Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME											
CENTRE NUMBER							CANDIDATE NUMBER				

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 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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You may not need to use all of the materials provided.

1 In this experiment, you will investigate the balance of a pivoted rule.

(a) The apparatus has been partially assembled for you.

- Add the mass M to the apparatus as shown in Fig. 1.1. The mass M should be suspended approximately 15 cm from the nail.

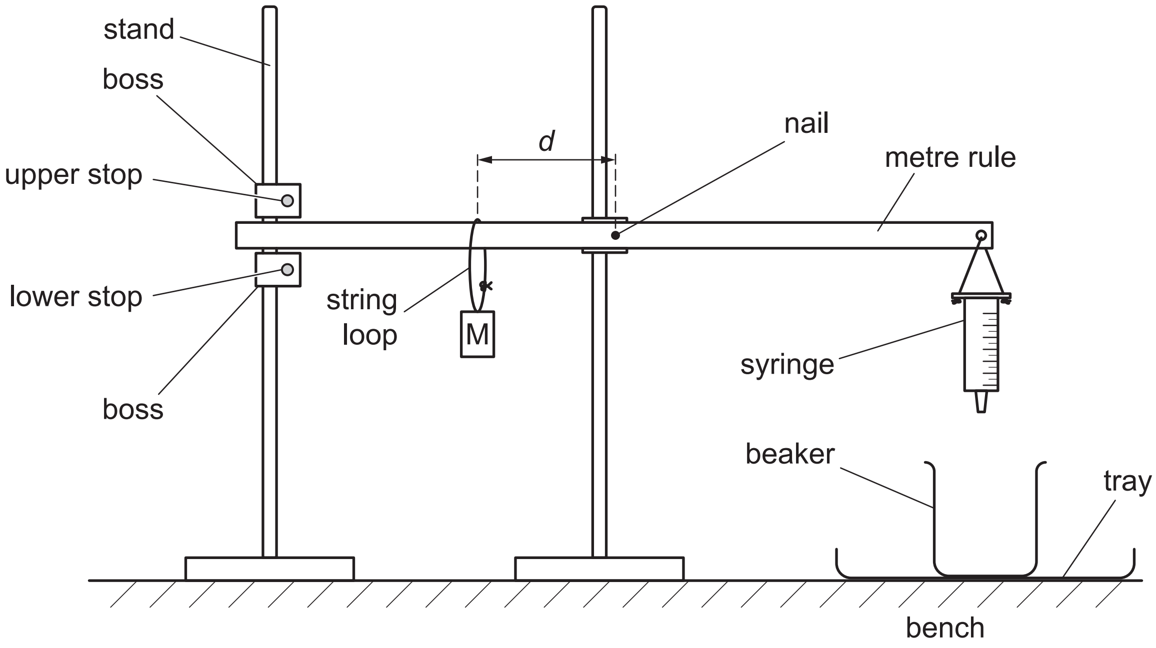

Fig. 1.1

- The distance between the nail and the string loop attached to M is *d*, as shown in Fig. 1.1.

  Measure and record *d*.

d = ... cm [1]

(b)
- Pour water into the syringe until it is full. The rule will tilt until it touches the upper stop. The water will flow out of the syringe.

- The time between the water level passing the 50 cm^3 mark on the syringe and the rule losing contact with the upper stop is *t*.

  Measure and record *t*.

t = ... s [2]

(c) Change d by moving M. All values of d should be less than 25 cm.

Measure d and t. Repeat until you have six sets of values of d and t.

Record your results in a table. Include values of $\frac{1}{d}$ and t^2 in your table.

[9]

(d) **(i)** Plot a graph of t^2 on the y-axis against $\frac{1}{d}$ 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 t and d are related by the equation

$$t^2 = \frac{a}{d} + b$$

where a and b are constants.

Use your answers in **(d)(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 amplitude of oscillations of a mass suspended from a spring.

(a) **(i)** • Assemble the apparatus as shown in Fig. 2.1.

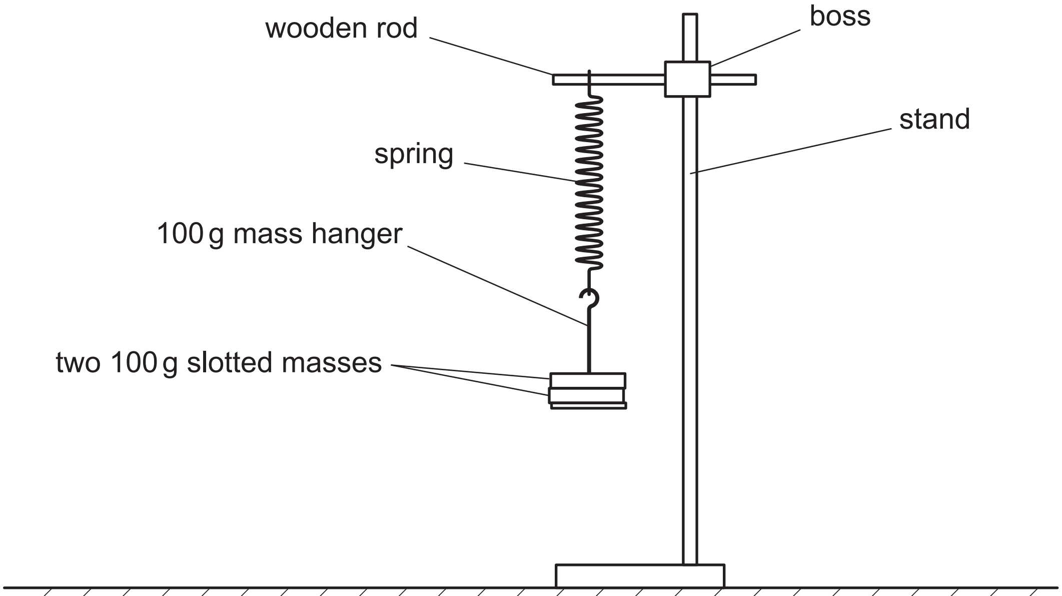

Fig. 2.1

• Pull the mass hanger and slotted masses down through a short distance. Release them so that they oscillate vertically.

• Measure and record the period T of the oscillations.

T = ... s [1]

(ii) Calculate the spring constant k using

$$k = \frac{4\pi^2 M}{T^2}$$

where M = 0.300 kg.

k = ... $N\,m^{-1}$ [1]

(b) • Slide the two 100 g slotted masses to the top of the mass hanger as shown in Fig. 2.2.

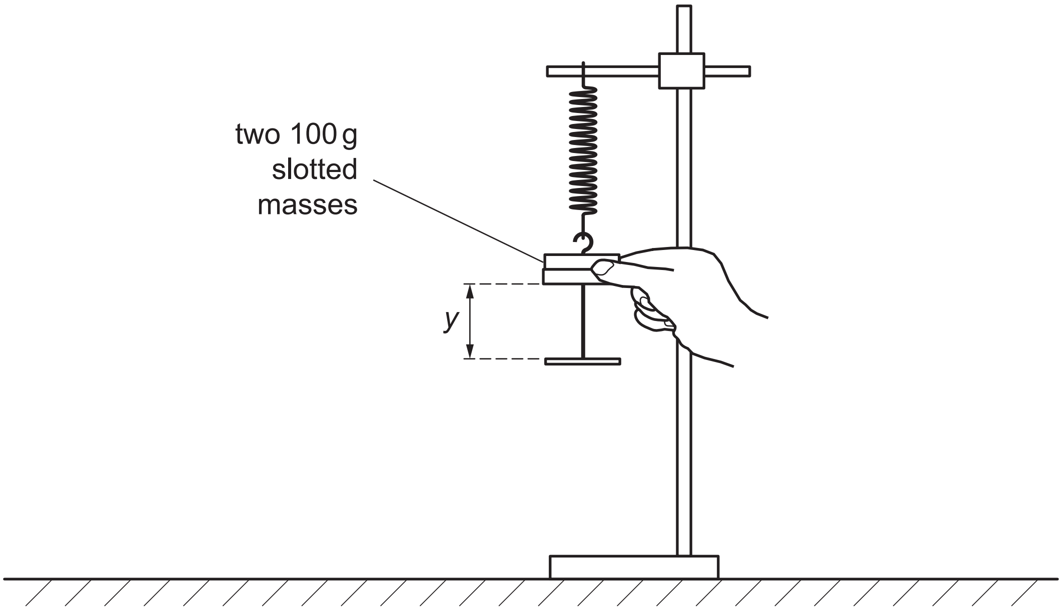

Fig. 2.2

• The height of the slotted masses above the base of the mass hanger is *y*, as shown in Fig. 2.2.

Measure and record *y*.

y = ... m [1]

(c) • Drop the two 100 g slotted masses. The masses and the mass hanger will oscillate vertically, as shown in Fig. 2.3.

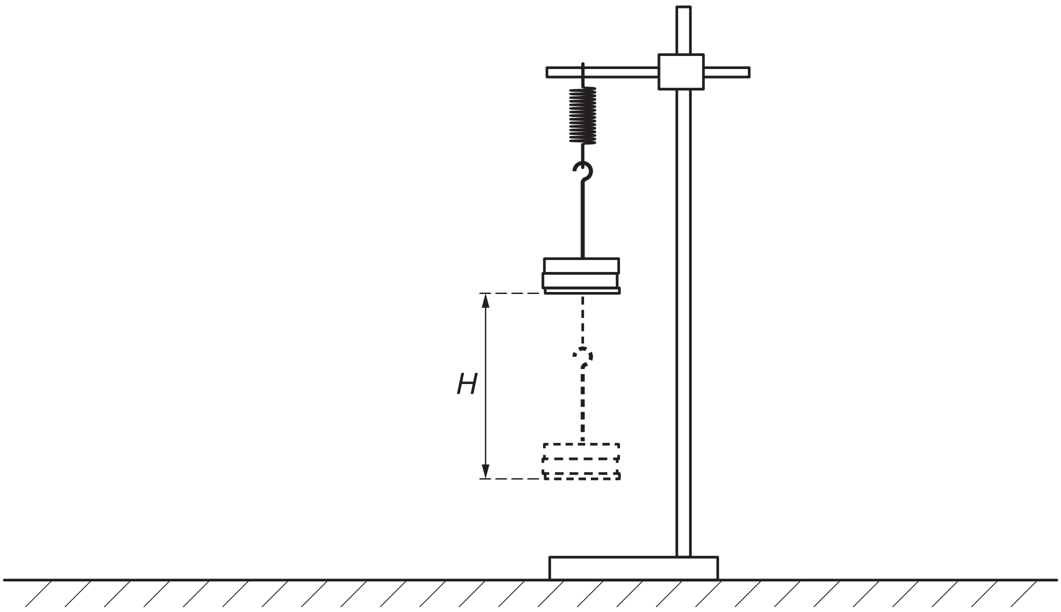

Fig. 2.3

- The distance between the lowest and highest positions of the oscillating mass hanger is H, as shown in Fig. 2.3.

  Measure and record H.

H = ... m [2]

(d) Estimate the percentage uncertainty in your value of H. Show your working.

percentage uncertainty = ... [1]

(e) Repeat **(b)** and **(c)** but this time sliding the two slotted masses approximately half-way up the mass hanger.

y = ... m

H = ... m
[2]

(f) It is suggested that the relationship between H and y is

$$H = c\sqrt{y}$$

where c is a constant.

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

first value of c = ...

second value of c = ...
[1]

(ii) Justify the number of significant figures you have given for your values of c.

....

....

.... [1]

(iii) Explain whether your results in **(f)(i)** support the suggested relationship.

....

....

.... [1]

(g) Theory suggests that an approximate value for the acceleration of free fall g is given by

$$g = \frac{c^2 k}{8m}$$

where $m = 0.200\,\text{kg}$.

Use your value of k from **(a)(ii)** and your first value of c to calculate g. Include an appropriate unit.

g = ... [1]

(h) **(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]