Name:		Centre/Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 PHYSICS — 9749/04

Paper 4 Practical

21 August 2023

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.

Shift
Laboratory

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.

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

This document consists of **19** printed pages and **3** blank pages.

1 In this experiment, you will investigate how the power P dissipated in a resistor varies with the resistance R of the resistor.

Set up the circuit shown in Fig. 1.1. Use the 10 Ω resistor for the value of resistance R.

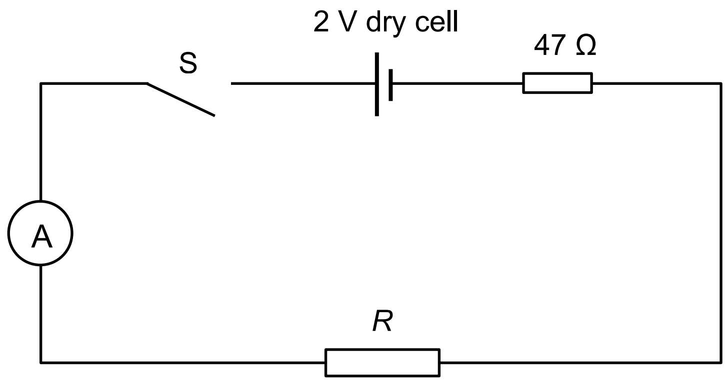

Fig. 1.1

(a) **(i)** Close the switch S.

(ii) Measure and record the current I.

I = ……………………………….. [1]

(iii) Open the switch.

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(b) Use the two 10 Ω and three 100 Ω resistors to obtain the value of the resistance R as shown in the Fig.1.2. For each value of R, repeat **(a)**.

Also calculate the power dissipated P where $P = I^2R$.

***R* / Ω**	***I* / mA**	***P* / W**
10		
20		
33		
43		
50		
60		
70		
100		

Fig. 1.2

[4]

(c) Plot a graph of P against R. [3]

(d) From your graph, state the value of R when P is a maximum.

R = ……………………………….. [1]

[Total: 9]

2 In this experiment, you will investigate the movement of a chain of paper clips.

(a) **(i)** You have been provided with a chain of paper clips.

Measure and record the mass M of the chain.

M = ………………………………. [1]

(ii) Using your answer in **(a)(i)**, calculate the mass m of **one** paper clip.

m = ………………………………. [1]

(iii) Justify the number of significant figures that you have given for your value of m.

………………………………………………………………………………………..

………………………………………………………………………………………..

……………………………………………………………………………………….[1]

(b) **(i)** You have been provided with two identical spheres of modelling clay.

Measure and record the mass S of one of the spheres.

S = ………………………………. [1]

(ii) Calculate c where

$$c = \frac{S}{m} .$$

c = ………………………………. [1]

(c) **(i)** You have been provided with a wooden strip on the bench which is fixed in position. One end of the wooden strip overhangs the bench, as shown in Fig. 2.1.

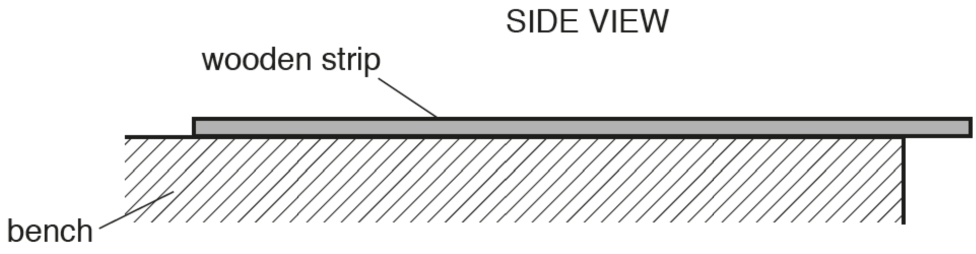

Fig. 2.1

Place the chain on the wooden strip and place one of the spheres on the paper clip at the end of the chain, as shown in Fig. 2.2. The sphere must **not** touch the wooden strip.

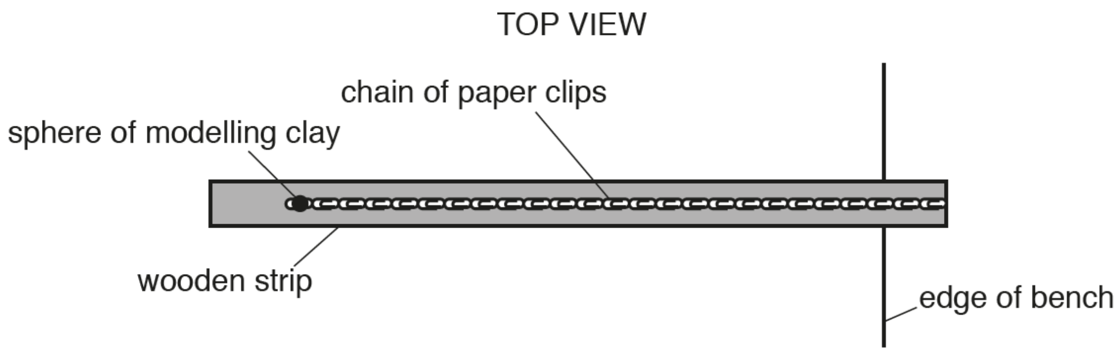

Fig. 2.2

Gradually move the paper clips off the end of the wooden strip so that they hang down, as shown in Fig. 2.3.

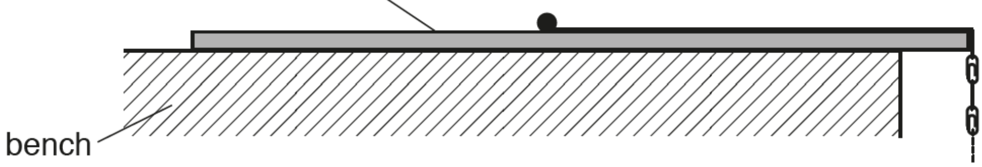

Fig. 2.3

When the chain starts to slip, count and record the number p of paper clips hanging off the end of the wooden strip and the number q of paper clips remaining on the strip.

p = ……………………………….

q = ……………………………….
[2]

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

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

(d) Replace the chain on the wooden strip and place both spheres on the paper clips at the end of the strip, as shown in Fig. 2.4.

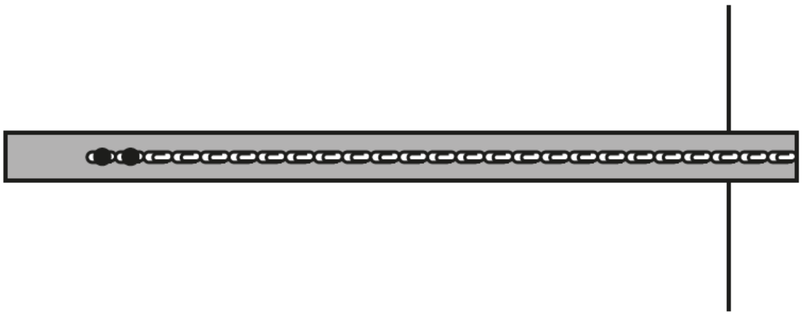

Fig. 2.4

Determine p and q.

p = ……………………………….

q = ……………………………….
[1]

(e) It is suggested that the relationship between p, q and c is

$$p = k\,(q + nc)$$

where n is the number of spheres on the chain and k is a constant.

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

first value of k = ……………………………….

second value of k = ……………………………….
[1]

(ii) Explain whether your results support the suggested relationship.

……………………………………………………………………………………………..

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

[Total: 12]

3 In this experiment, you will observe the motion of two simple pendulums, and measure the interval between successive times at which the pendulums are moving together.

You will investigate how this time interval is affected when the length of one of the pendulums is changed.

(a) Set up two pendulums side by side as shown in Fig. 3.1, with each string clamped between two wooden blocks.

Set the length of pendulum A to about 0.65 m. Pendulum A should be left at its set length throughout the experiment.

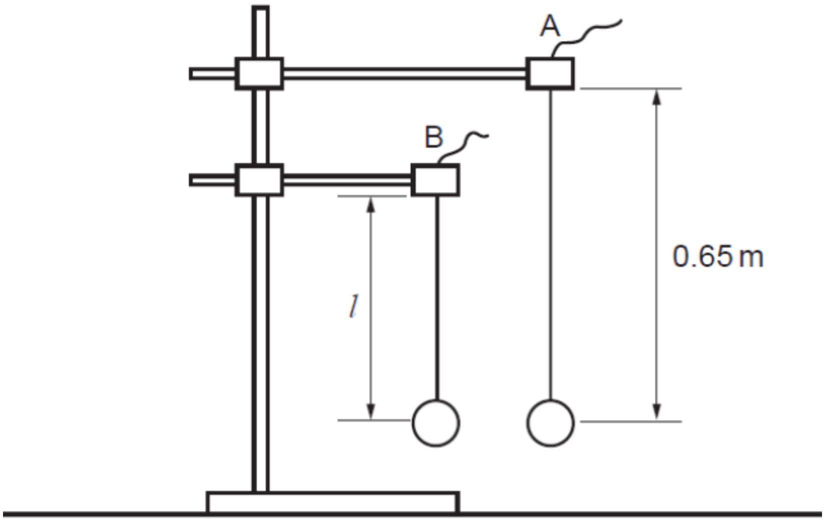

Fig. 3.1

(b) **(i)** Adjust pendulum B so that its length l is about 0.5 m.

Measure and record the value of l.

l = ………………………………. [1]

(ii) Estimate the percentage uncertainty of l.

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

(c) Set both pendulums into motion with small oscillations.

Start the stopwatch when the two pendulums are lined up as shown in Fig. 3.2 and are moving in the same direction.

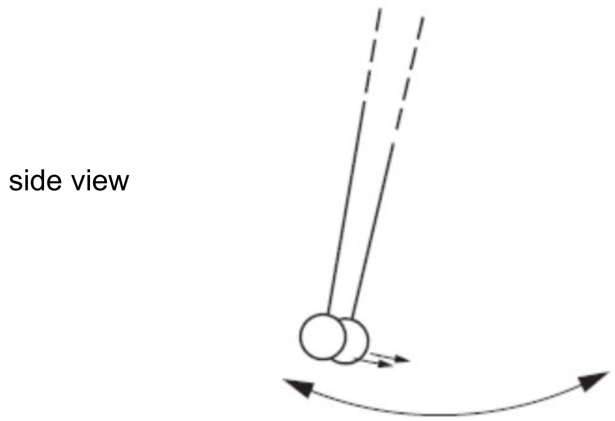

Fig. 3.2

(i) Determine the time *t* that elapses before the next occasion when the two pendulums are lined up and moving in the same direction.

t = ………………………………. [1]

(ii) Calculate the percentage uncertainty of *t*.

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

(d) Change the length of l to about 0.4 m.

Repeat **(b)(i)** and **(c)(i)**.

l = ………………………………

t = ………………………………
[2]

(e) It is suggested that

$$\frac{1}{t} = \frac{k}{\sqrt{l}}$$

where k is a constant.

(i) Use your values from **(b)(i)**, **(c)(i)** and **(d)** to determine two values of k. Give your values of k to an appropriate number of significant figures.

first value of k = ………………………………

second value of k = ………………………………
[2]

(ii) Justify the number of significant figures that you have given for your values of k.

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……………………………………………………………………………………………

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

(iii) Explain whether your results support the suggested relationship. Justify your conclusion by referring to your values in **(b)(ii)** and **(c)(ii)**.

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………………………………………………………………………………………………..

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

(iv) Using the results obtained in **(e)(i)**, calculate the number of times pendulum B which is initially in phase will go out of phase and back in phase again in 1 minute when l is 10 cm.

number of times = ………………………………. [1]

(f) Describe a source of uncertainty or limitation of the procedure for this experiment.

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

(g) In a separate investigation, the length L of pendulum B was varied. The results of $\frac{1}{t}$ and $\frac{1}{\sqrt{L}}$ were recorded in Fig. 3.3.

$\frac{1}{t}$ / s^{-1}	0.03	0.05	0.08	0.13	0.18
$\frac{1}{\sqrt{L}}$ / $m^{-1/2}$	1.29	1.35	1.40	1.50	1.60

Fig. 3.3

(i) Plot a graph of $\frac{1}{t}$ against $\frac{1}{\sqrt{L}}$ on the grid in Fig. 3.4 and draw the line of best fit.

[2]

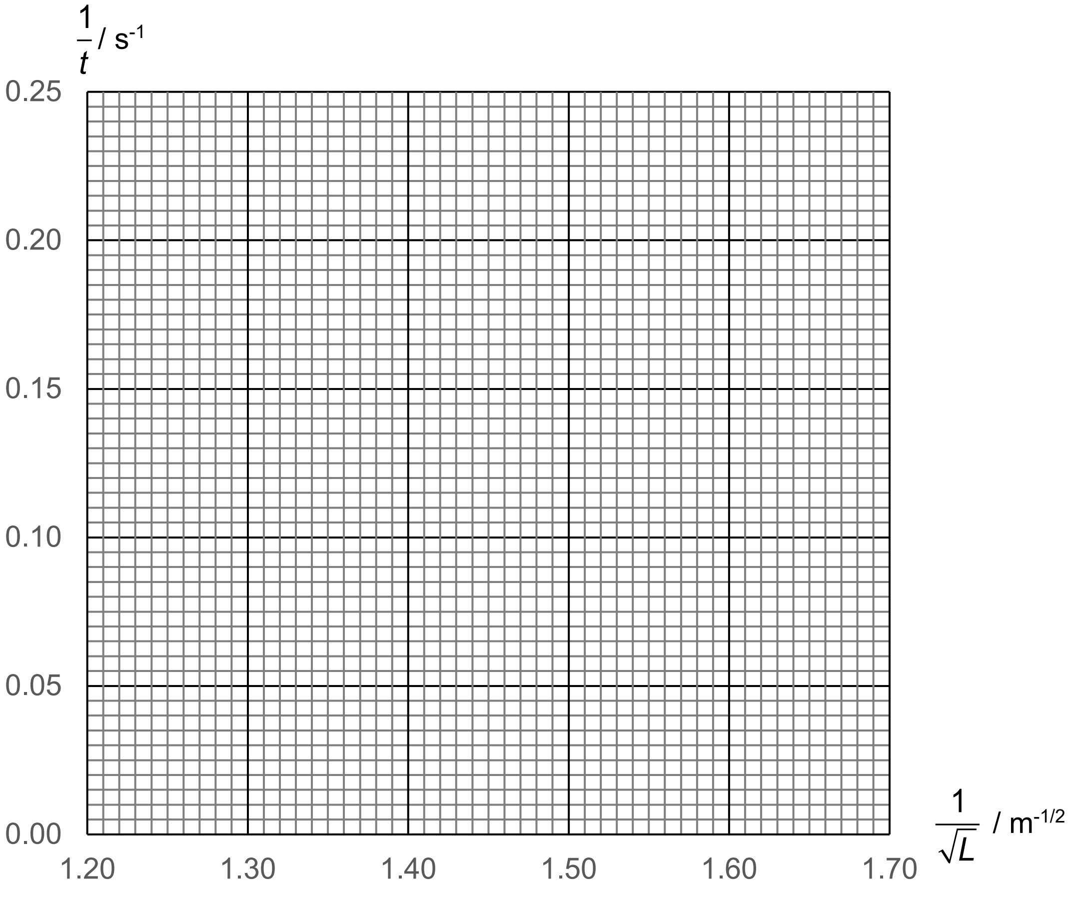

Fig. 3.4

(ii) Determine the gradient of your graph in **(g)(i)**.

gradient = ………………………………. [1]

(iii) With reference to your graph in **(g)(i)**, state and explain if $\frac{1}{t}$ is directly proportional to $\frac{1}{\sqrt{L}}$.

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……………………………………………………………………………………………..

…………………………………………………………………………………………[2]

(h) A student wishes to investigate if the period *T* of a simple pendulum when it oscillates with small oscillations is directly proportional to the mass *m* of the pendulum.

Design an experiment to investigate this relationship.

You are provided with pendulums of different masses.

Your account should include:

- a diagram
- your experimental procedure
- control of variables
- how you would use your results to investigate the relationship.

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[Total: 22]

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4 A student is investigating the angle at which a glass cylinder containing oil topples, as shown in Fig.4.

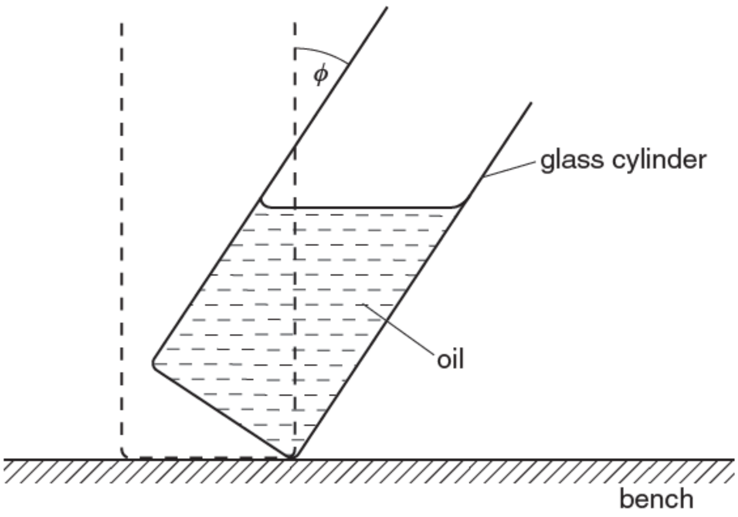

Fig. 4

A cylinder of diameter d containing a mass m of oil can be tilted through a maximum angle of ϕ from the vertical before it topples.

It is suggested that the relationship between d, m and ϕ is

$$\tan \phi = k\, d^{p} m^{q}$$

where k, p and q are constants.

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

You are provided with several glass cylinders of different diameters.

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

- the equipment you would use
- the procedure to be followed
- the control of variables
- safety precautions
- any precautions that should be taken to improve the accuracy and safety of the experiment.

Diagram

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