Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You are reminded of the need for good English and clear presentation in your answers.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

Additional answer paper and graph paper should be used only if it becomes necessary to do so.

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.

For Examiner's Use	
1	
2	
Total	

DC (JM/SG) 164896/4

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

1 In this experiment, you will investigate the forces acting on a metre rule.

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

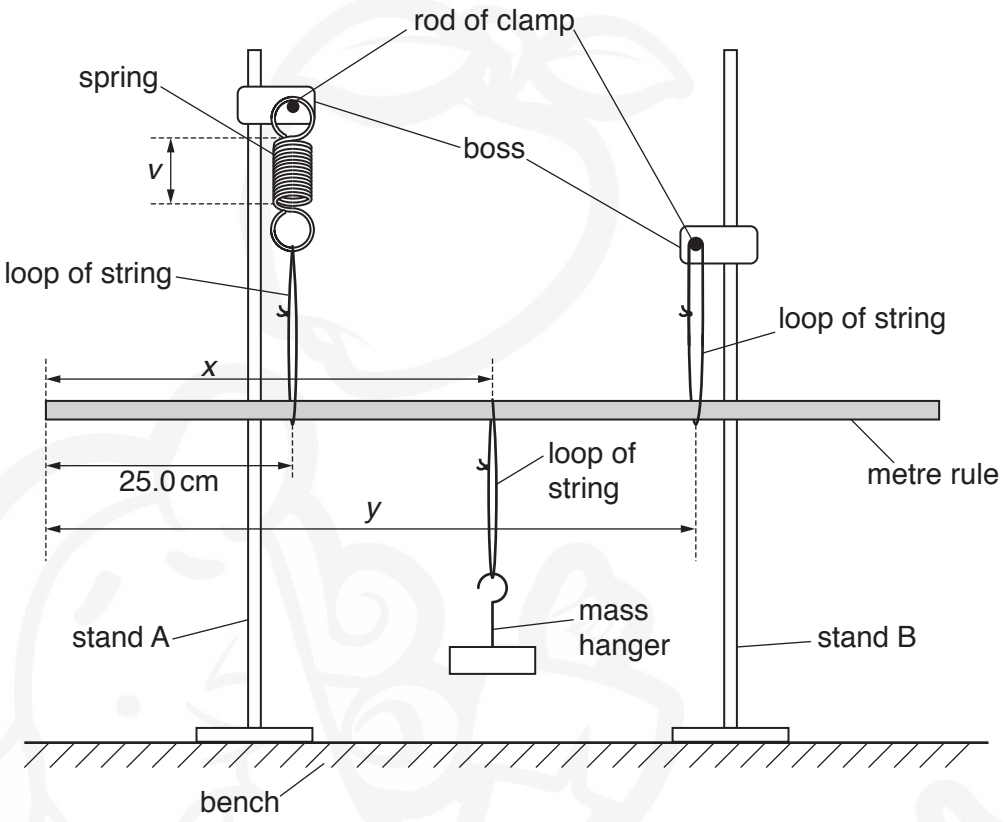


Fig. 1.1

- The distance between the end of the rule and the loop of string attached to the spring is 25.0 cm. **Keep this distance constant throughout the experiment.**

  The distance between the end of the rule and the loop of string supporting the mass hanger is *x*.

  The distance between the end of the rule and the loop of string attached to stand B is *y*.

  Adjust the apparatus until $x = 50.0$ cm and $y = 75.0$ cm.

- The strings and spring should be vertical and the rule should be parallel to the bench.

  The length of the coiled section of the spring is *v*. To view this more clearly, you may use the adhesive putty to attach the white card to stand A behind the spring.

  Measure and record *v*.

  v = ... [1]

(b) • Change *x* by moving the loop of string supporting the mass hanger to a different position on the rule.

• Move stand B and slide the loop of string attached to stand B along the rule until ***v* has the same value as in (a)**.

• Ensure the strings and spring are vertical and the rule is parallel to the bench.

• Measure and record *x* and *y*.

x = ...

y = ...

[1]

[Turn over

(c) • Write down your value of v from **(a)**.

$v =$ .....

• Repeat **(b)** until you have six sets of values of x and y. Record your results in a table.

[8]

(d) **(i)** Plot a graph of y on the y-axis against x on the x-axis. [3]

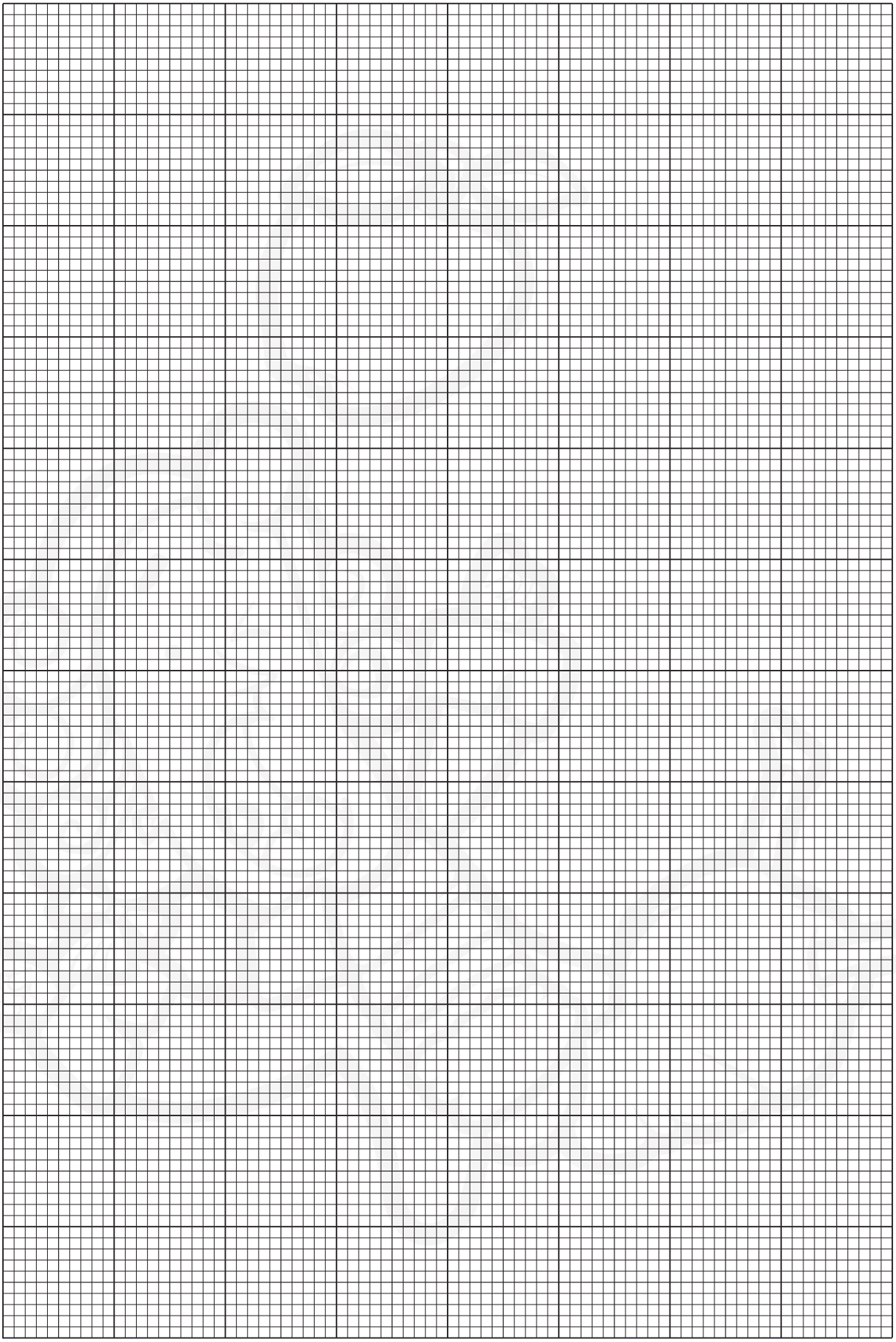
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities y and x are related by the equation

$$y = Px + Q$$

where P and Q are constants.

Using your answers in **(d)(iii)**, determine the values of P and Q.
Give appropriate units.

$P =$ .....

$Q =$ .....
[2]

(f) Theory suggests that

$$P = \frac{2m}{(R+m)}$$

where R is the mass of the metre rule and $m = 0.100\,\text{kg}$.

Calculate R. Give your answer to three significant figures.

$R =$ ..... kg [2]

[Total: 20]

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

2 In this experiment, you will investigate the upthrust on lids placed in water.

(a) (i) You have been provided with two lids and some coins.

- Take the **larger** of the two lids.
- The diameter of the lid is *d*. The height of the lid is *t*, as shown in Fig. 2.1.

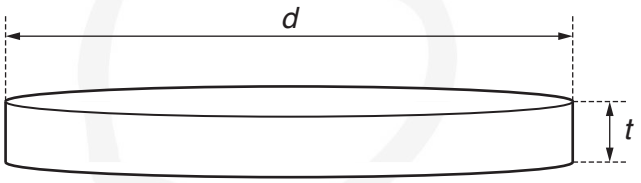


Fig. 2.1

Measure and record *d* and *t*.

d = ...

t = ...
[1]

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

percentage uncertainty = ... [1]

(b) (i) The volume of the air space within the lid is V.

Calculate V where

$$V = \frac{\pi d^2 t}{4}.$$

V = ... [1]

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

.....

.....

..... [1]

(c)
- Place the lid on the surface of the water so that it floats with its open face upwards.
- Add coins to the inside of the lid. After you have added n coins, the lid will sink.
- Record n.

n = ... [2]

(d) Take the **smaller** lid and repeat **(a)(i)**, **(b)(i)** and **(c)**.

d = ...

t = ...

V = ...

n = ...
[3]

[Turn over

(e) It is suggested that the relationship between n and V is

$$n = kV$$

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]

(f) Theory suggests that

$$k = \frac{\rho}{M}$$

where the density ρ of water is $1.00\,\text{g}\,\text{cm}^{-3}$ and M is the mass of a coin.

Using your second value of k, calculate M. Give an appropriate unit.

M = ... [1]

(g) (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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