Name	Class	Index Number

JURONG PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination

PHYSICS **9749/04**
Higher 2

Paper 4 Practical

17 August 2023

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.

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	/ 12
2	/ 9
3	/ 22
4	/ 12
Total	/ 55

This document consists of **18** printed pages and **2** blank pages.

1 In this experiment, you will investigate the motion of a system of masses.

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

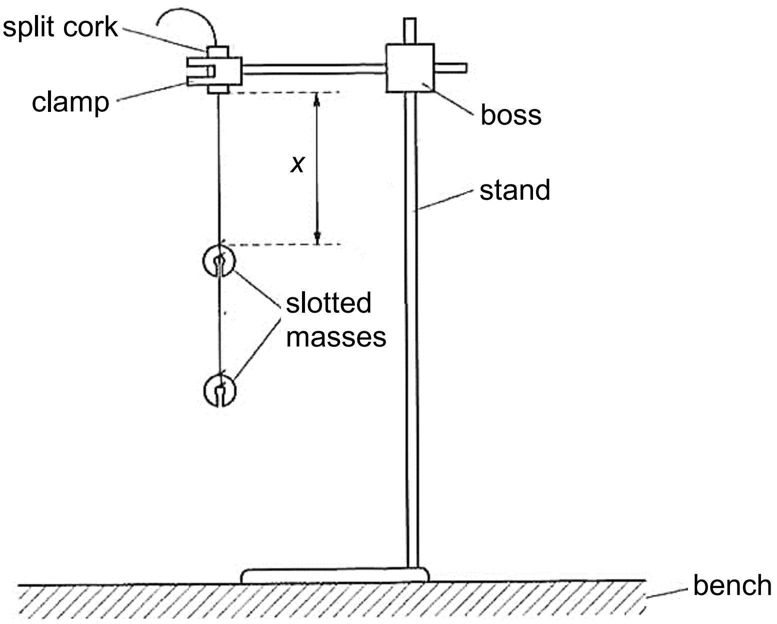


Fig. 1.1

The distance between the bottom of the split cork and the top of the upper string loop is *x*.

Adjust the apparatus until *x* is approximately 15 cm.

Measure and record *x*.

x = ...

Move the bottom mass a short distance to the left and release it. The masses will oscillate with a period *T*.

Determine and record *T*.

T = ...
[2]

(b) Vary x and repeat **(a)**.

Present your results clearly.

[4]

(c) T and x are related by the expression:

$$T^4 = Px + Q$$

where P and Q are constants.

Plot a suitable graph to determine P and Q.

P = ……..

Q = ……..

[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.

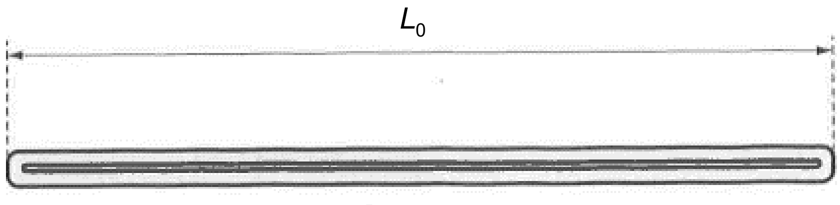


Fig 2.1

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.

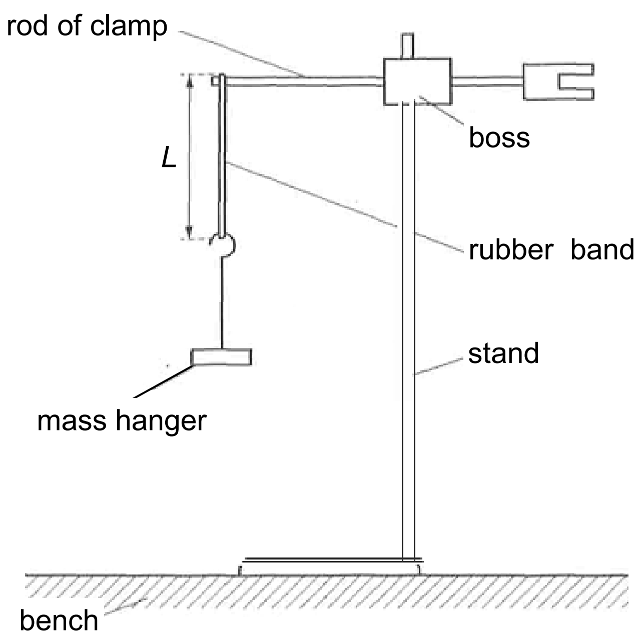


Fig 2.2

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 $g = 9.81\ \text{N kg}^{-1}$.

Calculate and record *F*.

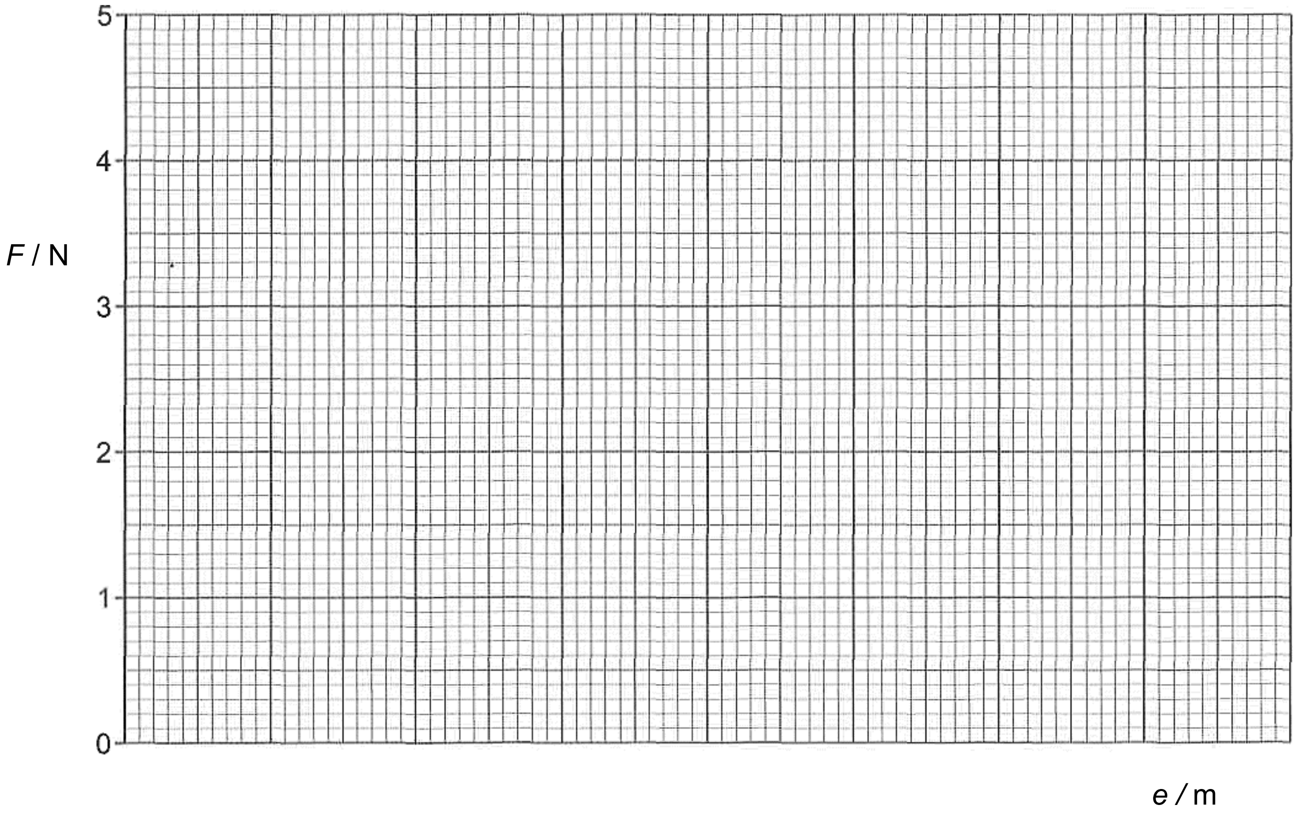
F = ... N
[1]

(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]

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.

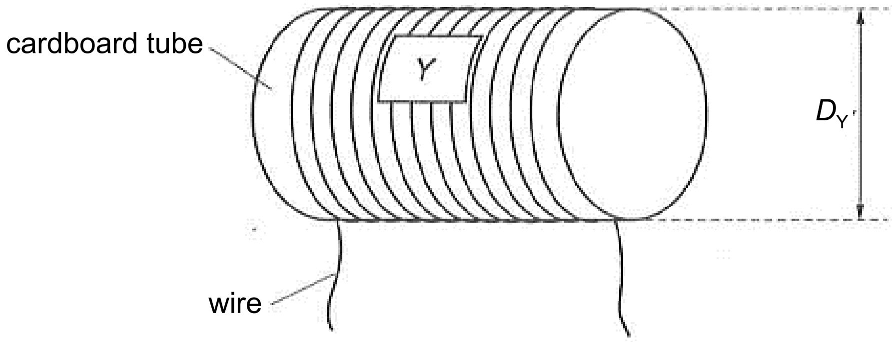


Fig. 3.1

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.

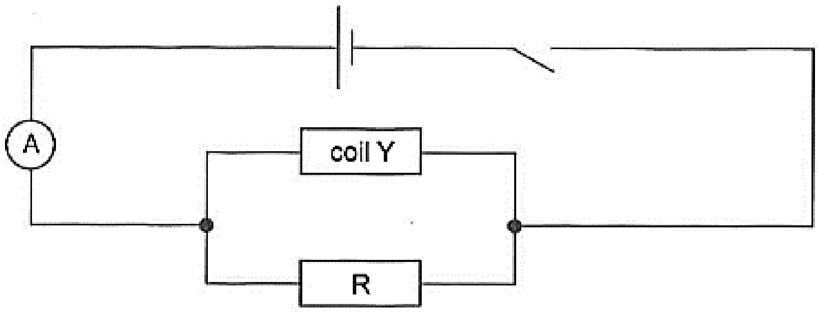


Fig. 3.2

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.

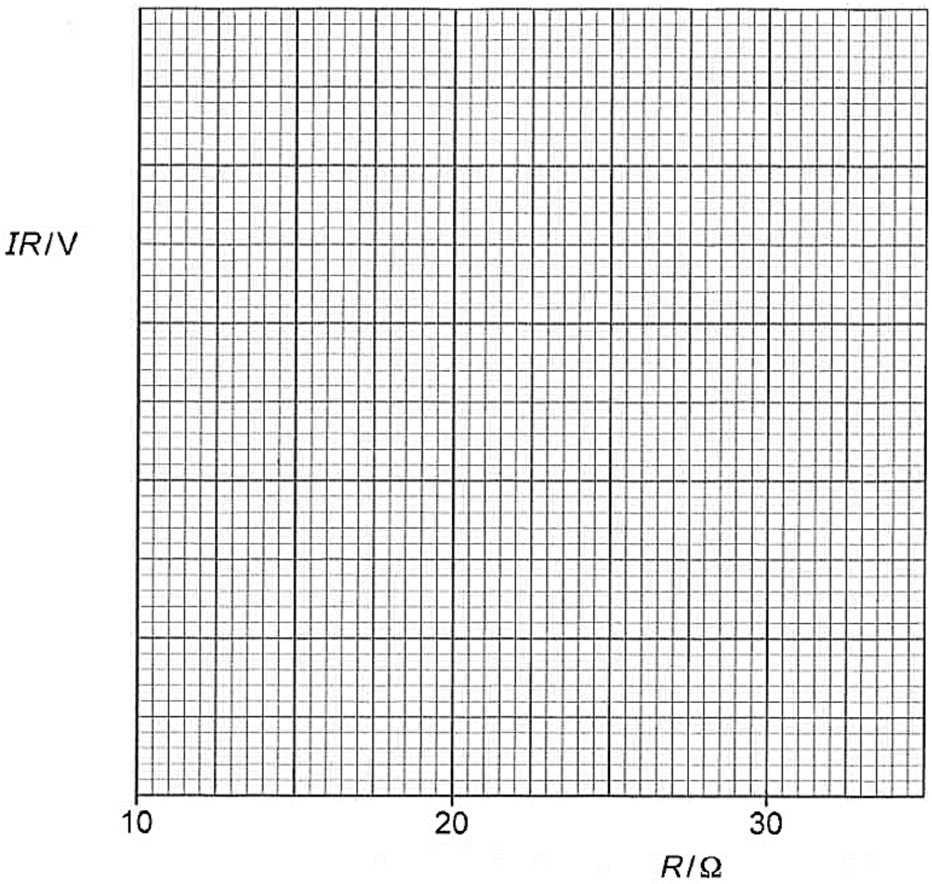


Fig. 3.3

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 tube 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.

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.... [1]

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

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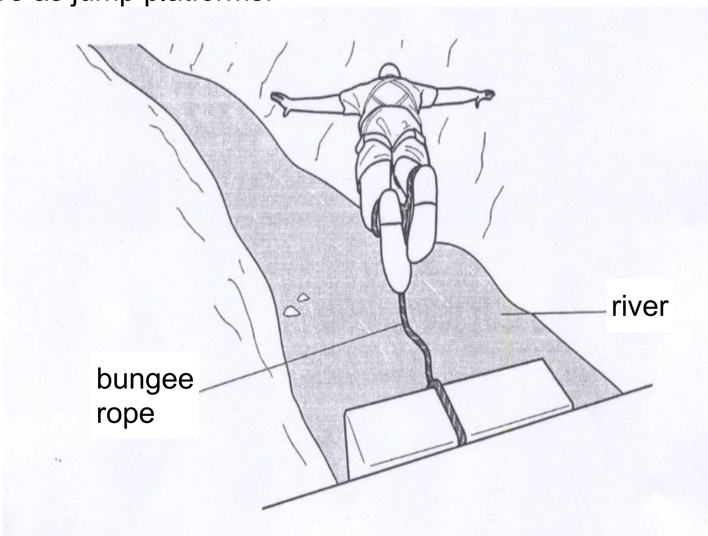
.... [3]

[Total: 22]

4 The origin of bungee-jumping is quite recent but the activity is related to the centuries-old ritualistic practices of "land divers" of the Pentecost Island in the Pacific Archipelago of Vanuatu. The men would demonstrate their courage and offer their injuries to the gods for a plentiful harvest of yams. Nowadays, the sport uses cranes, towers, bridges or hot-air balloons to serve as jump platforms.



A group of bungee jumping enthusiasts proposed to set up a Bungee Jumping Extreme Club in the college. There are many safety considerations to consider. One of the most important safety considerations would be the minimum safety height from which the jumper jumps. If this safety consideration is not enforced, the jumper might hit the ground and suffer serious injury before the rubber cord that is tied to his ankles is fully extended. It is suggested that the minimum safety height depends on the mass of the jumper and the original length of the rubber cord.

For the safety of the bungee jumping enthusiasts, design a scaled down experiment in the laboratory to investigate how the minimum safety height H (from the point of release) depends on the mass of the object M and the length of the rubber cord, L.

The minimum safety height is given by the equation

$$H = k M^p L^q$$

where k, p and q are constants.

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

The apparatus available includes the following:
rubber cords, metre ruler, spherical bobs, G-clamp, retort stand with clamp and boss head

You should 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) how the minimum safety height is measured,
(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]

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