



CANDIDATE
NAME

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CIVICS
GROUP

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REGISTRATION
NUMBER

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PHYSICS

Paper 4 Practical

9749/04

15th September 2023

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number 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 working.

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	14
2	19
Total	33

1 In this experiment, you will investigate the behaviour of a system in static equilibrium.

(a) (i) Determine the mass of one paper clip.

mass of one paper clip = [2]

(ii) You are provided with two strings.

Connect two mass hangers with the shorter string and place them on both sides of a pulley. The mass hangers should balance each other's weight and hang in equilibrium.

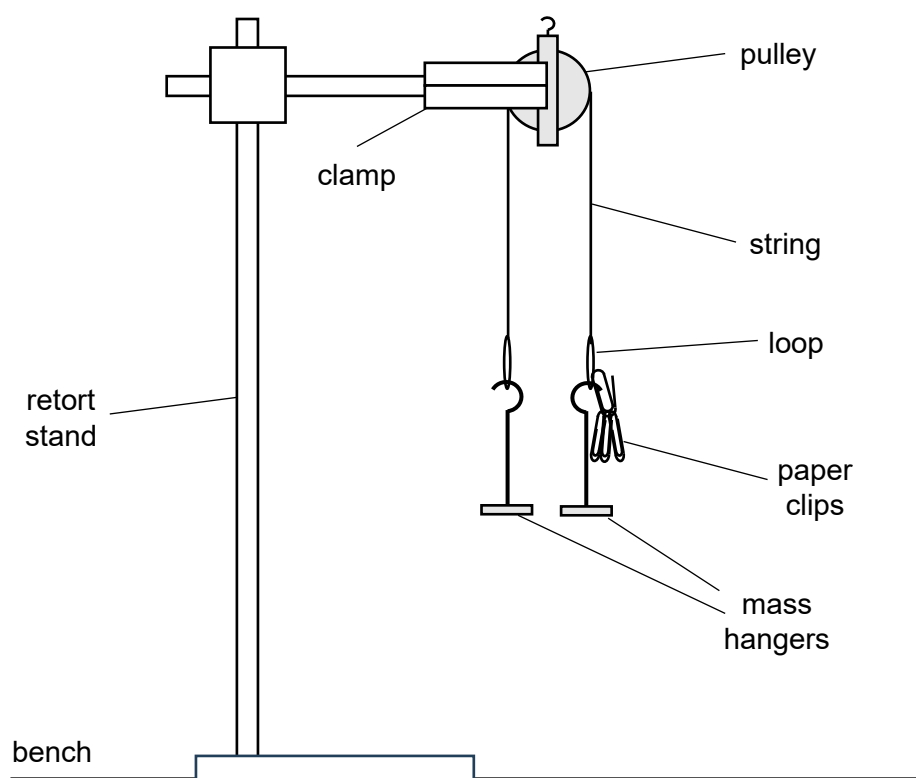


Fig 1.1

Add paper clips, one by one, to one side as shown in Fig. 1.1 until the pulley starts to rotate. Record the minimum number of paper clips that is required to cause the pulley to rotate.

number of paper clips =[1]

- (b) Using the longer string, set up the apparatus as shown in Fig. 1.2.
Mass m and M are provided by a 50 g mass hanger and a pendulum bob, respectively.

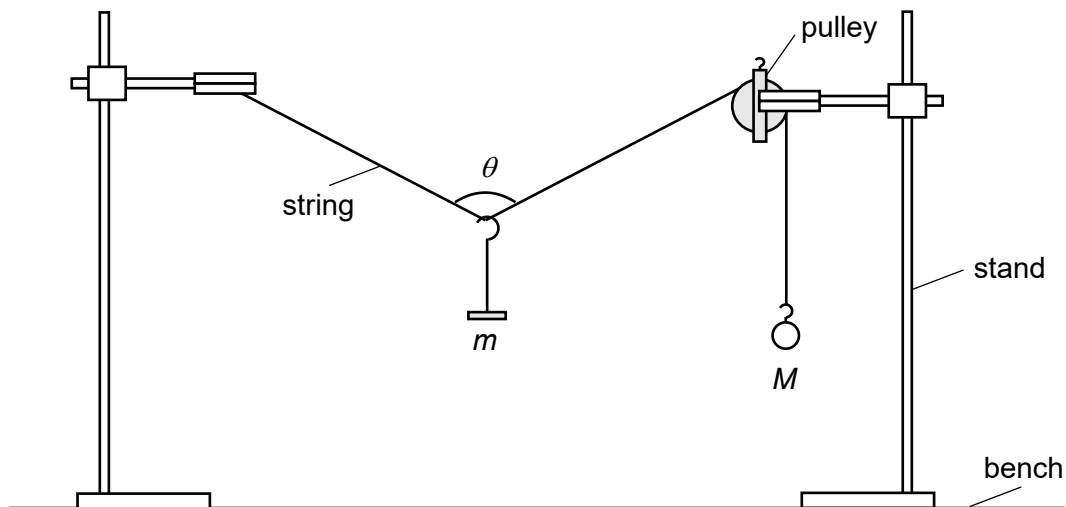


Fig 1.2

- (i) Adjust the position of m along the string until the angle θ is symmetrical about the vertical axis.

Measure and record θ .

$\theta = \dots\dots\dots$ [1]

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

percentage uncertainty in $\theta = \dots\dots\dots$ [1]

(c) M , m and θ are related by the expression

$$2M \cos \frac{\theta}{2} = m.$$

(i) Calculate the value of M .

$$M = \dots\dots\dots [1]$$

(ii) Using your values in (a)(ii) and (b)(ii), estimate the maximum value of M .

$$\text{maximum } M = \dots\dots\dots [1]$$

(iii) Repeat (b)(i) for $m = 100$ g.

$$\theta = \dots\dots\dots [1]$$

(d) It is suggested that

$$m^2 = k(1 + \cos \theta)$$

where k is a constant.

(i) Use your values from (b)(i) and (c)(iii) to determine two values of k .

first value of k =

second value of k =

[2]

(ii) State whether the results of your experiment support the suggested relationship. Justify your conclusion by referring to your value in (b)(ii).

.....

 [2]

- (e) (i) Suggest a significant source of error in the measurement of θ .

.....

.....

.....

..... [1]

- (ii) Suggest an improvement that could be made to address the error identified in (e)(i).
You may suggest the use of other apparatus or a different procedure.

.....

.....

.....

..... [1]

[Total: 14 Marks]

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- 2 In this experiment, you will investigate how the period of oscillation of a bent metal wire varies with the angle between the straight parts of the wire

- (a) (i) Make a sharp bend at the centre of the wire so that the angle θ between the straight parts of the wire is about 140° as shown in Fig. 2.1.

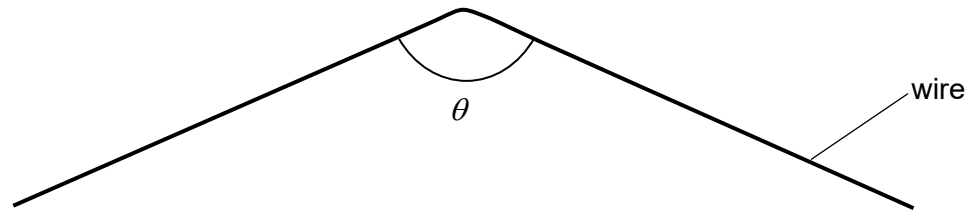


Fig 2.1

- (ii) Measure and record θ .

$\theta = \dots\dots\dots$ [1]

- (b) (i) Secure the cork using the clamp so that the pin is mounted horizontally.
Suspend the wire on the pin so that the arrangement is as shown in Fig. 2.2.

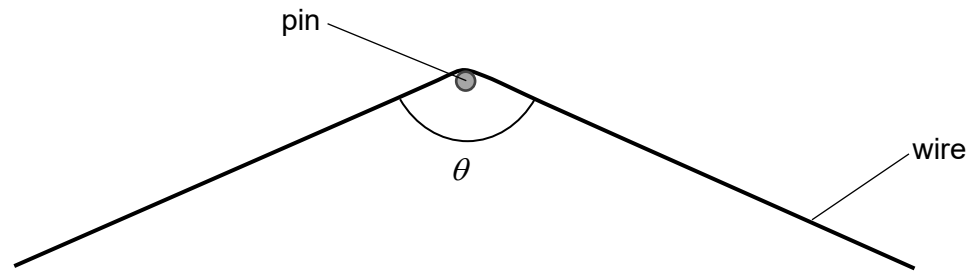


Fig 2.2

- (ii) Displace the wire from its equilibrium position and release it so that it performs small oscillations in a vertical plane, as shown in Fig. 2.3.

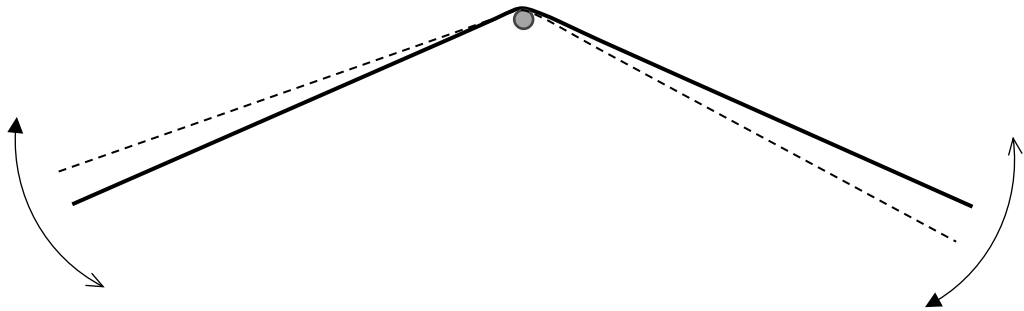


Fig 2.3

- (iii) Make and record measurements to determine the period T of these oscillations.

$T = \dots\dots\dots$ [1]

- (c) Remove the wire from the pin. Change the value of θ by gently bending the wire. The new value of θ should be in the range $30^\circ \leq \theta \leq 140^\circ$.

Repeat (b) until you have six sets of readings for θ and T .

Record your results in a table. Include values of $\frac{1}{T^4}$ and $\cos \theta$ in your table of results.

- (d) (i) The quantities T and θ are related by the equation

$$\frac{1}{T^4} = A \cos \theta + B$$

where A and B are constants.

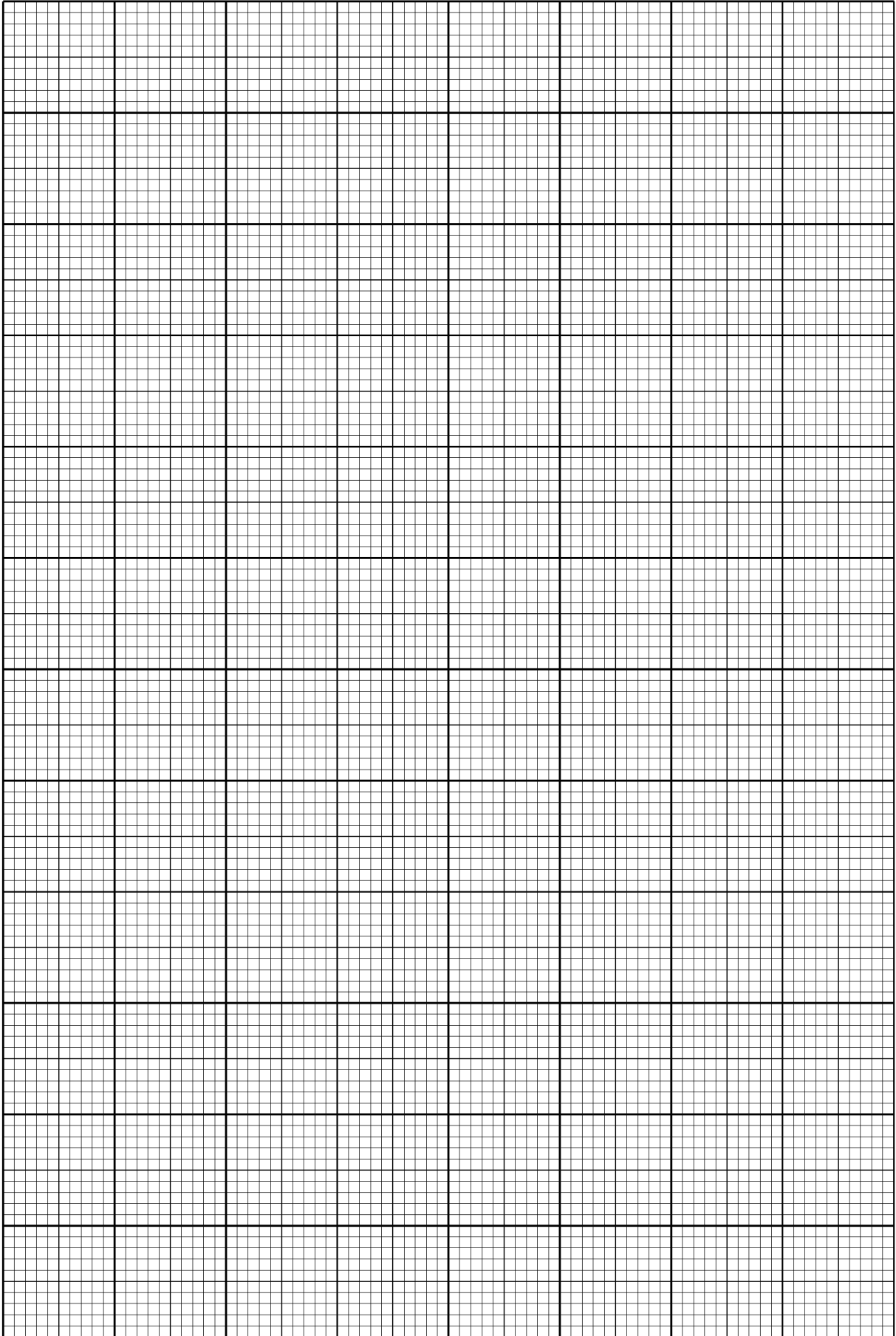
Plot a suitable graph to determine the values of A and B .

[7]

$A =$

$B =$

[4]



[3]

- (ii) Comment on any anomalous data or results that you may have obtained.

.....

 [1]

- (e) A theoretical treatment of this oscillator shows that

$$A = \frac{1}{2} \left(\frac{3g}{4\pi^2 L} \right)^2$$

where L is the total length of the wire and g is the acceleration of free fall.

By making one further measurement, and using the results of your experiment, calculate a value for g .

$g =$ [2]

[Total: 19 Marks]