YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	
CG	INDEX NO

PHYSICS 9749/04

Paper 4 Practical **26 August 2024**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the apparatus list.

READ THESE INSTRUCTIONS FIRST

Write your name and class 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, highlighters, glue or correction fluid/tape.

Answer **all** questions.

You will be allowed a maximum of one hour 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, where appropriate, in the spaces provided.

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	**/11**
2	**/11**
3	**/22**
4	**/11**
Total	**/55**

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1 In this experiment, you will determine the resistivity of a metal.

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

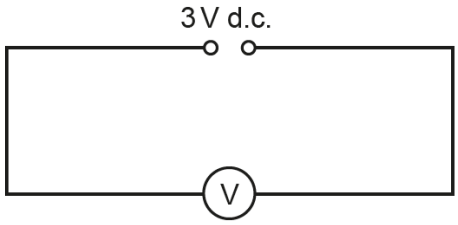


Fig. 1.1

Record the voltmeter reading E.

E = ... V

Set up the circuit shown in Fig. 1.2.

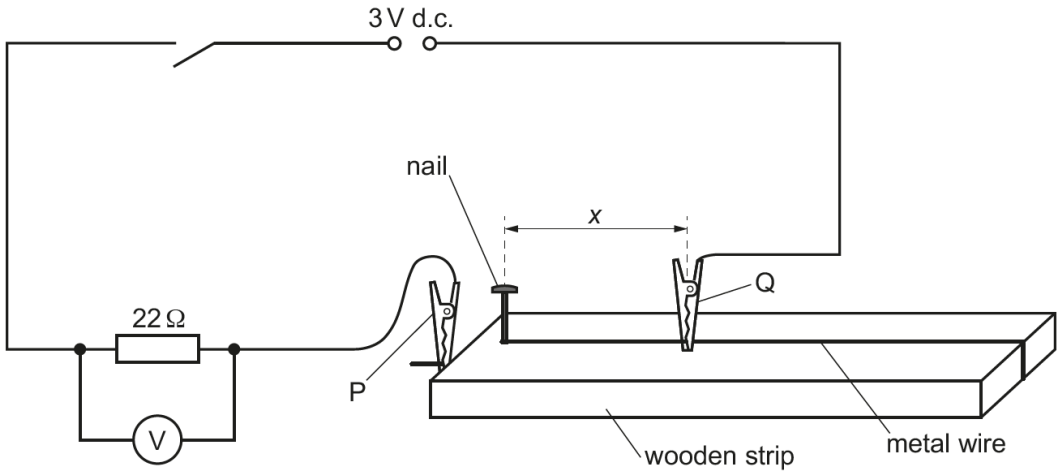


Fig. 1.2 (not to scale)

P and Q are crocodile clips.

The distance between the nail and Q is x, as shown in Fig. 1.2.

Adjust the position of Q until x is approximately 45 cm.

Close the switch.

The voltmeter reading is V.

Measure and record x and V.

x = ...

V = ...

[1]

Open the switch.

(b) Vary x by adjusting the position of Q on the wire. For each value of x, measure V.
Record your results in a table.

[3]

(c) It is suggested that V and x are related by the expression:

$$\frac{1}{V} = Ax + B$$

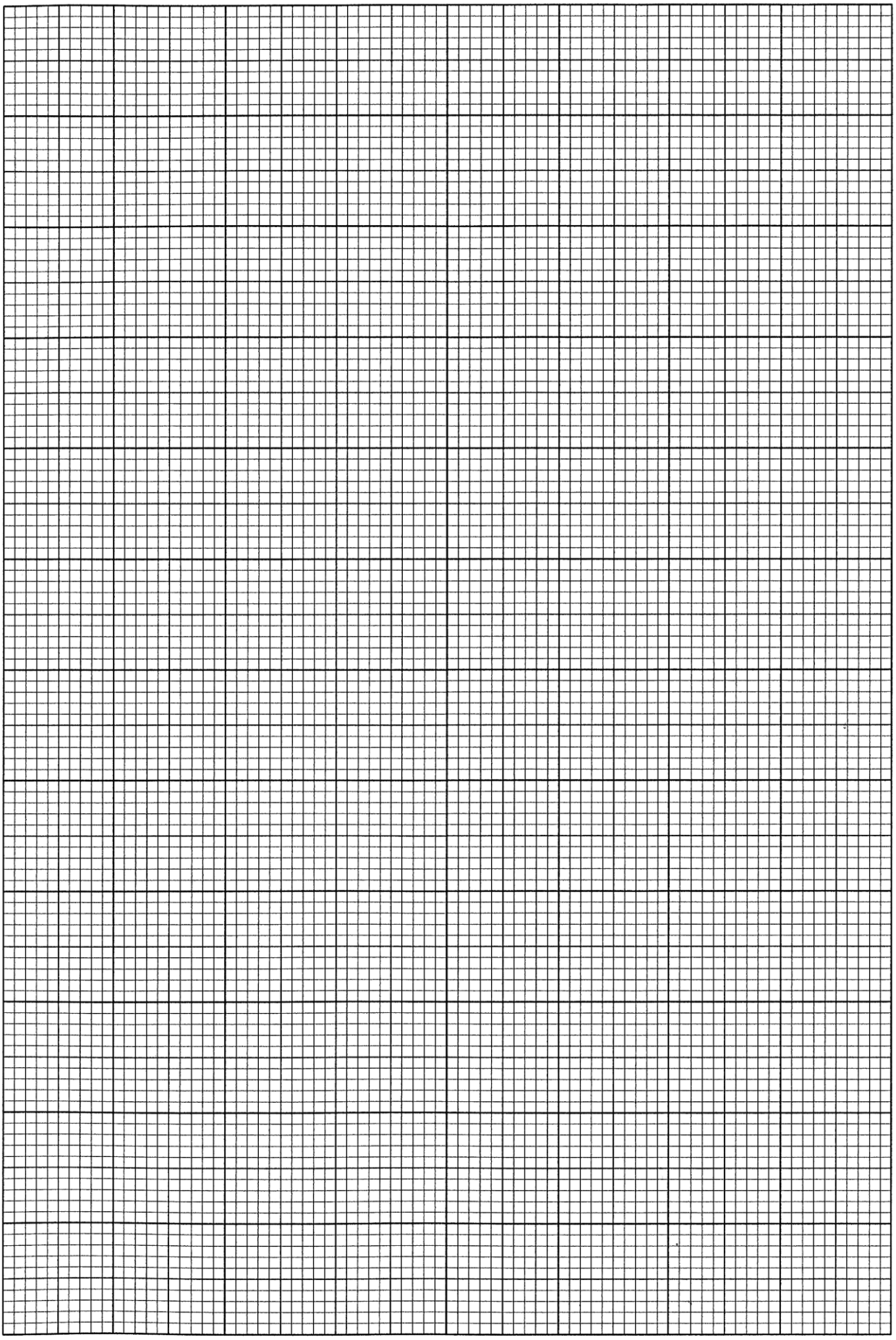
where A and B are constants.

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

A = ……

B = ……

[5]



(d) Theory suggests that A is given by the equation

$$A = -\frac{4\rho}{\pi d^2 ER}$$

where d is the diameter of the metal wire, R is 22 Ω and ρ is the resistivity of the metal.

Determine a value for ρ.

ρ = …….. Ω m [2]

[Total: 11]

2 In this experiment, you will investigate the oscillations of a loaded wooden strip.

(a) You have been provided with a rectangular wooden strip with a hole in its centre.

Use some of the Blu-Tack to attach the two 100 g masses as near as possible to one end of the strip, as shown in Fig. 2.1 and Fig. 2.2.

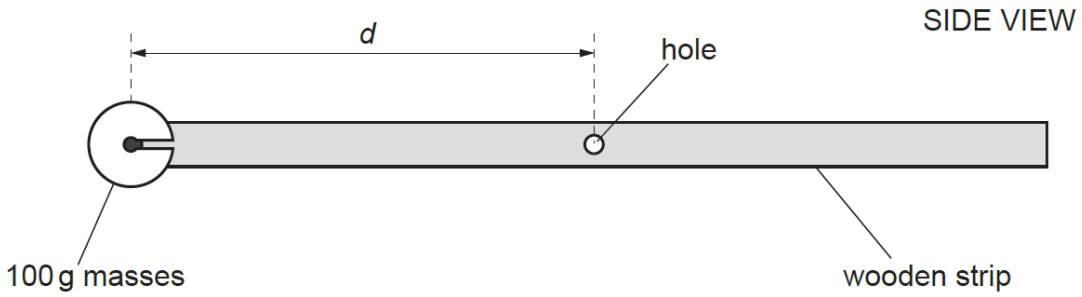


Fig. 2.1

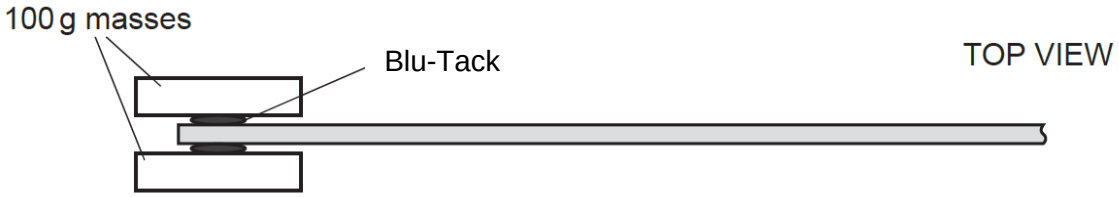


Fig. 2.2

The distance between the centre of the masses and the hole is *d*, as shown in Fig. 2.1.

Measure and record *d*.

d = ... [1]

(b) **(i)** Attach the two 20 g masses to the other end of the strip so that the distance between the centres of these masses and the hole is equal to *d*. Insert the nail into the hole in the centre of the wooden strip.

Set up the apparatus as shown in Fig. 2.3.

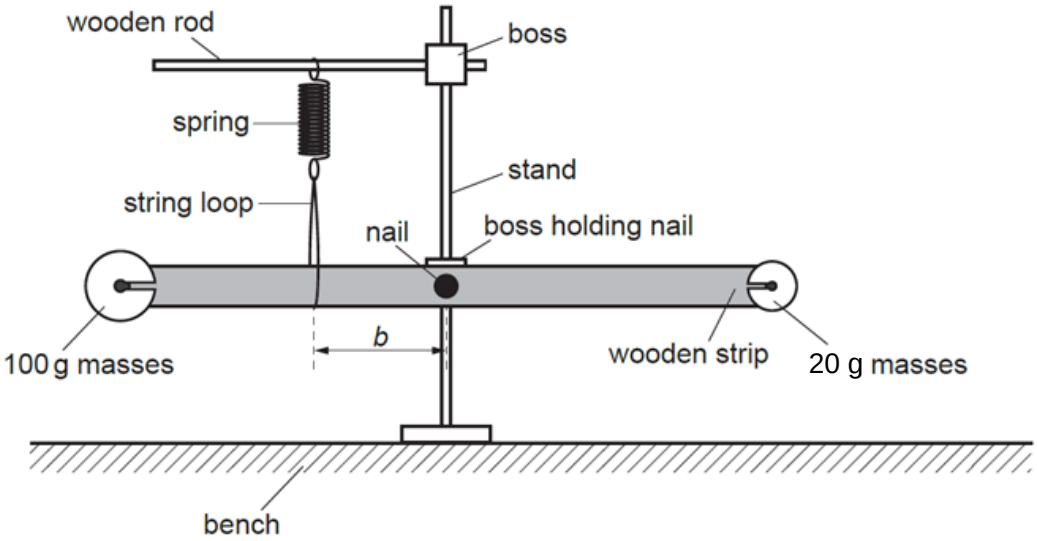


Fig. 2.3 (not to scale)

The distance between the string loop and the nail in the centre of the strip is *b*. Adjust the position of the string loop and spring until *b* is approximately 10 cm.

Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.

Measure and record *b*.

b = ... [1]

(ii) Calculate α where

$$\alpha = \frac{b}{d}$$

α = ... [1]

(iii) Estimate the percentage uncertainty in your value of α.

percentage uncertainty in α = …… [1]

(c) Move the end of the strip with the two 100 g masses vertically down through a short distance. Release the end of the strip. The strip will oscillate up and down.

(i) Take measurements to determine the period T of these oscillations.

T = …… [2]

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

percentage uncertainty in T = …… [1]

(d) Change the value of b to approximately 20 cm.

Adjust the heights of the bosses until the strip is horizontal and the spring and string loop are vertical.

Measure and record b.

b = ……..……

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

α = ……..……

T = ……..……

[2]

(e) It is suggested that the relationship between T and α is

$$T = \frac{C}{\alpha}$$

where C is a constant.

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

first value of C = ……

second value of C = ……

[1]

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

……

……

……

……..… [1]

[Total: 11]

3 In this experiment, you will investigate a wooden strip resting at an angle.

(a) **(i)** You are provided with a wooden strip, as shown in Fig. 3.1

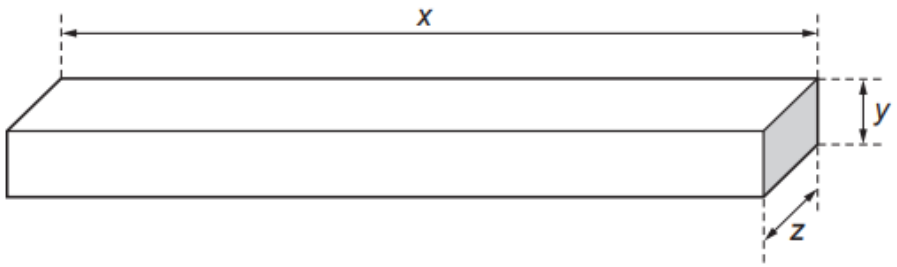


Fig. 3.1

The dimensions of the strip are x, y and z.

Measure and record x, y, and z.

x = ...

y = ...

z = ...

(ii) Use a weighing balance to determine the mass m of the wooden strip.

m = ... [2]

(iii) The volume V of the strip is given by the equation:

$$V = xyz$$

Calculate V.

V = ... m^3 [1]

(b) Set up the apparatus as shown in Fig. 3.2.

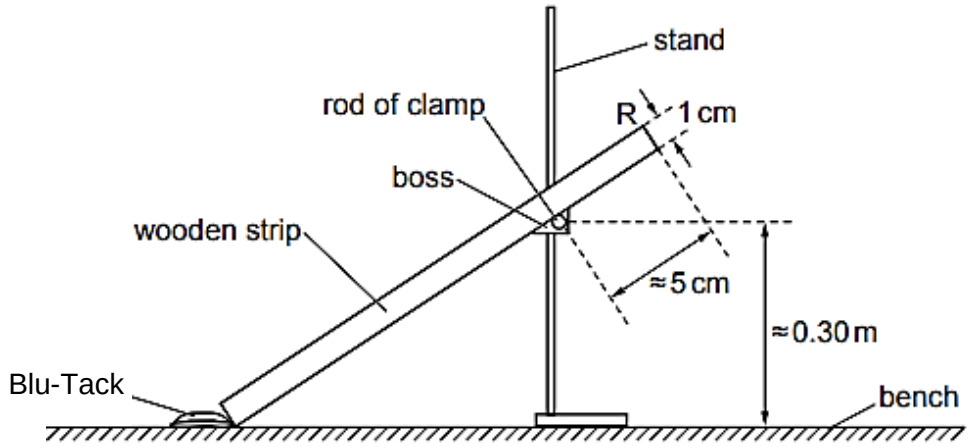


Fig. 3.2 (not to scale)

Adjust the position of the boss so that the rod of the clamp is approximately 0.30 m above the bench.

Adjust the wooden strip so that the distance between the rod and the raised end R of the wooden strip is approximately 5 cm. Use some Blu-Tack to prevent the wooden strip from slipping.

(i) Use Blu-Tack to attach the 50 g mass holder to the wooden strip. Adjust the distance *d* between the lower end of the wooden strip and the centre of the mass holder so that it is approximately 0.15 m, as shown in Fig. 3.3.

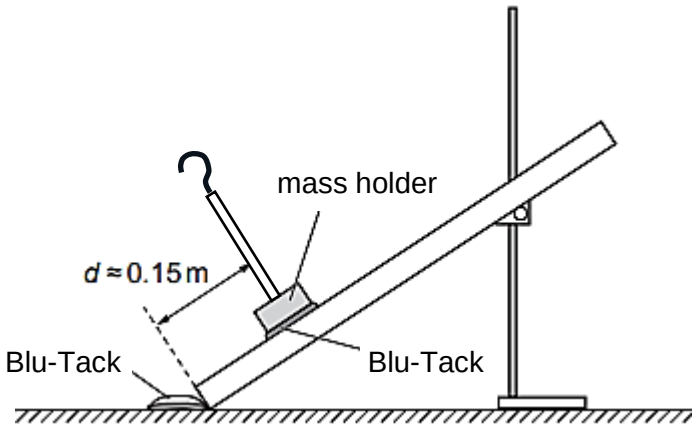


Fig. 3.3

Measure and record *d*.

d = ... [1]

(ii) Use Blu-Tack to attach the loop of string at the raised end of the wooden strip, as shown in Fig. 3.4.

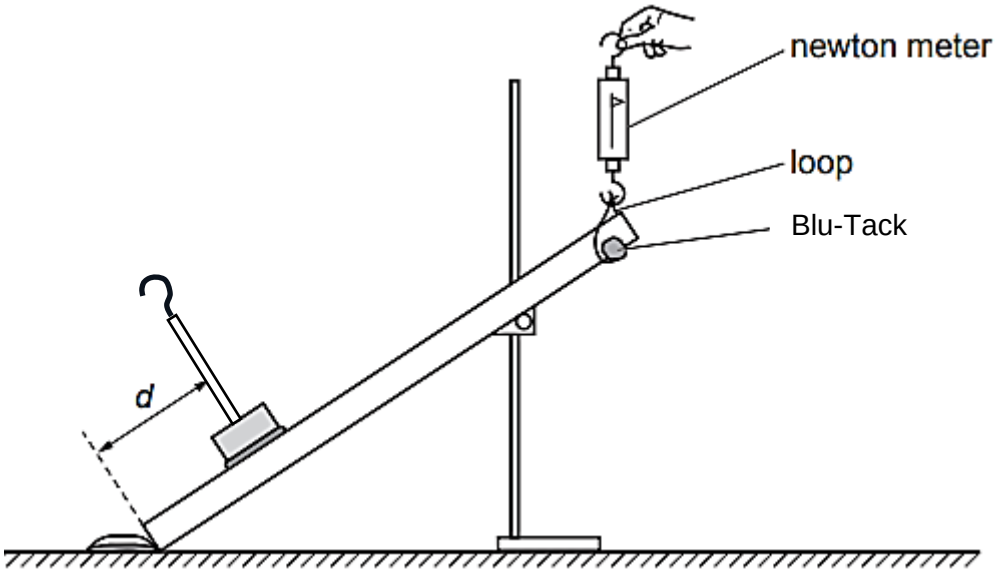


Fig. 3.4

Use the newton-meter to determine the vertical force F needed to just lift the wooden strip from the rod.

F = ... N [1]

(iii) The combined mass of the mass holder and the slotted masses is M. Vary M by adding more 50 g slotted mass onto the mass holder and repeat **(b)(ii)**.

Present your results clearly.

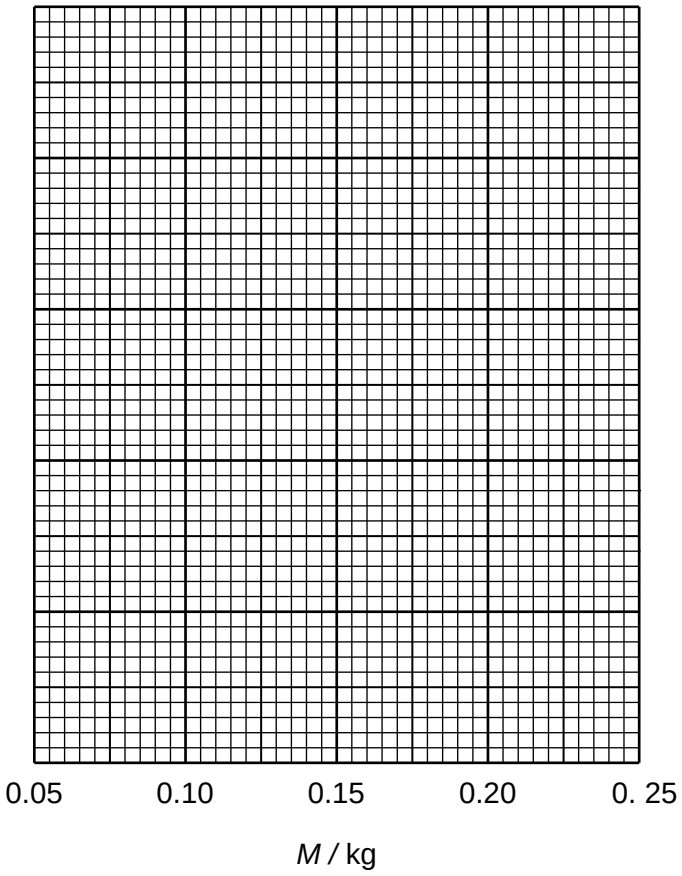
[3]

(c) Theory suggests that

$$F = \frac{Mgd}{x} + S$$

where g is 9.81 N kg^{-1}.

Plot a suitable graph to determine the value of S.



S = ……

[4]

(d) S is related to the density ρ of the wooden strip by the equation

$$S = \frac{1}{2}\rho V g$$

where g = 9.81 N kg^{-1}.

Calculate ρ.

ρ = ... [2]

(e) **(i)** Suggest **one** significant source of uncertainty in this experiment.

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..... [1]

(ii) Suggest **one** improvement that can be made to this experiment to reduce the uncertainty identified in **(e)(i)**.

You may suggest the use of other apparatus or a different procedure.

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..... [1]

(f) A ladder leaning on a wall experiences frictional forces to keep it from slipping. A person stands on the ladder a distance d along the ladder from the point that the ladder touches the ground.

It is suggested that the expression of the **minimum** angle θ that the ladder makes with the ground before the ladder slips is

$$\tan\theta = Pd + Q$$

where P and Q are constants.

Plan an investigation to find P and Q, using the mass holder as a model of a person, and the wooden strip as a model of the ladder by leaning it against a vertical wooden board.

Your answer should include a diagram and your experimental procedure.

Use your apparatus to determine P and Q by obtaining **two** sets of values of θ and d.

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[6]

[Total: 22]

4 When a light plastic ball is placed in a vertical column of moving air, the ball becomes stationary at a height *h*, as shown in Fig. 4.1.

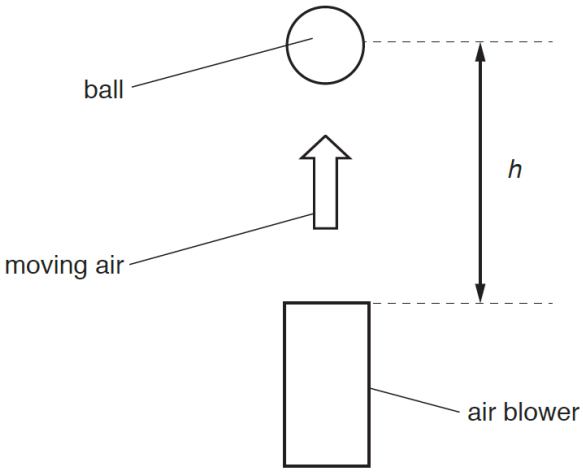

Fig. 4.1

A student is using an air blower to create a vertical column of moving air. The student connects the motor of the air blower to a d.c. power supply.

It is suggested that *h* is related to the diameter *d* of the ball and the power *p* of the motor by the relationship

$$h = C\,d^{a}p^{b}$$

where *C* is a constant.

Design a laboratory experiment to determine the values of constants *a* and *b*.

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.

Diagram

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[Total : 11]