Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7610146019

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **October/November 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	

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

1 In this experiment, you will investigate an electrical circuit.

(a) • Place the 10 Ω resistor in component holder P.

• Place the 22 Ω resistor in component holder Q.

• Set up the circuit shown in Fig. 1.1.

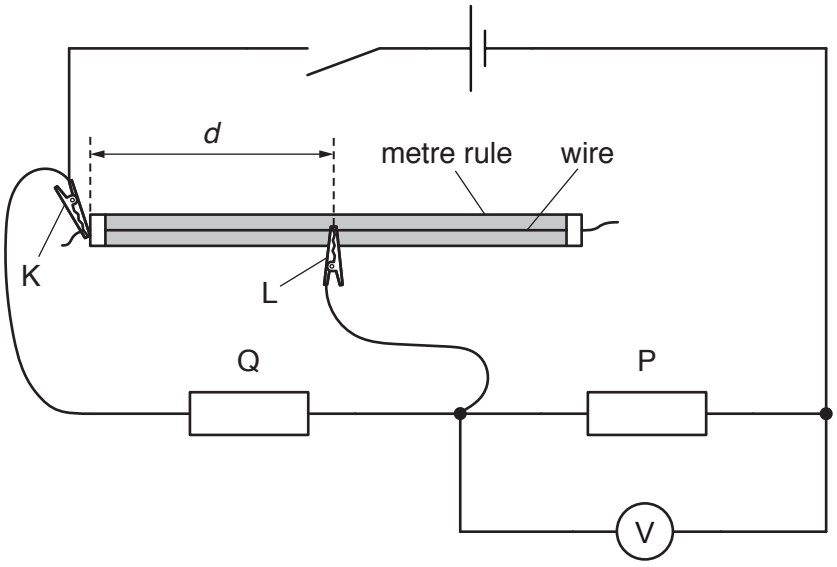

Fig. 1.1

• K and L are crocodile clips.

The resistor in component holder Q has resistance *R*.

Place L approximately half-way along the wire.

• The distance between K and L is *d*, as shown in Fig. 1.1.

Record *R* and *d*.

R = ...

d = ...

• Close the switch.

• Record the voltmeter reading *V*.

V = ...

• Open the switch.

[1]

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(b) • Change the resistor in Q. Do **not** change the resistor in P.

• Record the new value of *R*.

R = ...

• Close the switch.

• Change the position of L on the wire so that the voltmeter reading is as close as possible to the value for *V* in **(a)**.

• Record *d*.

d = ...

• Open the switch.

[1]

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

V = ...

• Repeat **(b)** until you have six sets of readings of R and d. Include your readings from **(a)** and **(b)**.

Record your results in a table. Include values of $\frac{R}{d}$ in your table.

[10]

(d) (i) Plot a graph of $\frac{R}{d}$ on the y-axis against R 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]

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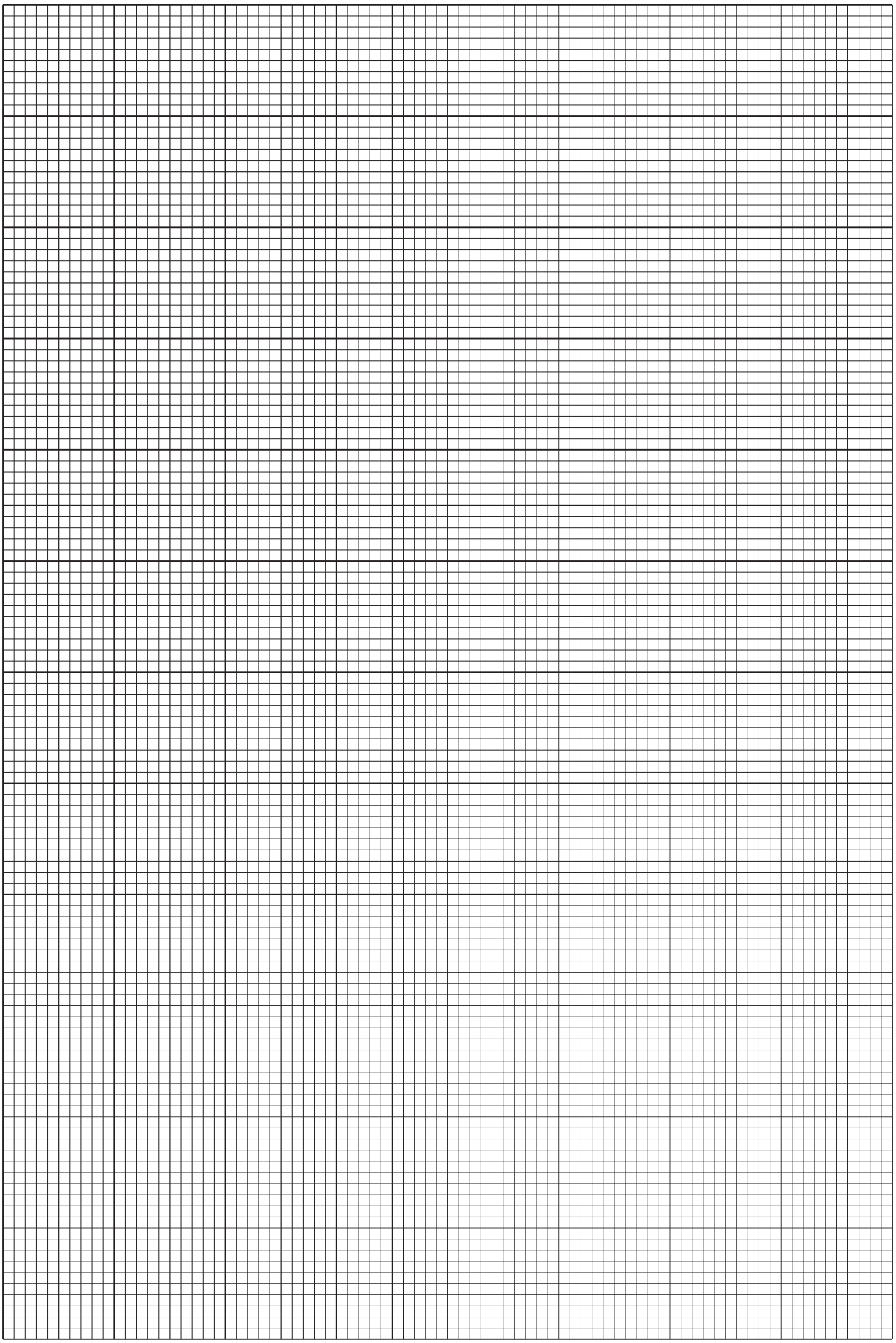

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[Turn over

(e) It is suggested that the quantities R and d are related by the equation

$$\frac{R}{d} = AR + B$$

where A and B are constants.

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

$A =$ .....

$B =$ .....
[2]

[Total: 20]

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

2 In this experiment, you will investigate the motion of two pendulums.

(a) (i) You have been provided with two pendulums.

- Set up the apparatus using the pendulum that has a loop of string at the end, as shown in Fig. 2.1.

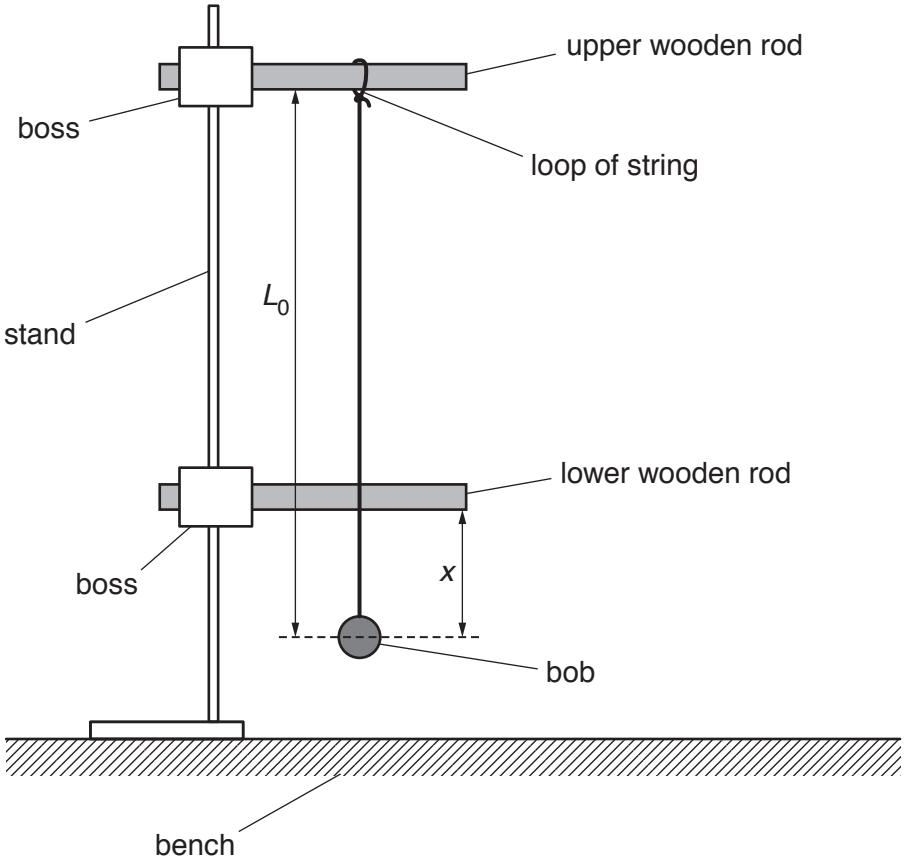

Fig. 2.1

- The distance between the bottom of the lower wooden rod and the centre of the bob is x.

  The distance between the bottom of the upper wooden rod and the centre of the bob is L_0.

  Adjust the position of the lower wooden rod until x is approximately 10 cm.

- Measure and record x and L_0.

x = ...

L_0 = ...
[1]

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[Turn over

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

percentage uncertainty = ... [1]

(b) (i) • Set up a second pendulum as shown in Fig. 2.2.

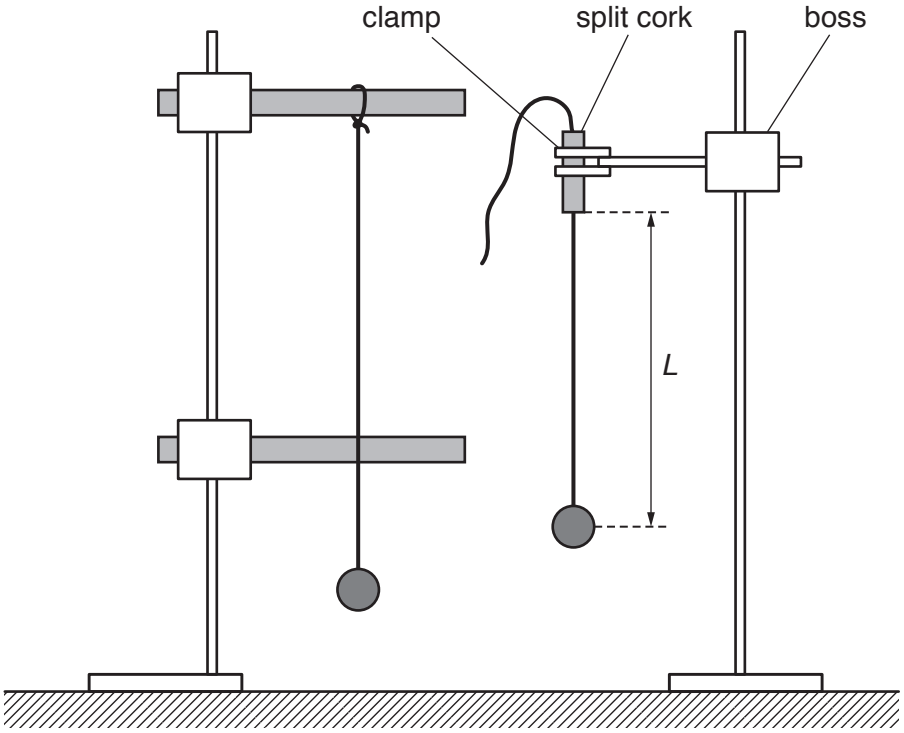

Fig. 2.2

- The distance between the bottom of the split cork and the centre of the bob is *L*.

  Adjust the string in the split cork until *L* is approximately 30 cm.

- Pull both bobs towards you through a short distance.

- Release the bobs at the same time. The oscillations of the bobs will be out of phase.

- Adjust *L* so that the oscillations of the bobs remain in phase for several cycles after release.

- Measure and record *L*.

L = ... [1]

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(ii) Calculate $\sqrt{L}$.

$\sqrt{L}$ = ... [1]

(iii) Justify the number of significant figures that you have given for your value of $\sqrt{L}$.

.....

.....

..... [1]

(c) • Adjust the position of the lower wooden rod until x is approximately 35 cm.

• Measure and record x.

x = ...

• Repeat **(b)(i)** and **(b)(ii)**.

L = ...

$\sqrt{L}$ = ...
[3]

(d) It is suggested that the relationship between L and x is

$$2\sqrt{L} = k + \sqrt{x}$$

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)

- Remove the lower wooden rod.
- Take measurements to determine the period T of the oscillations of the pendulum of length L_0.

T = ... s [1]

(ii) Theory suggests that

$$T = \frac{2\pi k}{\sqrt{g}}$$

where g is the acceleration of free fall.

Use your second value of k to determine a value for g. Give appropriate units.

g = ... [1]

(f) (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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