Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2389908586 1

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2021**

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	

This document has **16** pages. Any blank pages are indicated.

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

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

(a) (i) ● Assemble the apparatus as shown in Fig. 1.1 with the nail held securely in the boss.

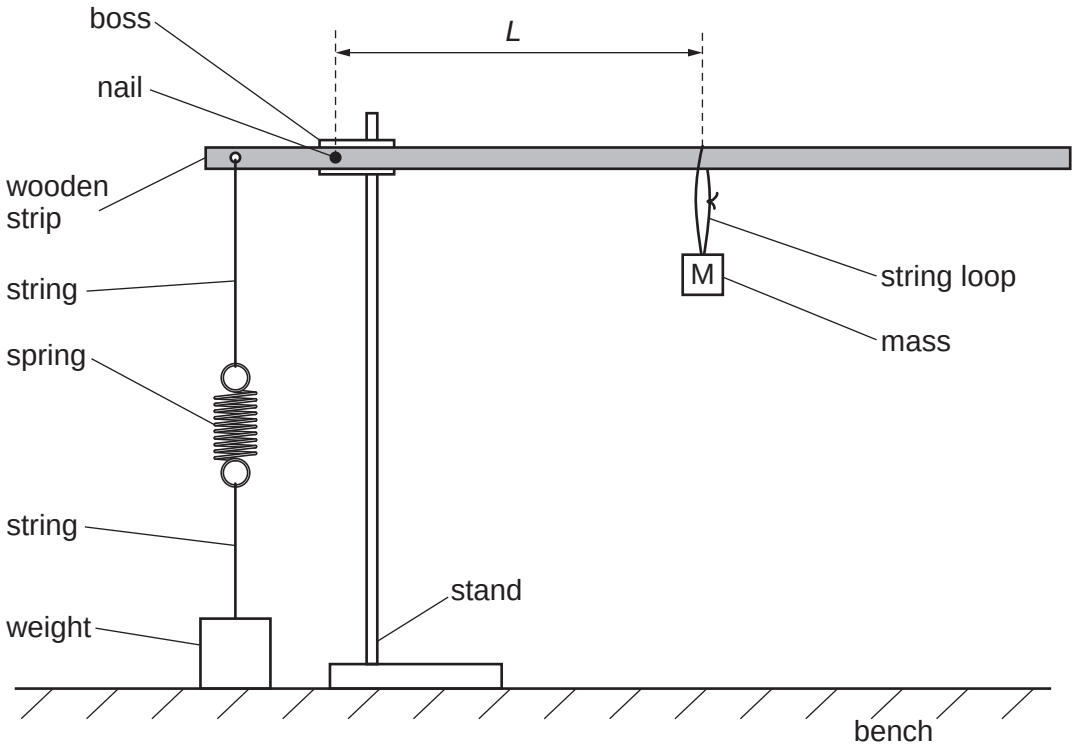


Fig. 1.1

- Hang the mass labelled M midway between the nail and the end of the strip.
- Adjust the height of the boss so that the strip is parallel to the bench.
- Move the weight so that the spring is vertical.
- *L* is the distance between the nail and the string loop attached to M, as shown in Fig. 1.1.

  Measure and record *L*.

L = ... [1]

(ii) ● Pull the free end of the strip down by approximately 2 cm. Release the strip so that it oscillates.

● Take measurements to determine the period T of the oscillations.

T = ... s [2]

(b)
- Move M along the strip and adjust the apparatus so that the strip is parallel to the bench.
- Measure L and determine T.
- Repeat until you have six sets of values of L and T.
  Record your results in a table. Include values of L^2 and T^2 in your table.

[9]

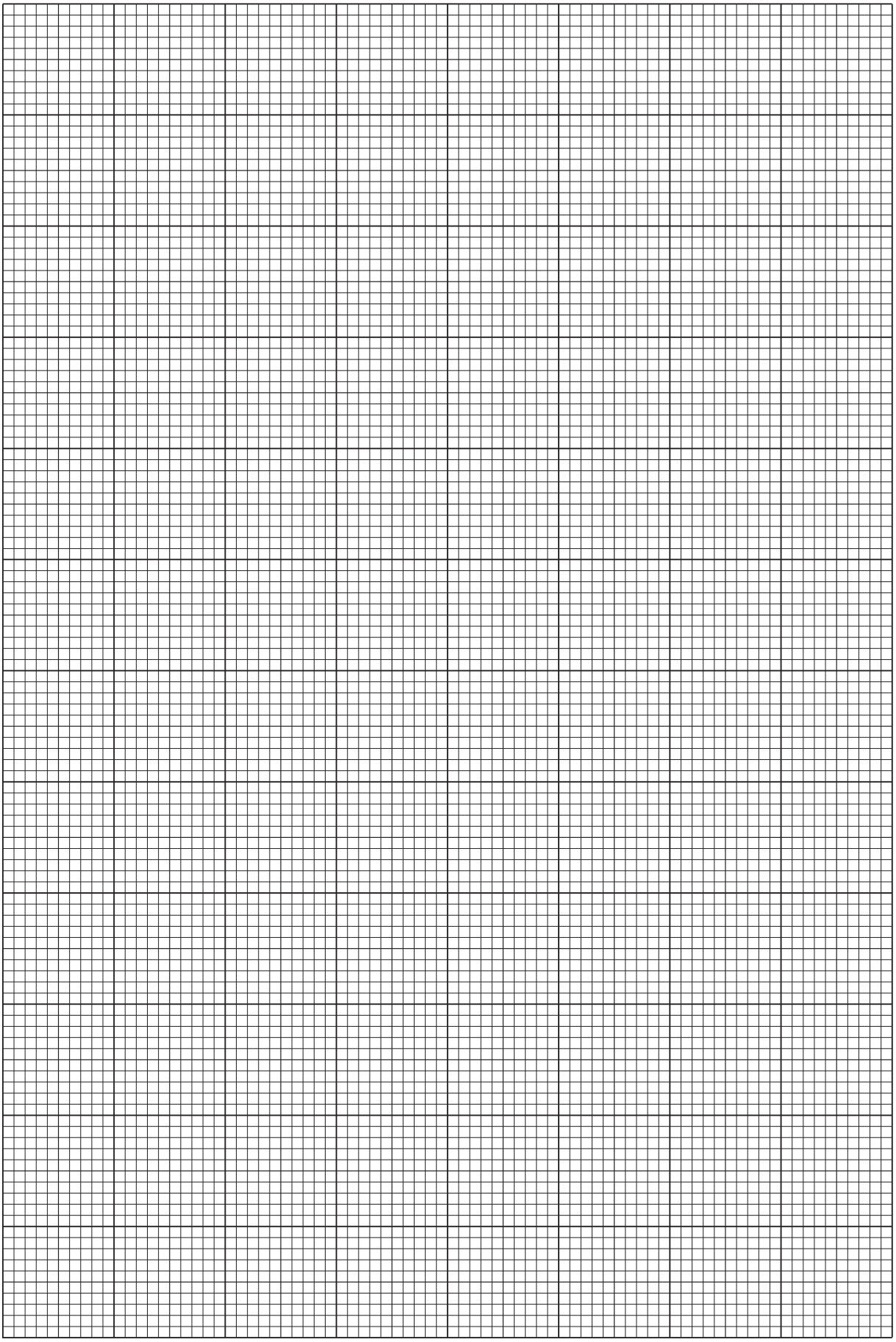
(c) (i) Plot a graph of T^2 on the y-axis against L^2 on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...
[2]



(d) It is suggested that the quantities T and L are related by the equation

$$T^2 = aL^2 + b$$

where a and b are constants.

Use your answers in **(c)(iii)** to determine the values of a and b.
Give appropriate units.

a = ...

b = ...
[2]

[Total: 20]

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

2 In this experiment, you will investigate the amount of air needed to lift an underwater load.

(a) You are provided with a syringe attached to a long tube containing a wire.

- Bend the end of the tube as shown in Fig. 2.1.

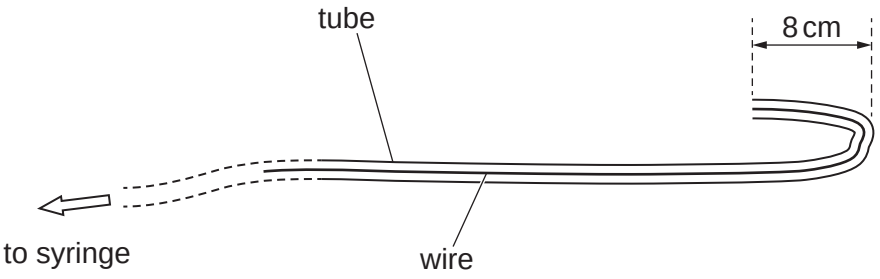


Fig. 2.1

- Pull the plunger of the syringe to the 50 cm^3 mark (1 cm^3 = 1 ml).
- Bend the tube and hook it over the container so that the end is approximately 11 cm above the bottom of the container, as shown in Fig. 2.2.

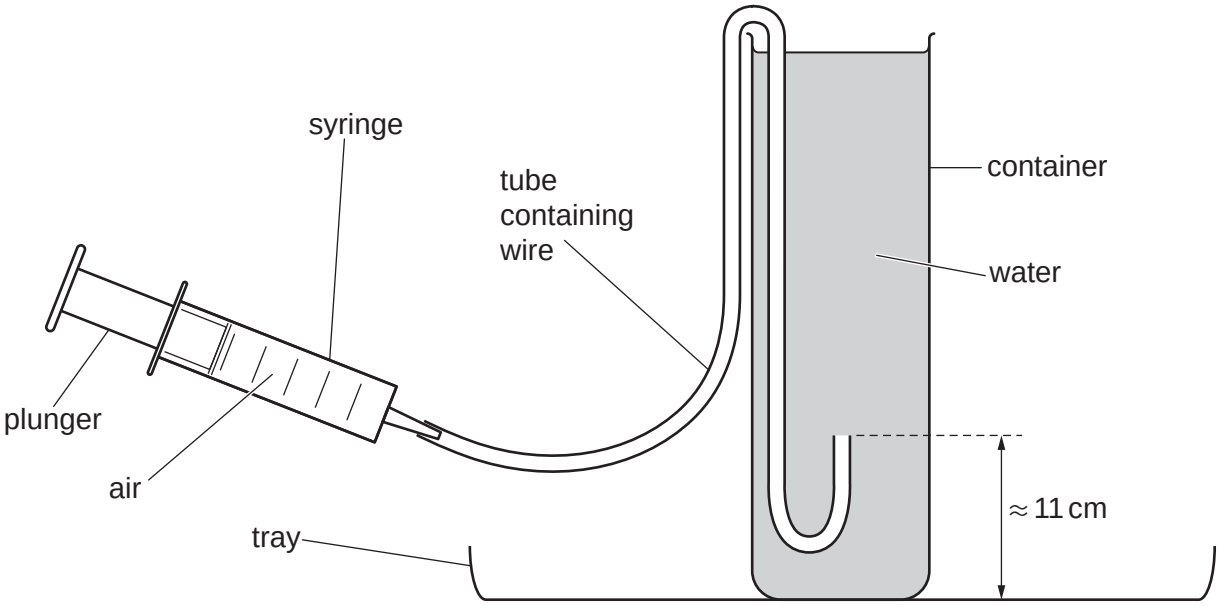


Fig. 2.2

(i) You have been provided with a set of metal rings.

Take measurements to determine the average thickness t of the rings.
Show your working.

t = ... cm [1]

(ii) Measure and record the inner diameter d_1 and the outer diameter d_2 of one of the metal rings, as shown in Fig. 2.3.

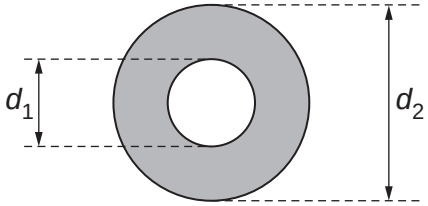


Fig. 2.3

d_1 = ... cm

d_2 = ... cm
[1]

(iii) Calculate the volume V_R of a metal ring using

$$V_R = \frac{\pi t(d_2^2 - d_1^2)}{4}.$$

V_R = ... cm^3 [1]

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

.....

.....

..... [1]

(b) You have been provided with a paper clip and a plastic cup with string attached.

(i) ● Bend the paper clip into a hook shape as shown in Fig. 2.4. Add 8 metal rings to the paper clip and hook it onto the string loop, as shown in Fig. 2.4.

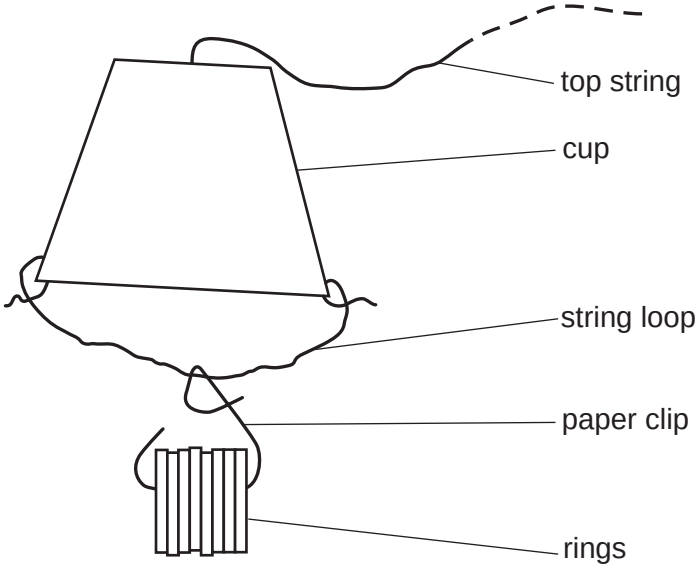


Fig. 2.4

● Lower the cup into the water. Ensure that the cup is **completely** filled with water.

● Use the top string to position the cup over the end of the tube, as shown in Fig. 2.5.

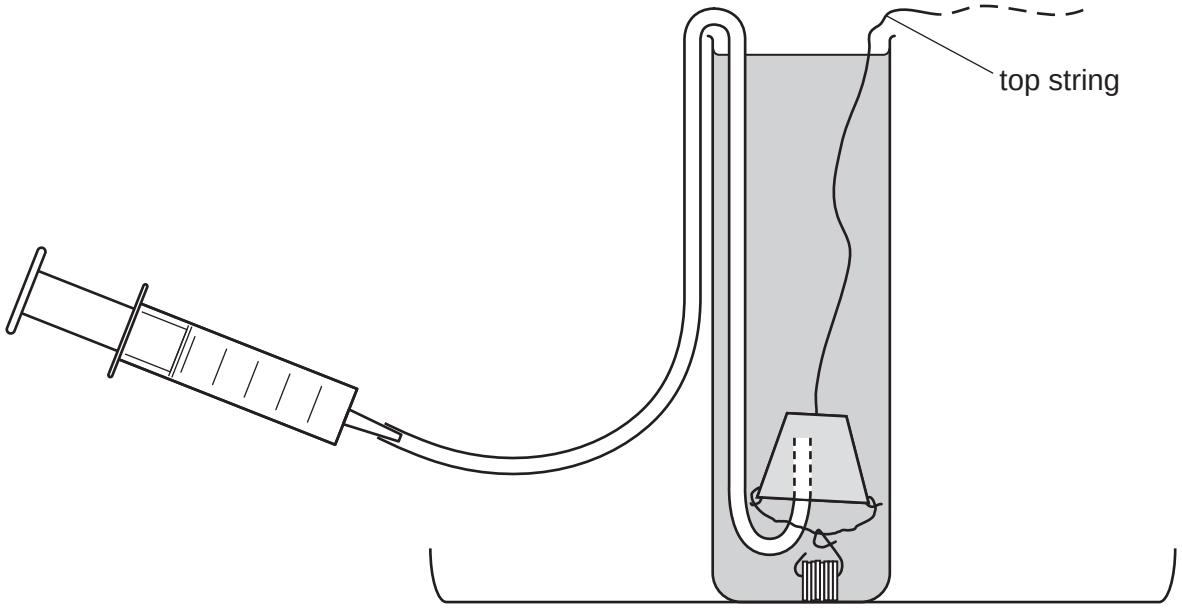


Fig. 2.5

● Record the initial reading x_1 from the syringe scale.

x_1 = ... cm^3 [1]

(ii) ● Slowly press the plunger of the syringe so that air enters the cup.
Continue until the cup starts to lift the rings towards the surface of the water.

● Record the final reading x_2 from the syringe scale.

x_2 = ... cm^3

● Calculate the volume of air V_A in the cup using

$$V_A = x_1 - x_2.$$

V_A = ... cm^3
[2]

(iii) Estimate the percentage uncertainty in your value of V_A. Show your working.

percentage uncertainty = ... [1]

(c)

- Remove the cup and the tube from the container of water.
- Pull the plunger of the syringe to the 50 cm^3 mark to draw air into the syringe.
- Replace the tube in the container of water.
- Repeat **(b)(i)** and **(b)(ii)** using 12 metal rings.

x_1 = ... cm^3

x_2 = ... cm^3

V_A = ... cm^3

[2]

(d) (i) The mass M of one metal ring is given on the card.

- Write down the value of M.

M = ... g

- The number of rings attached to the paper clip is n.
  It is suggested that the relationship between n, M, V_R and V_A is

$$nM = k(nV_R + V_A)$$

  where k is a constant.

  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. .....

.....

[4]

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

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

[Total: 20]

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