Name:		Centre/Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 PHYSICS **9749/04**

Paper 4 Practical

22 August 2024

2 hours 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number, name and class at the top of this page.
Give details of the practical shift and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions 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.

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 **20** printed pages.

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

(a) Tie two 50 g slotted masses to the string as shown in Fig. 1.1 to create a pendulum.

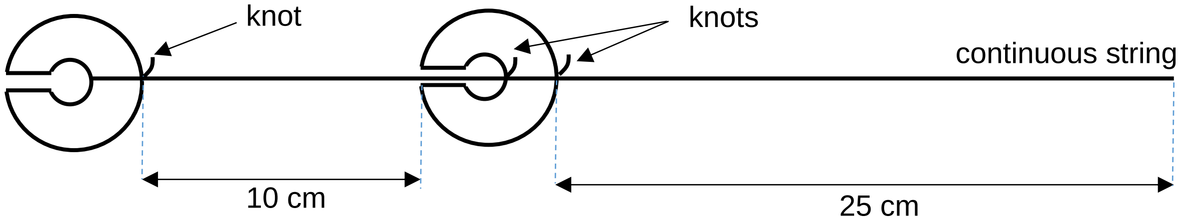


Fig. 1.1

(b) Set up the apparatus as shown in Fig. 1.2 with the pendulum created in **(a)**.

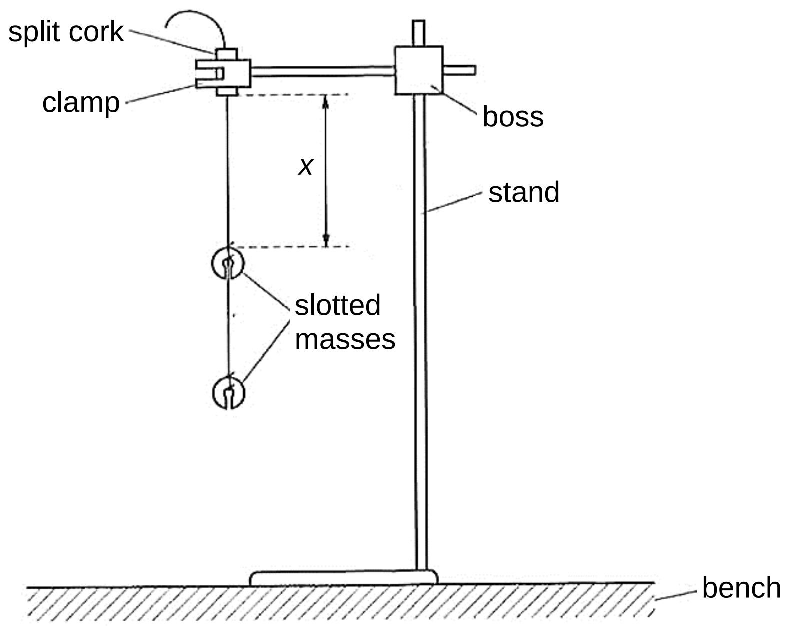


Fig. 1.2

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]

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

Present your results clearly.

[4]

(d) 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 width, thickness and length of the rubber band are w, t and L_0 respectively.

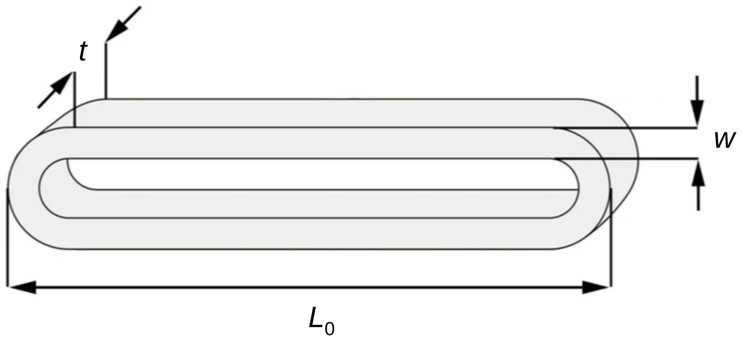


Fig. 2.1

Measure and record w, t and L_0 for your rubber band.

w = ……………………………………

t = ……………………………………

L_0 = ……………………………………
[1]

(ii) 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.

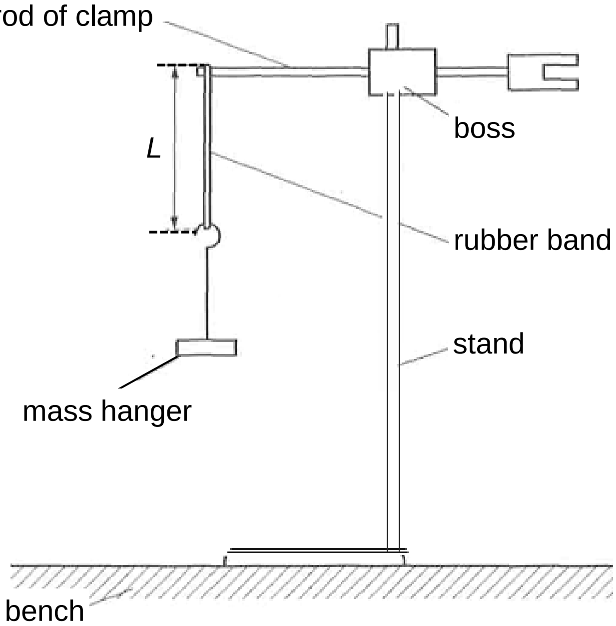


Fig. 2.2

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*.

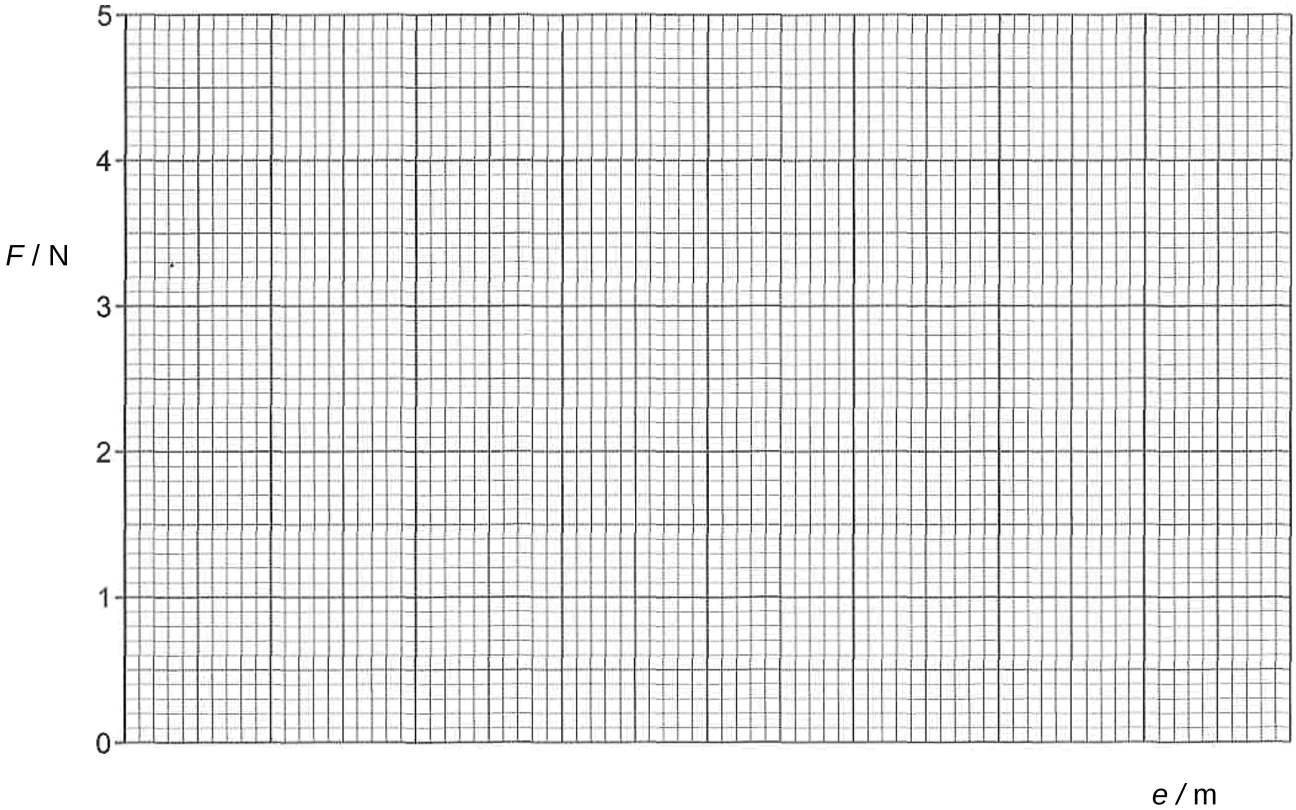
F = ………................................... N
[1]

(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.

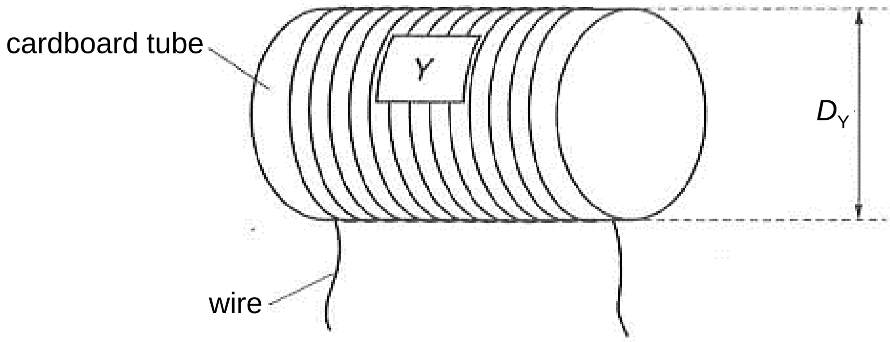


Fig. 3.1

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 for 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.

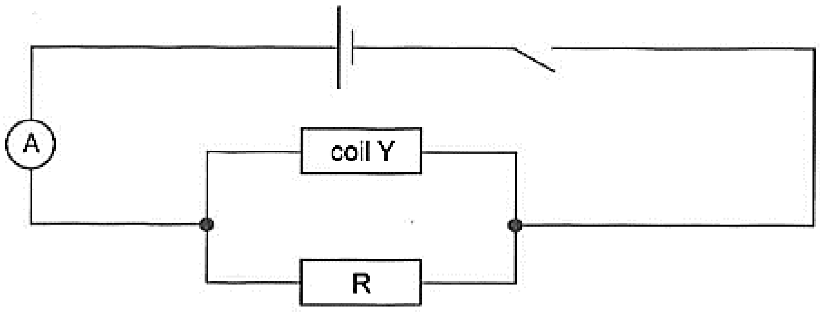


Fig. 3.2

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.

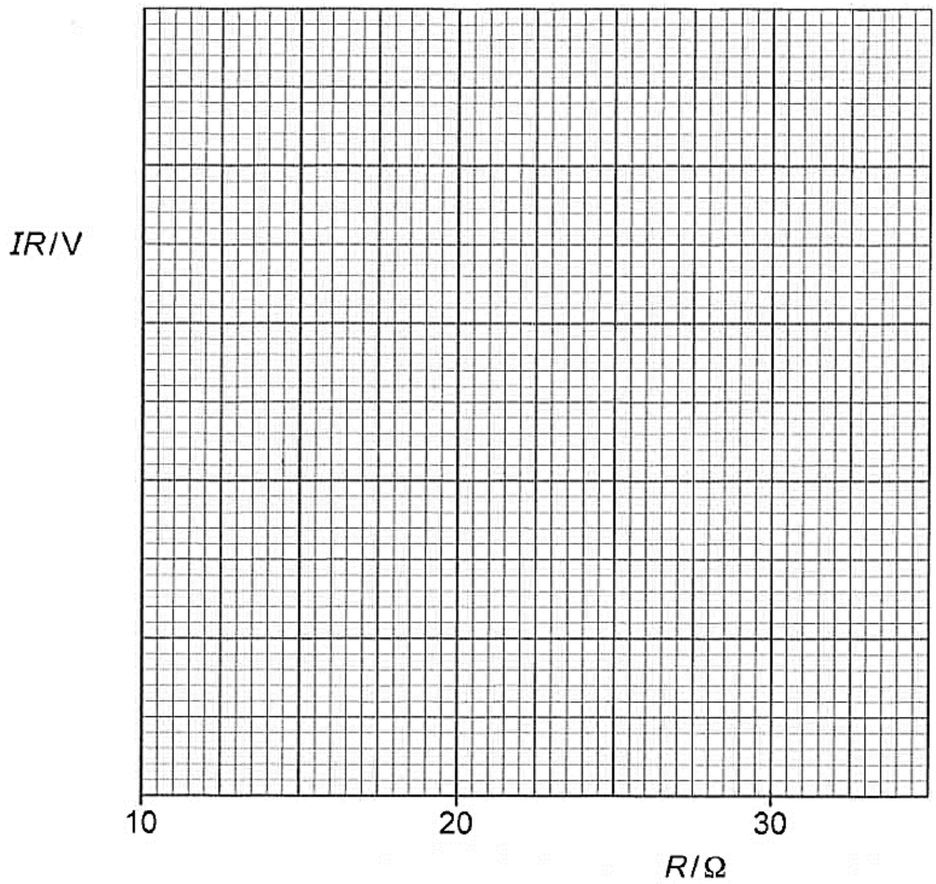


Fig. 3.3

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)**.

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(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 Fig. 4.1 shows a thin cylindrical metal rod of length L and density ρ .

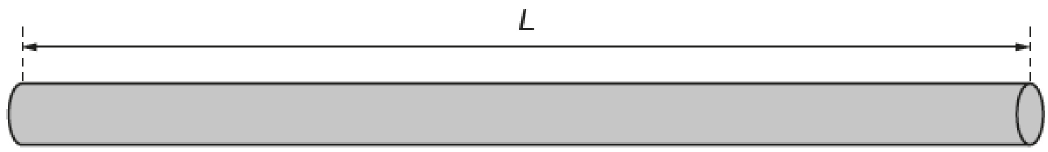

Fig. 4.1

When one end of the rod is struck with a hammer while the rod is firmly clamped at its middle, the resulting stationary sound wave within the rod will oscillate at a fundamental frequency f.

A student suggests the following relationship

$$f = k\,\rho^{x}\,L^{y}$$

where k, x and y are constants.

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

You would be provided with rods of different metals. For each metal there would be rods of different lengths.

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

- the equipment you would use
- the procedure to be followed
- how the fundamental frequency of the rod is measured
- the control of variables
- any precautions that should be taken to improve the accuracy of the experiment.

Diagram

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[Total: 12]