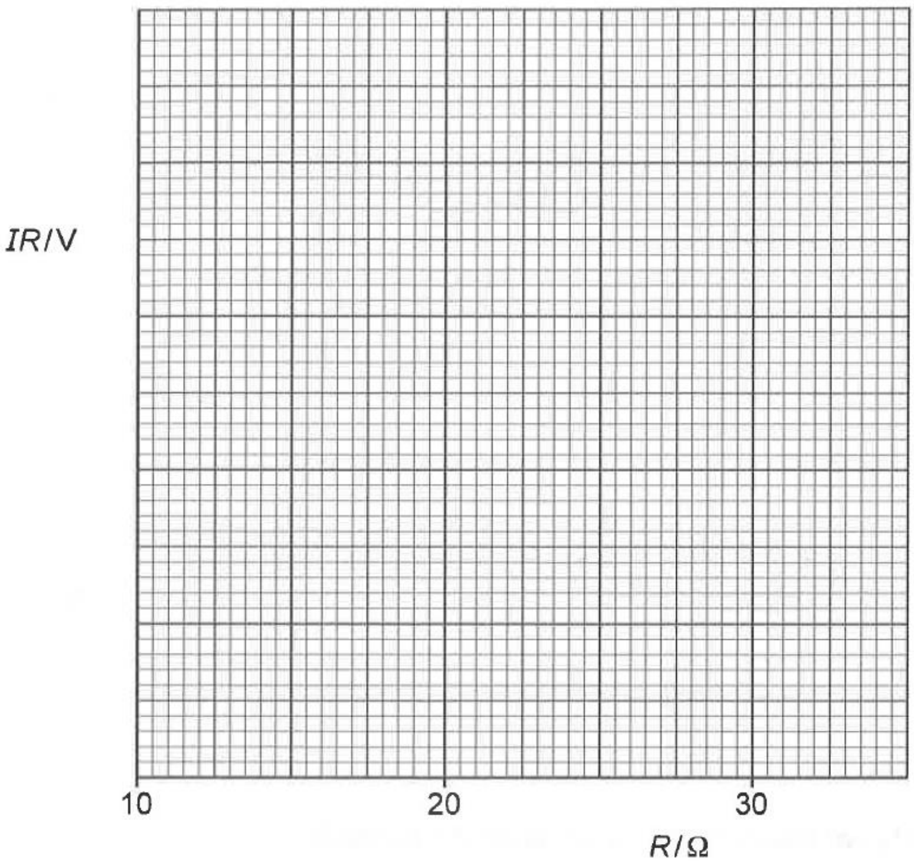

Fig. 3.3

I and R are related by the expression:

$$IR = GR + H$$

where G and H are constants.

The resistance X_Y of coil Y is given by:

$$X_Y = \frac{H}{G}.$$

Use your graph to determine X_Y.

X_Y = ... Ω
[3]

(f) The diameter of the tube labelled Z is D_Z. The diameter of the wire is d_Z.

(i) Measure and record D_Z and d_Z.

D_Z = ... cm

d_Z = ... mm

The length of wire wrapped around Z is L_Z, where:

$$L_Z = \frac{3L_Y}{4}.$$

Calculate L_Z.

L_Z = ... cm
[1]

(ii) The resistance of coil Z is X_Z.

Repeat **(c)**, **(d)** and **(e)** to find X_Z.

Plot your results on Fig. 3.3 and label this line Z.

X_Z = ... Ω
[2]

(iii) Use a digital multimeter to measure X_Z.

Describe any difference between your two values for X_Z and suggest a reason for this difference.

difference ....

reason ....

....
[1]

(g) It is suggested that the resistance of a wire, *X*, is given by the relationship:

$$X = \frac{kL}{d^2}$$

Where *L* is the length of the wire, *d* is the diameter of the wire and *k* is a constant.

(i) Use your values from **(a)**, **(b)(i)**, **(e)**, **(f)(i)** and **f(ii)** to determine 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 value in **(b)(ii)**.

....

....

....

....

.... [1]

(h) **(i)** When there is a current I in one of the coils, the magnetic flux density B at each end of the tube along its axis is given by:

$$B = CnI$$

Where C is a constant and n is the number of turns of wire per unit length on the tube.

Without taking further readings, explain whether tube Y or tube Z has a greater magnetic flux density at its ends when the voltage supply is connected directly across the coil.

....

....

....

....

.... [1]

(ii) Describe, using a diagram, how you could check your conclusion in **(h)(i)** using a small compass.

....

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....

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....

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....

....

....[3]

[Total: 22]

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C

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PHYSICS

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4 A student is investigating how the boiling point of a salt solution varies with pressure and the density of the salt solution.

It is suggested that the relationship between the Celsius temperature θ at which the water of the solution starts to boil, the air pressure P and the density σ of the salt solution is

$$\theta = k\sigma^{x}P^{y}$$

where k, x and y are constants.

Design a laboratory experiment to determine the values of x and y.

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) the control of variables

(d) any precautions that should be taken to improve the accuracy of the experiment.

Diagram

....

....

....

....

....

[Total: 12]