Anglo-Chinese Junior College

Physics Preliminary Examination
Higher 2

A Methodist Institution
(Founded 1886)

CANDIDATE NAME		CLASS	
CENTRE NUMBER	S 3 0 0 4	INDEX NUMBER	

PHYSICS **9749/04**

Paper 4 Practical

1 August 2024
2 hours 30 mins

Candidates answer on the Question Paper.
Additional Materials: As listed In the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your name and index 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 the appropriate units.

Give details of your 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 Examiners' use only	
1	/ 10
2	/ 12
3	/ 21
4	/ 12
Total	/ 55

For Examiner's Use

1 In this experiment, you will investigate an electrical circuit.

(a) Set up the circuit shown in Fig. 1.1.

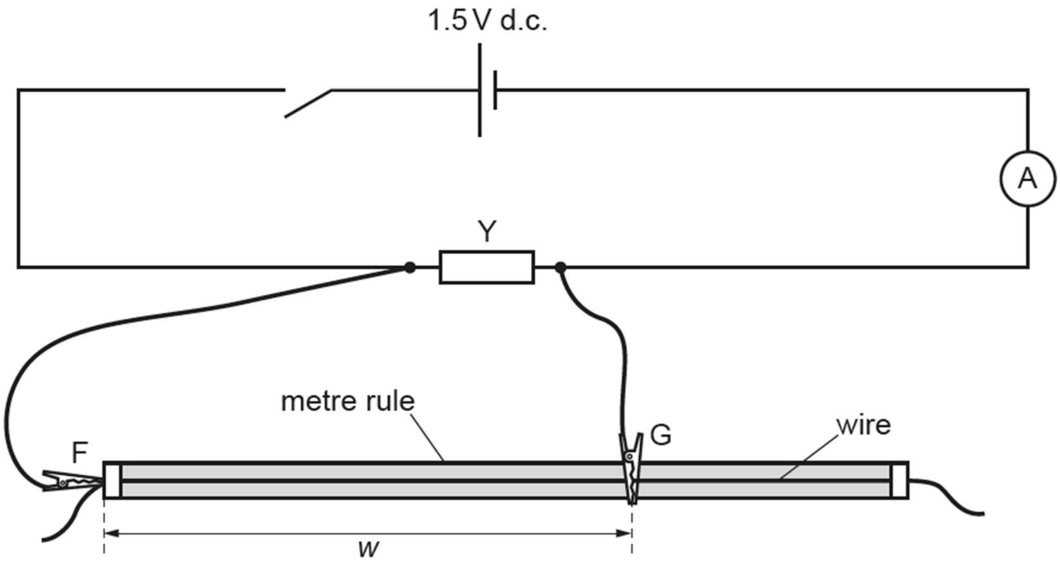


Fig. 1.1

The distance between F and G is *w*. Attach G to the wire so that *w* is approximately 70 cm.

Close the switch.

Record *w* and the ammeter reading I_1.

w = ……………………….…………..

I_1 = ……………………….…………..

[1]

Open the switch.

For Examiner's Use

(b) Keep F and G in the **same** positions so that the value of *w* remains the **same**.

Change some of the connecting wires to set up the circuit shown in Fig. 1.2.

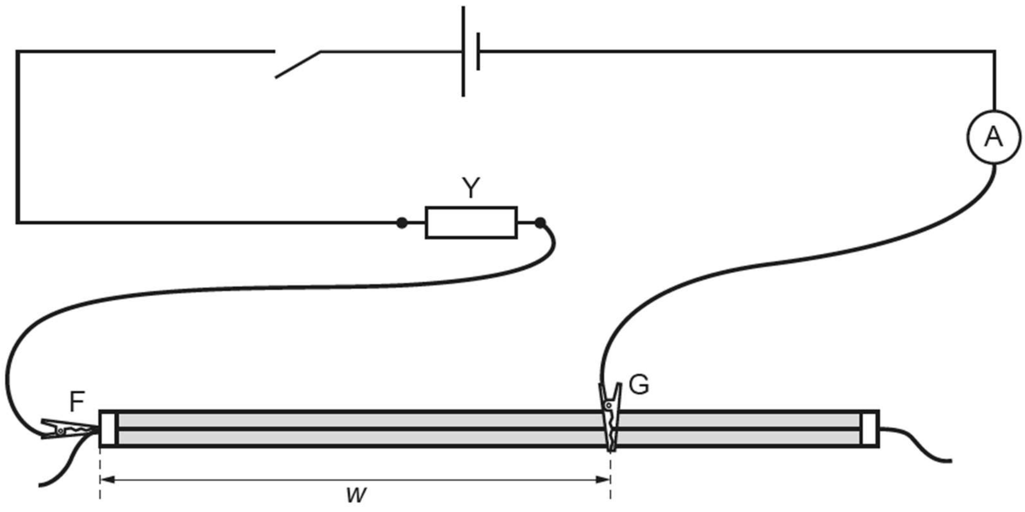


Fig. 1.2

Close the switch.

Record the ammeter reading I_2.

I_2 = ……………………….……………..

Open the switch.

Calculate $I_1 I_2$.

$I_1 I_2$ = ……………………….……………..

[1]

(c) Using values of w greater than 55 cm, vary w by adjusting G and repeat **(a)** and **(b)** until you have four sets of readings.

Present your results clearly.

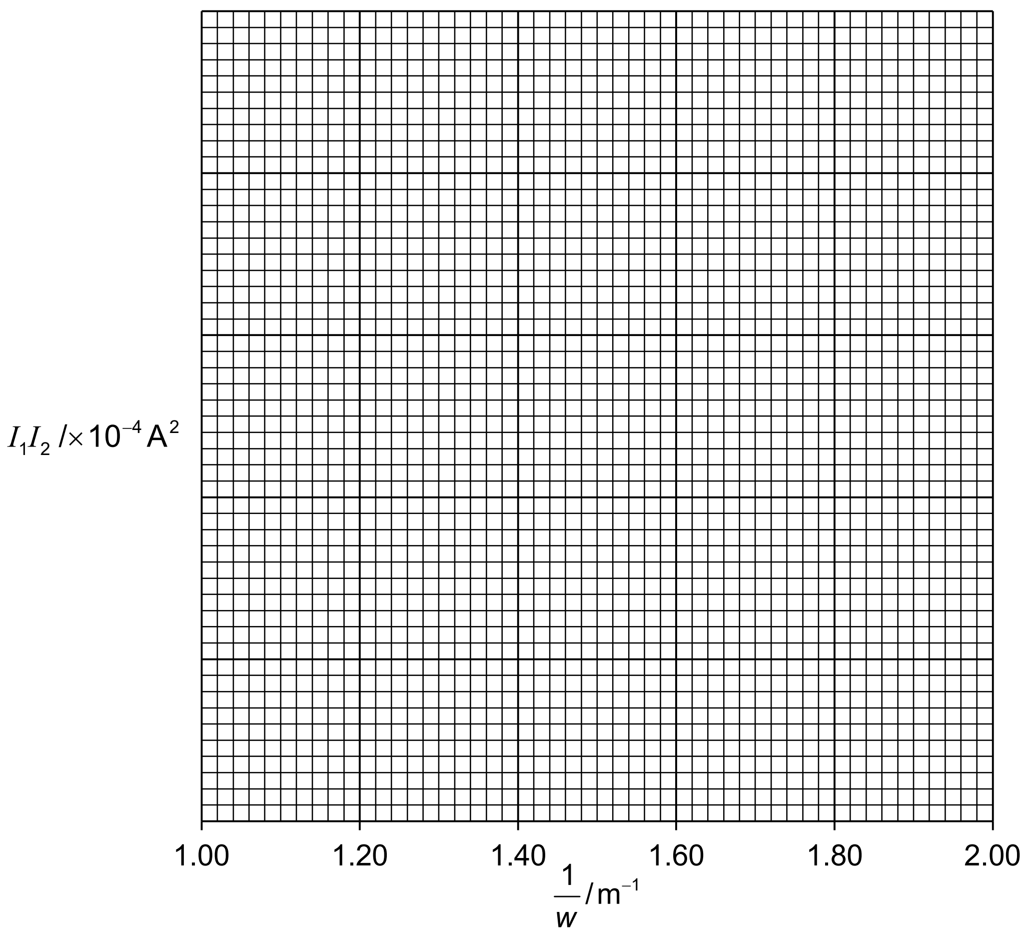
[3]

(d) It is suggested that w, I_1 and I_2 are related by the expression:

$$I_1 I_2 = \frac{P}{w} + Q$$

where P and Q are constants.

(i) Plot your results on the grid and draw the line of best fit.



[2]

For Examiner's Use

(ii) Use your graph to determine values for P and Q.

P = …………………….……………..

Q = …………………….……………..

[2]

(iii) Explain why the value of Q is not useful.

……………………………………………………………………………………..

……………………………………………………………………………………..

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

[Total: 10]

[Turn over

For Examiner's Use

2 In this experiment, you will investigate the properties of a flywheel.

(a) **(i)** A slotted mass is fixed to a length of plastic tube, as shown in Fig. 2.1.

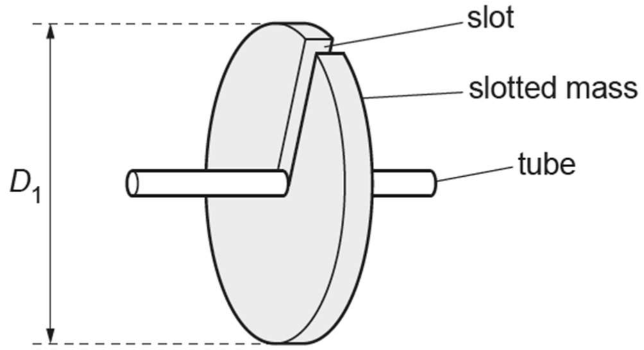


Fig. 2.1

Measure and record the diameter D_1 of the slotted mass.

D_1 = ………………………………….. cm

Calculate C using

$$C_1 = \frac{M_1 D_1^2}{2}$$

where M_1 = 0.100 kg.

C_1 = …………………………………..

[2]

(ii) Justify the number of significant figures that you have given for your value of C_1.

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………. [1]

For Examiner's Use

(iii) Set up the apparatus as shown in Fig. 2.2.

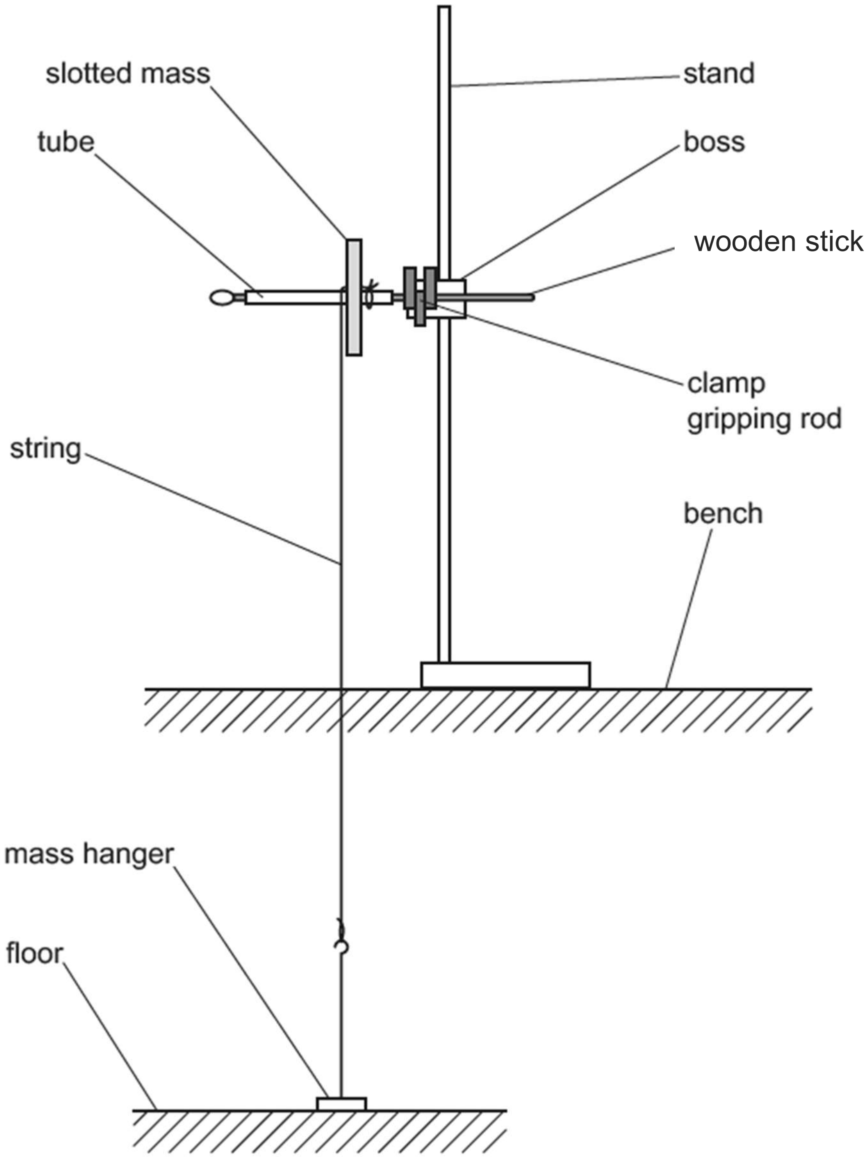


Fig. 2.2

The string tied to the tube will pass through the slot of the slotted mass as shown in Fig. 2.2.

Hook the mass hanger onto the other end of the string and then adjust the height of the boss until the mass hanger is just touching the floor.

For Examiner's Use

Rotate the slotted mass and tube 20 times so that the string is wound around the tube, as shown in Fig. 2.3.

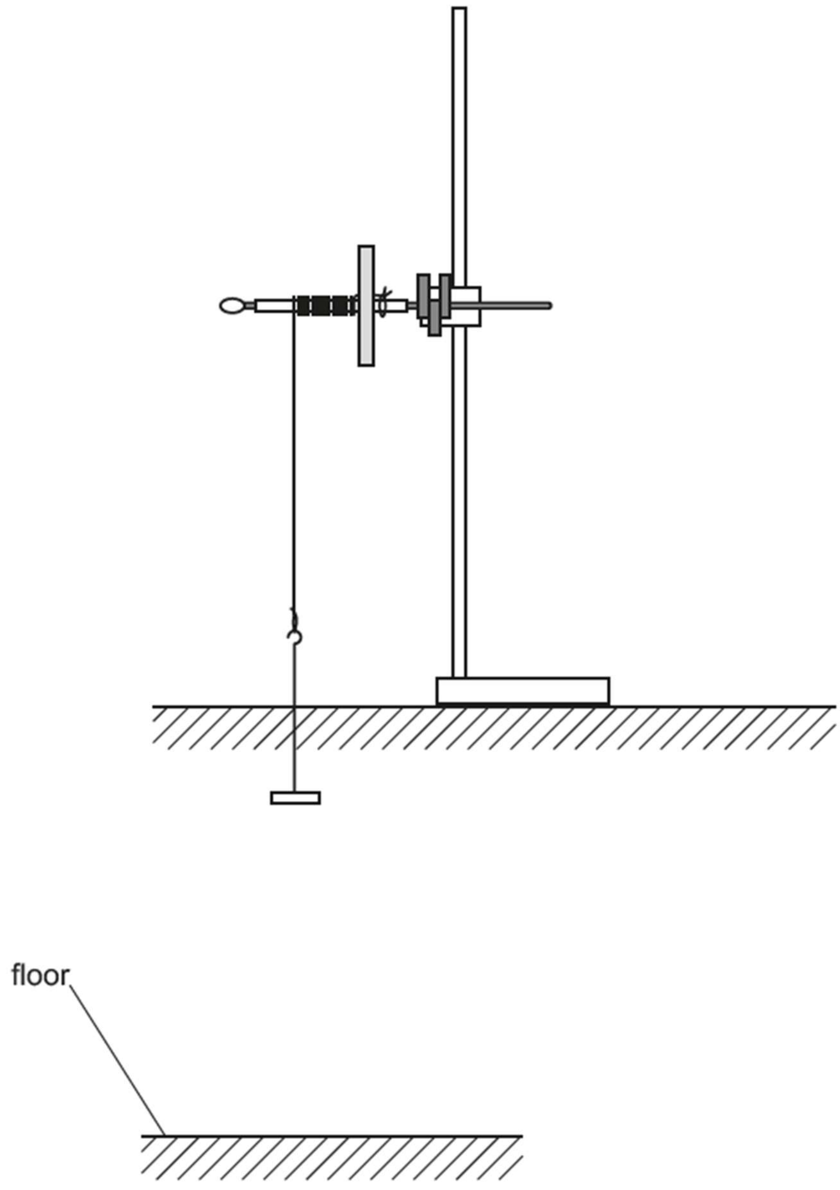


Fig. 2.3

Release the slotted mass and take measurements to determine the time *t* for the mass hanger to reach the floor.

t = ……………………………………..
[1]

For Examiner's Use

(iv) Estimate the percentage uncertainty in your value of t.

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

(b) **(i)** Using **all** the modelling clay provided, roll the modelling clay into a long cylinder and bend it to form a ring around the outside of the slotted mass, as shown in Fig. 2.4. Ensure it is securely attached to the slotted mass.

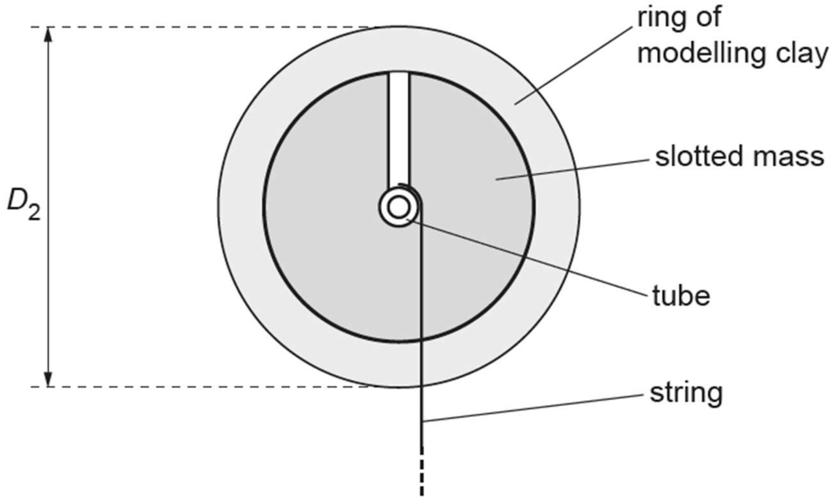


Fig. 2.4

For Examiner's Use

Measure and record the outside diameter D_2 of the ring of modelling clay, as shown in Fig. 2.4.

D_2 = …………………………………….. cm

Calculate C using

$$C_2 = \frac{M_1 D_1^2 + M_2 (D_2 + D_1)^2}{2}$$

where M_2 = 0.070 kg.

C_2 = ……………………………………..

[2]

(ii) Rotate the slotted mass and tube 20 times so that the string is wound around the tube, as shown in Fig. 2.3.

Release the slotted mass and take measurements to determine the time t for the mass hanger to reach the floor.

t = ……………………………………..

[1]

For Examiner's Use

(c) It is suggested the the relationship between t and C is

$$t^2 = kC$$

where k is a constant.

Using your data, calculate two values of k.

first value of k = …………………………………..

second value of k = …………………………………..

[1]

(d) Explain whether your results support the relationship in **(c)**. Justify your conclusion by referring to your answer in **(a)(iv)**.

…………………………………………………………………………………………

…………………………………………………………………………………………

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

For Examiner's Use

(e) The acceleration of the mass hanger a is given by:

$$a = \frac{2\pi dN}{t^2}$$

where d is the diameter of the plastic tube and N is the number of turns of the string around the plastic tube.

Take measurements to determine **two** values of a for different values of N.

[2]

[Total: 12]

For Examiner's Use

3 In this experiment, you will investigate oscillations involving a loaded metre rule.

(a) Set up the apparatus as shown in Fig. 3.1.

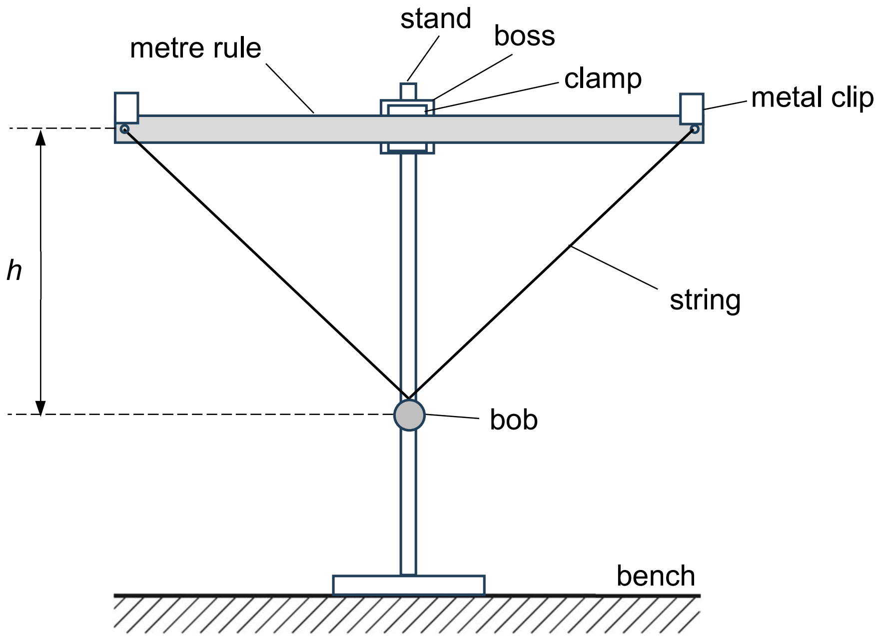


Fig. 3.1

Pass the string provided through one of the holes at the end of the metre rule and secure it using a metal clip.

Secure the pendulum bob onto the string by wrapping the string around the hook of the pendulum bob and pass the string through the hole at the other end of the metre rule.

Secure the string using another metal clip. The bob should be suspended approximately 60 cm below the centre of the metre rule.

(i) Measure and record the distance h from the centre of the pendulum bob to the centre of the metre rule.

h = ...

[1]

For Examiner's Use

(ii) Gently pull the pendulum bob towards you and release it so that the bob performs small oscillations perpendicular to the plane containing the metre rule and string.

Take measurements to determine the period T_1 of the oscillations.

T_1 = ……………………………………..

[1]

(b) Unclamp the metre rule. Clamp the cork and hook so that the metre rule may be suspended from the hook by the short loop of string at the centre of the metre rule as shown in Fig. 3.2. Ensure that the loop is not twisted.

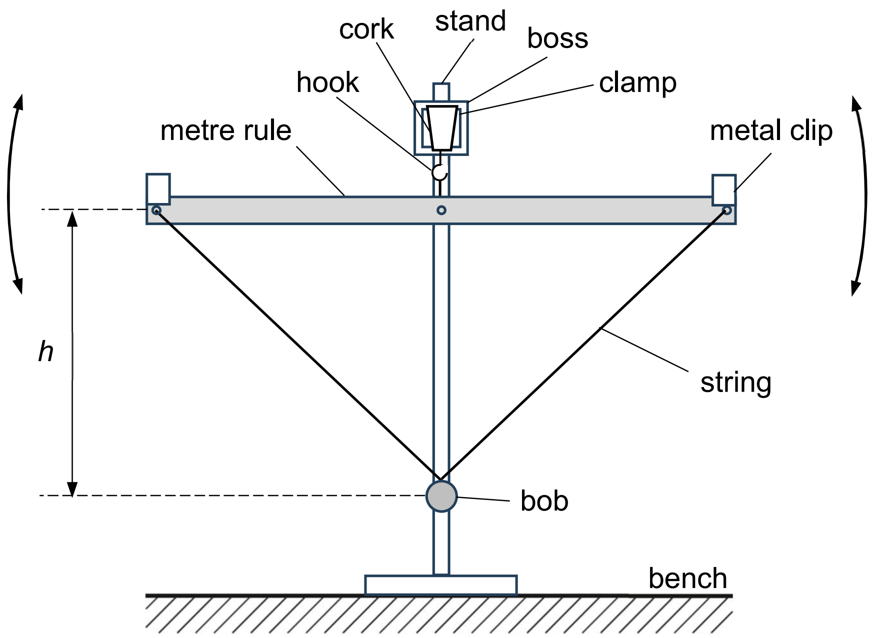


Fig. 3.2

For Examiner's Use

(i) Gently displace one end of the metre rule so that it performs small oscillations in the vertical plane containing the metre rule and string (i.e. a see-saw motion).

Take measurements to determine the period T_2 of the oscillations.

T_2 = ……………………………….....

[1]

(ii) Restore the metre rule to the set up shown in Fig. 3.1. Ensure that the pendulum bob remains vertically below the centre of the metre rule.

Vary h by adjusting the string using the metal clip and repeat **(a)(i)**, **(a)(ii)** and **(b)(i)** where 25 cm ≤ h ≤ 60 cm.

Present your results clearly.

[5]

[Turn over

For Examiner's Use

(c) It is suggested that T_1, T_2 and h are related by the expression:

$$T_2^2 - T_1^2 = \frac{X}{h} + Y$$

where X and Y are constants.

Plot a suitable graph to determine the values of X and Y.

X = ……………………..…………..

Y = ……………………..…………..

[7]

For Examiner's Use

[Turn over

For Examiner's Use

(d) Theory suggests that:

$$X = \frac{4\pi^2 ML^2}{3mg}$$

where:
- M is the mass of the metre rule
- L = 0.500 m
- m is the mass of the pendulum bob
- g = 9.81 m s^{-2}

Determine a value for M.

M = ... g
[2]

(e) Y is independent of M.

The experiment is repeated using a metre rule of a larger mass.

Sketch a line on your graph grid on page 17 to show the expected result.

Label this line W. [1]

For Examiner's Use

(f) It is suggested that the oscillation in **(b)** T_2 is independent of the mass m of the pendulum bob.

Explain how you would investigate this relationship.

You would be provided with pendulum bobs of different masses.

Your answer should include:
- your experimental procedure
- control of variables
- how you would use your results to show independence.

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.... [3]

[Total: 21]

For Examiner's Use

4 Bungee jumping is an adventure sport where people jump from higher ground such as a cliff or bridge with an elastic rope tied to their ankles to stop them from hitting the ground. The rope is designed to stretch and not break. As the jumper falls, the rope will reach its natural length and start to stretch. The rope reaches a maximum extension just before the jumper bounces back up.

The maximum extension E of the elastic rope depends on the mass m of the person and force constant k of the elastic rope and is given by the equation:

$$E = Cm^p k^q$$

where C, p and q are constants.

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

You are provided with different masses and elastic ropes of different material, lengths and diameters.

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 and safety of the experiment.

For Examiner's Use

Diagram

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[Turn over

For Examiner's Use

[12]

[Total: 12]

End of Paper