



Cambridge International AS & A Level

CANDIDATE
NAME
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PHYSICS

9702/31

Paper 3 Advanced Practical Skills 1

October/November 2020

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

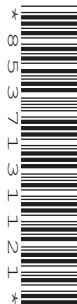
INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].

For Examiner's Use	
1	
2	
Total	

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2

You may not need to use all of the materials provided.

1 In this experiment, you will investigate the equilibrium of a plastic cup.

(a) You have been provided with a cup attached to a string loop. A mass is attached to the cup as shown in Fig. 1.1.

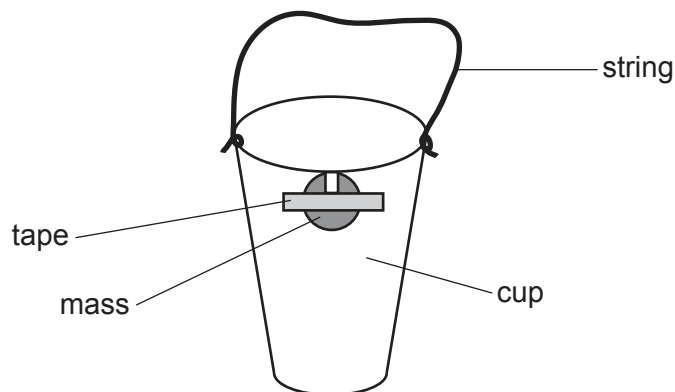


Fig. 1.1

- Set up the apparatus as shown in Fig. 1.2.

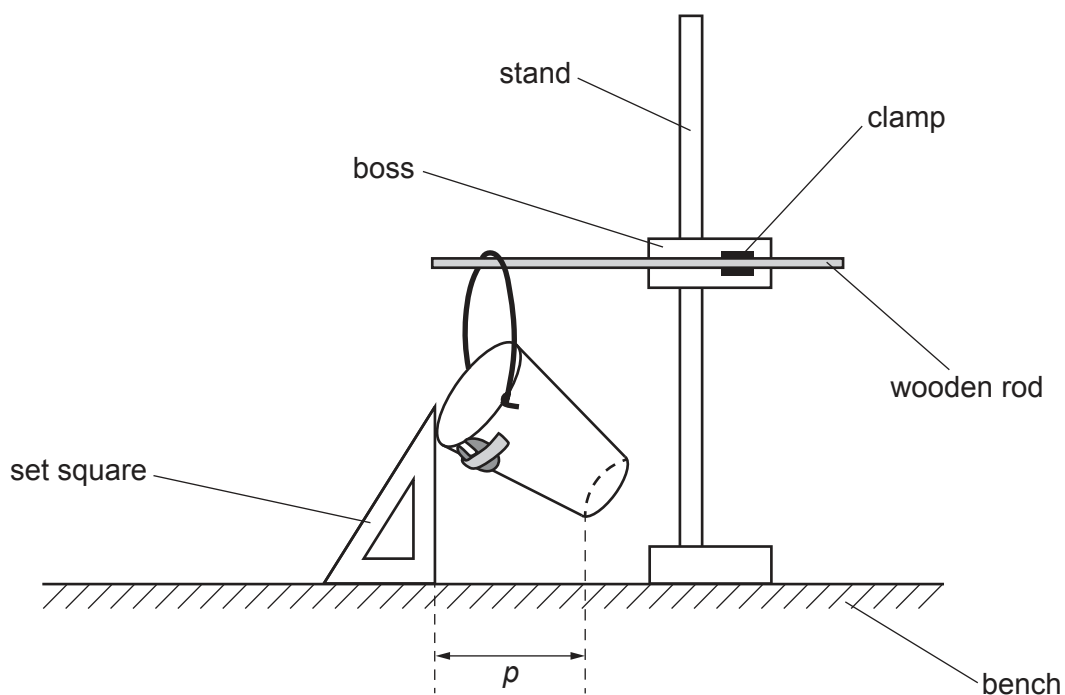


Fig. 1.2

- The horizontal distance between the edges of the cup is p , as shown in Fig. 1.2.

Measure and record p .

$p = \dots\dots\dots [1]$

3

- (b)
- Pour approximately 12 cm^3 of water into the measuring cylinder.
 - The mass of 1 cm^3 of water is 1 g.

Determine the mass of water in the measuring cylinder.

mass = g

- Gently pour this water from the measuring cylinder into the cup.
- Record the total mass m of water in the cup.

m = g

- Measure and record p .

p =
[1]

4

- (c) Using the measuring cylinder, add water to the cup to increase m . Measure and record p . Repeat until you have six sets of values of m and p .

Record your results in a table. Include values of $\sqrt{m}$ and $\sqrt{p}$ in your table.

[10]

- (d) (i) Plot a graph of $\sqrt{p}$ on the y -axis against $\sqrt{m}$ on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

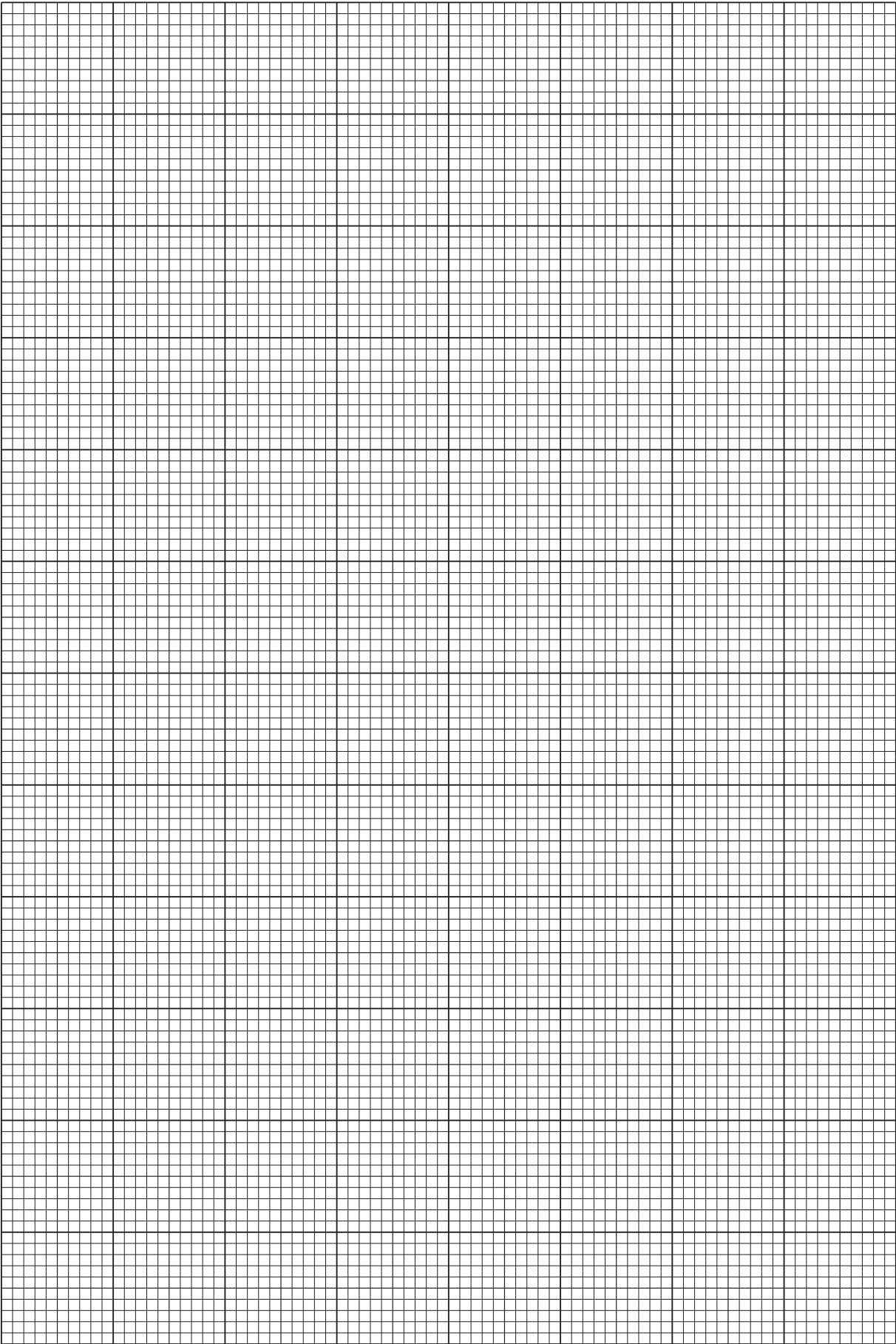
[1]

- (iii) Determine the gradient and y -intercept of this line.

gradient =

y -intercept =

[2]



6

- (e) It is suggested that the quantities p and m are related by the equation

$$\sqrt{p} = A\sqrt{m} + B$$

where A and B are constants.

Using your answers in (d)(iii), determine the values of A and B .
Give appropriate units.

$A =$

$B =$

[2]

[Total: 20]

7

You may not need to use all of the materials provided.

2 In this experiment, you will investigate a cardboard shape falling down a wooden board.

(a) (i) You have been provided with a wooden board with nails attached.

- Set up the apparatus as shown in Fig. 2.1.

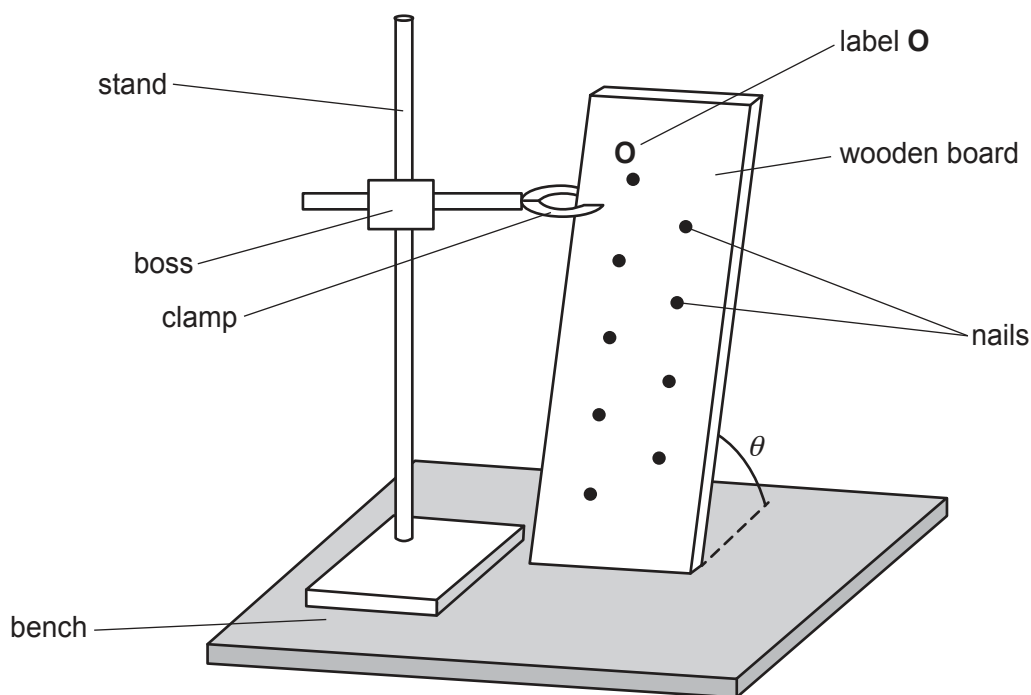


Fig. 2.1

- The angle between the wooden board and the bench is θ .
Adjust the apparatus until θ is between 80° and 89° .
- Measure and record θ .

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

(ii) Calculate $\sin \theta$.

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

(iii) Justify the number of significant figures that you have given for your value of $\sin \theta$.

.....

 [1]

8

- (b) (i) • Firmly press the adhesive putty centrally onto the cardboard shape as shown in Fig. 2.2.

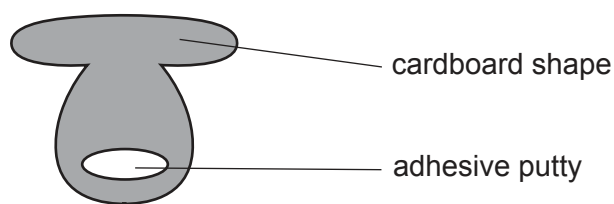


Fig. 2.2

- Flatten the adhesive putty so that it has a thickness of approximately 5 mm.
- Hold the cardboard shape centrally above the wooden board with the adhesive putty touching the board, as shown in Fig. 2.3.

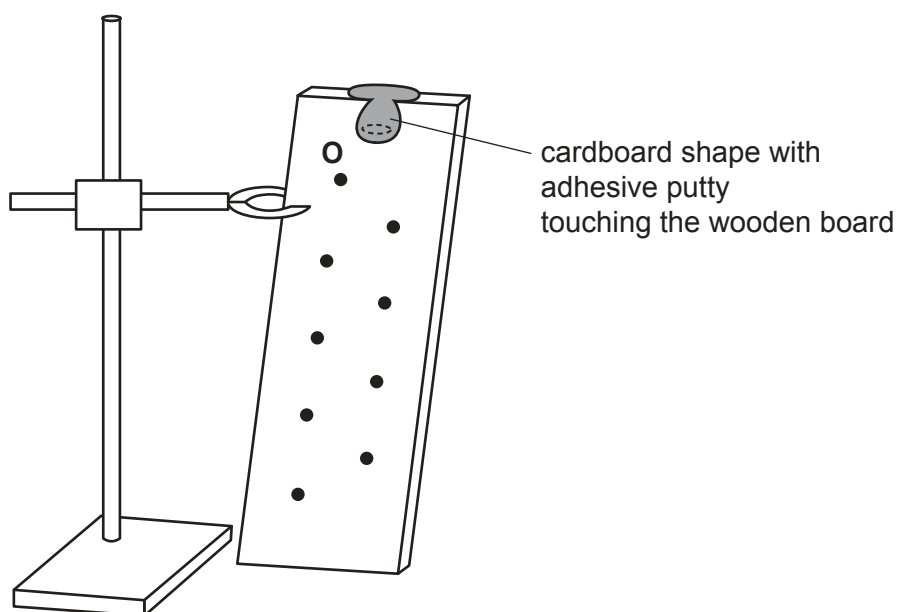


Fig. 2.3

- When the cardboard shape is released, it follows a path between the nails towards the bench.

The time between releasing the shape and the shape touching the bench is t .

Measure and record t .

$t = \dots\dots\dots$ s [2]

9

(ii) Estimate the percentage uncertainty in your value of t . Show your working.

percentage uncertainty = [1]

(c) Adjust the apparatus and determine the **smallest** angle at which the shape will still fall to the bottom of the wooden board after release.

(i) • Measure and record θ .

$\theta =$ °

• Calculate $\sin \theta$.

$\sin \theta =$ [2]

(ii) Measure and record t .

$t =$ s [2]

10

(d) It is suggested that the relationship between θ and t is

$$\sin \theta = \frac{k}{t}$$

where 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.

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

(e) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1.
.....
2.
.....
3.
.....
4.
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[4]

(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1.
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2.
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3.
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4.
.....

[4]

[Total: 20]

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