Candidate Name: _____

Class	Adm No

H

millennia institute

2024 Preliminary Exams

Pre-University 3

H2 PHYSICS **9749 / 04**

Paper 4 Practical **26 August**

Candidates answer on the Question Paper. **2 hours 30 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and admission number in the spaces provided at the top of this page.

Write in dark blue or black pen on both sides of the papers.

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 in this 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	/16
2	/8
3	/19
4	/12
TOTAL	**/ 55**

1 This investigation considers the size of the hole needed in a salt shaker for the salt to flow at a suitable rate.

(a) You have been provided with a beaker labelled **P** containing 100 g of salt as shown in Fig. 1.1.

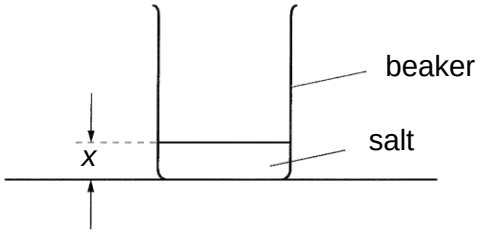

Fig. 1.1

(i) Measure and record the depth *x* of salt in beaker **P** using the vernier calipers.

x = ... [1]

(ii) State a significant source of error in your value of *x*.

.....

..... [1]

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

percentage uncertainty = ... [1]

(b) You have been provided with two cards. Each card has a hole of a different size.

(i) Measure and record the diameter *d* of the smaller hole.

d = ... [1]

(ii) Determine the area *A* of the smaller hole.

A = ... [1]

(c) (i) Fill the boiling-tube, as shown in Fig. 1.2, with salt from beaker **P**.

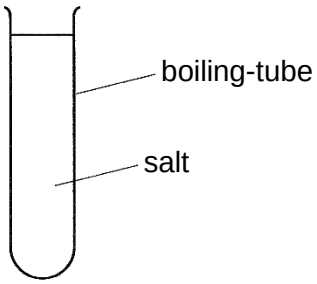

Fig. 1.2

(ii) Cover the open end of the boiling-tube with the card that has the smaller hole.

Use tape to attach the card to the boiling-tube.

The hole should not be covered by tape. When the boiling-tube is inverted, it should not be possible for salt to leave the boiling-tube other than through the hole.

(iii) Cover the hole with your finger.

Invert the boiling-tube over the empty beaker **Q**.

Remove your finger and allow the salt to flow through the hole into beaker **Q** for 50 seconds.

It may be necessary to shake the boiling-tube gently to achieve constant flow.

(iv) Tap beaker **Q** gently on the bench to ensure that the surface of the salt is level. Measure and record the depth *y* of salt in beaker **Q**.

y = ...

(v) Estimate the mass *m* of salt in beaker **Q**.

m = ... [1]

(d) The recommended daily intake of salt for an adult is 5 g.

Use your data to calculate the time that a shaker, with a hole the same size as that in **(c)(ii)** should be inverted to apply 5 g of salt to food.

time = ... [1]

(e) It is suggested that the rate of flow *R* of salt is proportional to the area *A* of the hole.

Use the card with the larger hole to take further measurements in order to investigate this suggestion. State and explain whether or not you agree with this suggestion.

Present your measurements and calculated results clearly.

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..... [6]

(f) A statement found on the internet says that:

"The salt shaker may be distinguished primarily by the size of the holes, and then by the number of holes. Salt is coarser than pepper, and needs the larger hole. It is also heavier and flows much more freely than pepper, accordingly there are often fewer holes on the salt shaker to help control the flow. However, there is no manufacturing standard."

Suggest changes that could be made to the salt investigation to study the flow of pepper from a shaker.

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..... [3]

[Total: 16 marks]

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2 In this experiment, you will determine the length of a metal in the form of a wire.

(a) Measure and record the diameter *d* of the short sample Y that is attached to the cardboard tube.

d = ... [1]

(b) Setup the circuit as shown in Fig. 2.1.

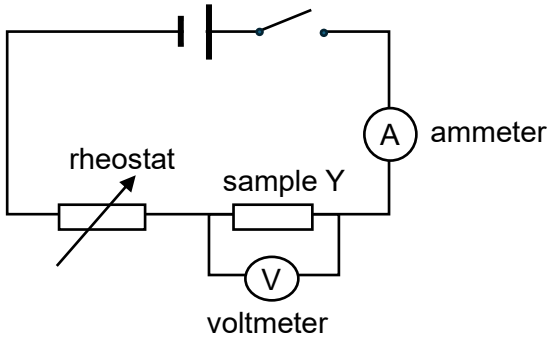

Fig. 2.1

(i) Set the rheostat to its maximum resistance.

(ii) Close the circuit.
Measure the current *I* and the potential difference *V* across sample Y.

I = ...

V = ... [1]

(iii) Open the circuit

(iv) Vary the resistance of the rheostat and repeat **(b)(ii)**, **(b)(iii)** until you have 3 more sets of I and V.

[2]

(c) Plot your values from **(b)(iv)** on Fig. 2.2.

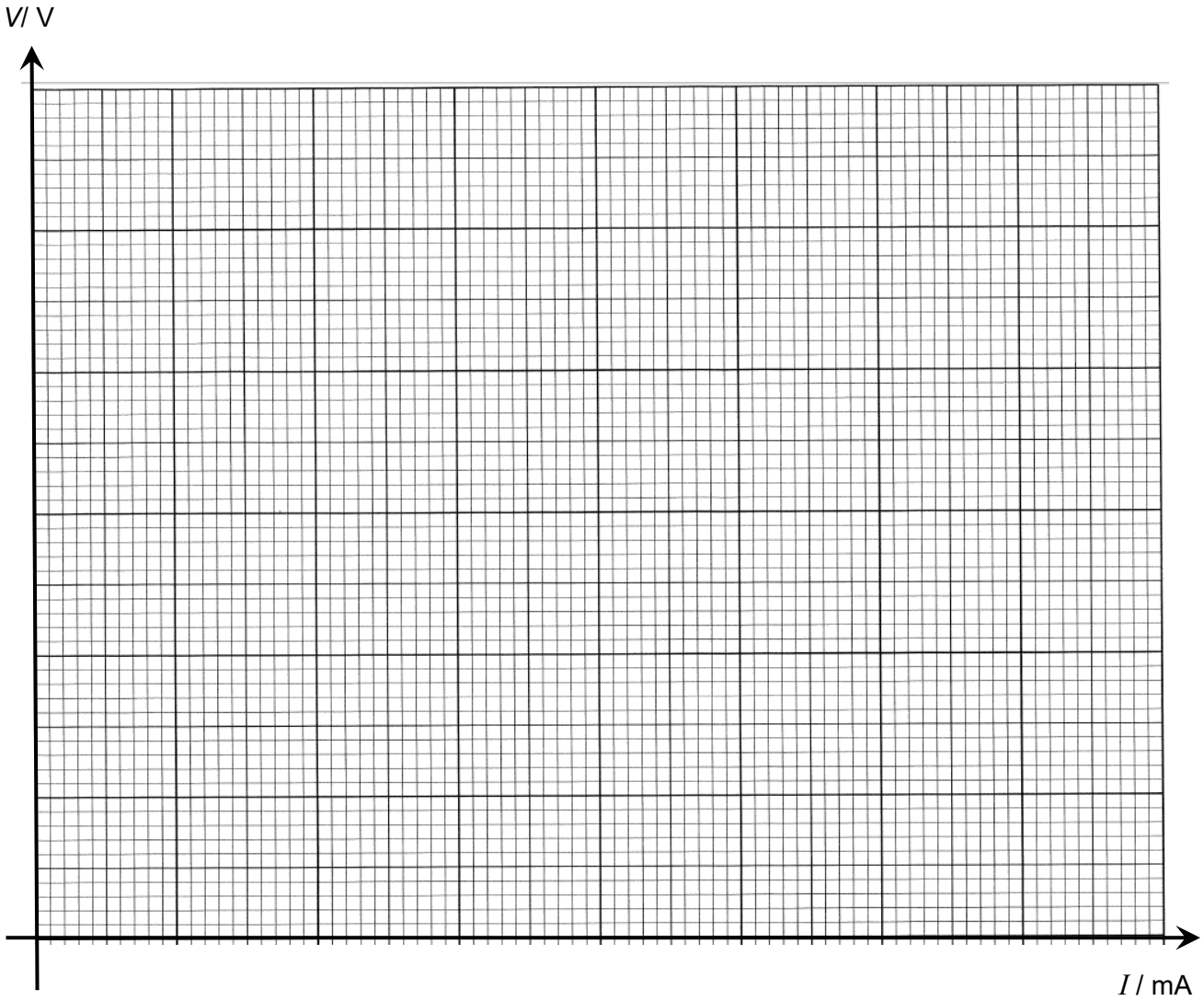

Fig. 2.2

[2]

(d) The ratio of the graph represents the resistance of the sample Y. Given that the resistance is given by

$$R = \frac{\rho L}{A}$$

where ρ is the resistivity of the metal from which the wire is made, L is the length of the wire and A is its cross-sectional area.

The resistivity of the given wire is 4.50×10^{-7} Ω m.

Estimate the length of the sample.

L = ... [2]

[Total: 8 marks]

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3 In this experiment, you will investigate how the motion of an oscillating system depends on the mass attached to the system.

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

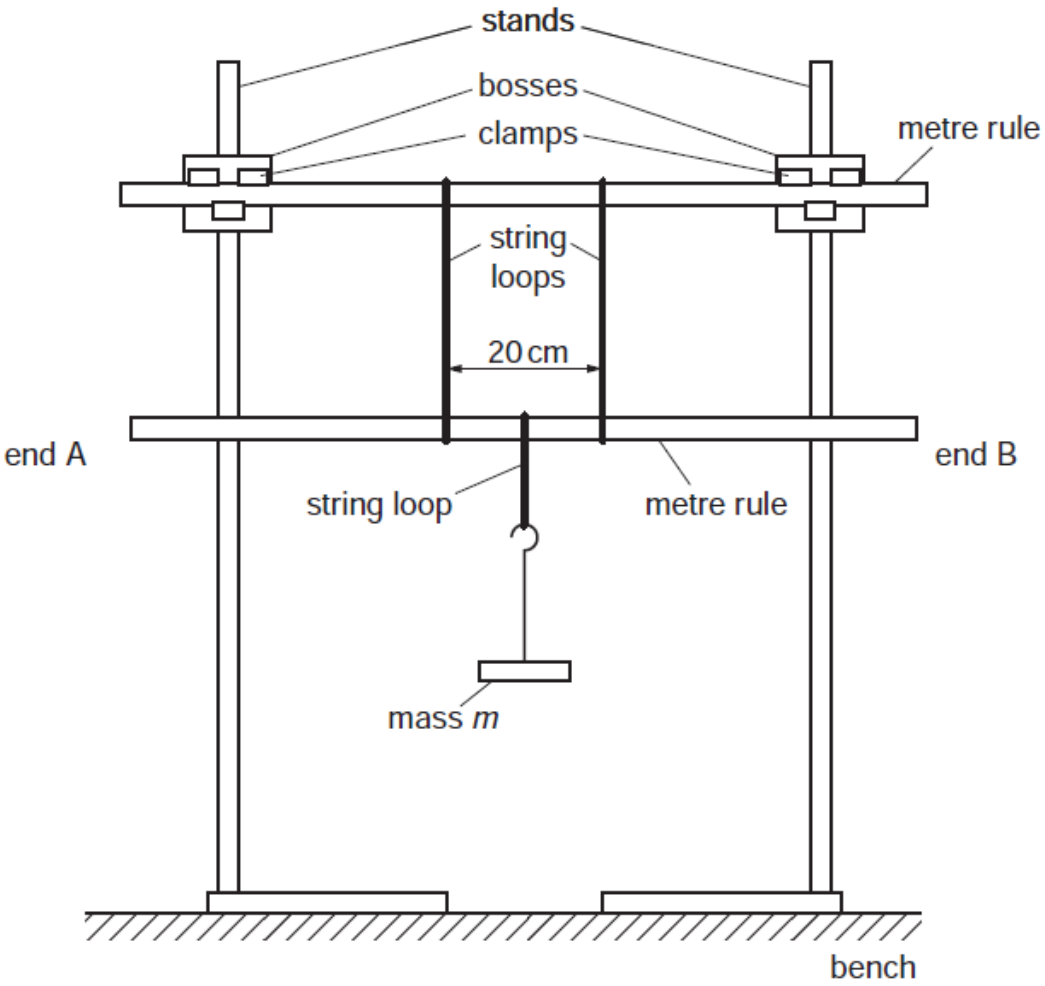


Fig. 3.1

Slide the two loops of string onto a rule and fix this rule in the clamps.

Adjust the clamps until the rule is parallel to the bench.

Using the string provided, make a loop of circumference 20 cm. Slide this shorter loop onto the second rule and use the longer loops to support this second rule.

Both rules should have their markings facing you. The strings should be vertical, 20 cm apart and at equal distances from the centre of the second rule.

Use the shorter loop of string to suspend a mass m at the 50 cm mark on the second rule, where m = 0.500 kg.

(ii) Move the end A of the lower rule towards you and the end B away from you. Release the rule and watch the movement.

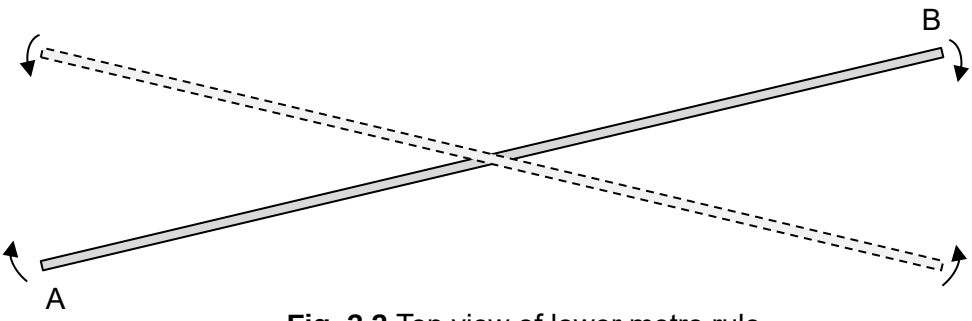


Fig. 3.2 Top view of lower metre rule

End A will move away from you and back towards you, completing a swing.
The time taken for one complete swing is *T*.
Determine an accurate value for *T*.

T = ……[1]

(b) Change *m* and repeat **(a)(ii)** until you have six sets of values of *m* and *T*.

[6]

(c) The quantities m and T are related by the equation

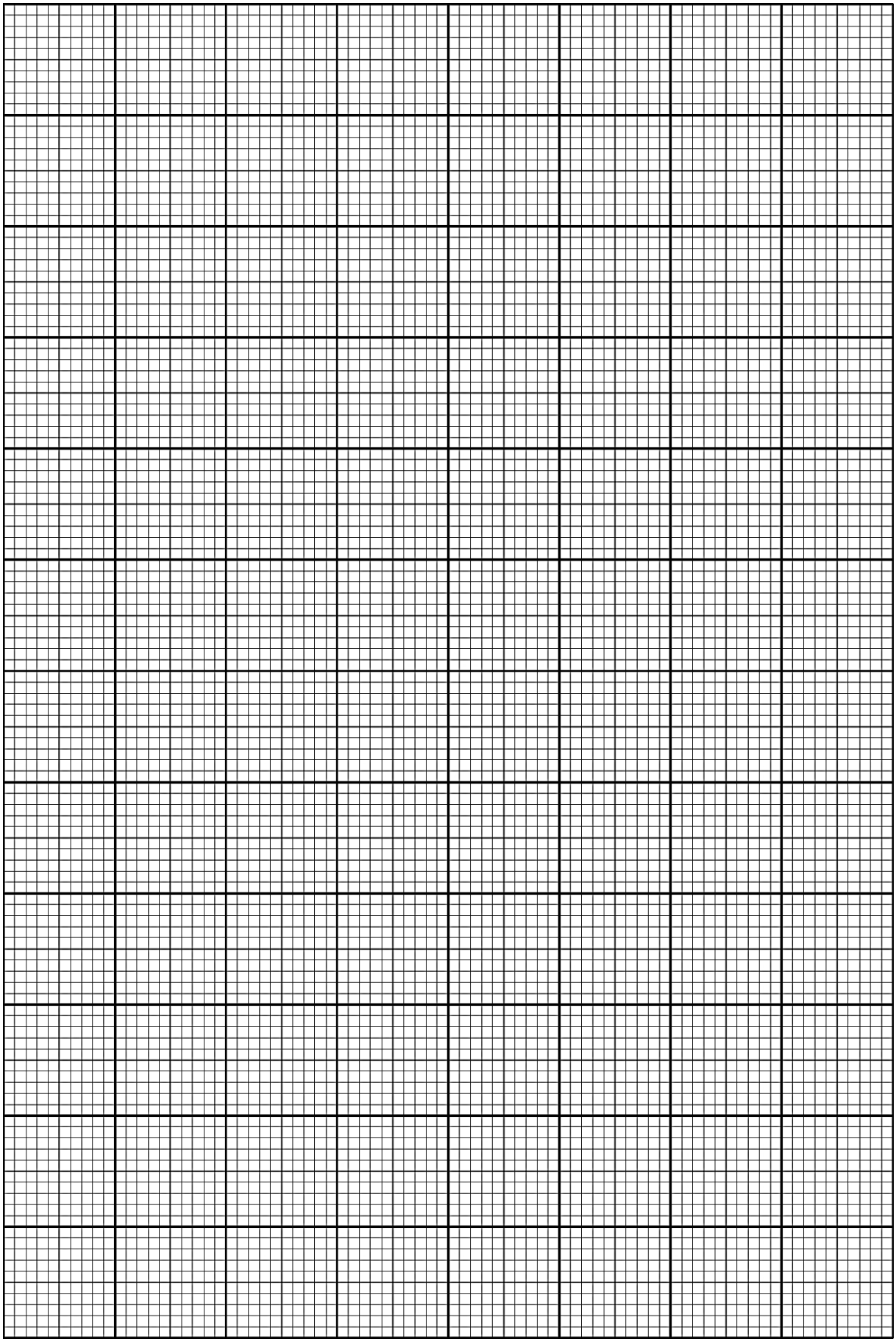
$$\frac{1}{T^2} = P\ m + Q$$

where P and Q are constants.

Plot a suitable graph to determine the values of P and Q.

P = ……

Q =……[4]



[3]

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

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..... [1]

(e) State two significant sources of errors in this experiment.

1 .....

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2 .....

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..... [2]

(f) Suggest improvements that could be made to the experiment to address the sources of error identified in **(e)**. You may suggest the use of other apparatus or different procedures.

1 .....

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2 .....

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..... [2]

[Total: 19 marks]

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Class Adm No

Candidate Name: _____

2024 Preliminary Exams - PU3 H2 Physics Paper 4

4 A student wishes to investigate projectile motion.

A small ball is rolled with velocity *v* along a horizontal surface. When the ball reaches the end of the horizontal surface, it falls and lands on a lower horizontal surface. The vertical displacement of the ball is *h* and the horizontal displacement of the ball is *d*, as shown in Fig. 4.1.

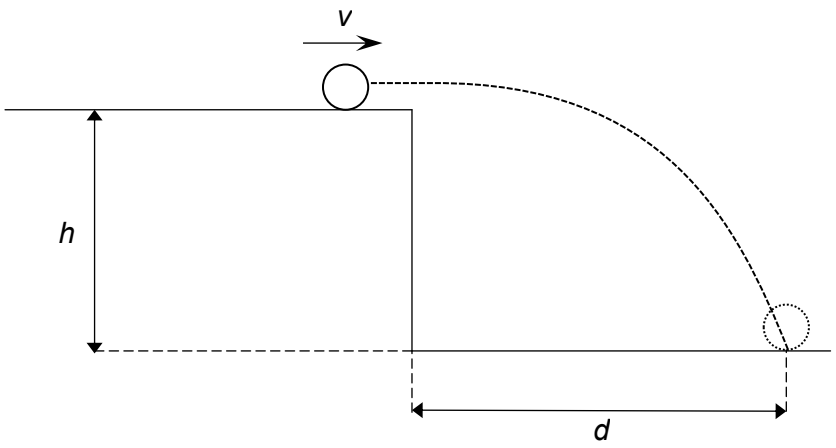

Fig. 4.1

The student suggests that *d* is dependent on *h* and *v* according to the equation

$$d = k\,h^{p}\,v^{q}$$

where *k, p* and *q* are constants to be determined.

Design a laboratory experiment to determine the values of *k*, *p* and *q*.

You should draw a diagram showing the arrangement of your equipment. In your account you should pay particular attention to

(a) the identification and control of variables,

(b) the equipment you would use and measurements to be taken,

(c) procedure to be followed,

(d) the analysis of the data,

(e) any precautions that would be taken to improve the accuracy and safety of the experiment.

Diagram

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[Total: 12 marks]