Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

PHYSICS **9702/03**

Paper 3 Advanced Practical Skills 1 **For examination from 2022**

SPECIMEN PAPER **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 **12** pages. Blank pages are indicated.

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

1 In this experiment, you will investigate the motion of a chain of paper clips.

You have been provided with a chain of fifteen paper clips with a sphere of modelling clay attached to one end of the chain.

(a) Measure and record the length *L* of one paper clip as shown in Fig. 1.1.

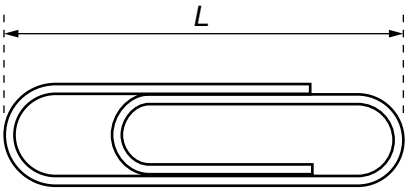


Fig. 1.1

L = ... [1]

(b) • Set up the apparatus as shown in Fig. 1.2.

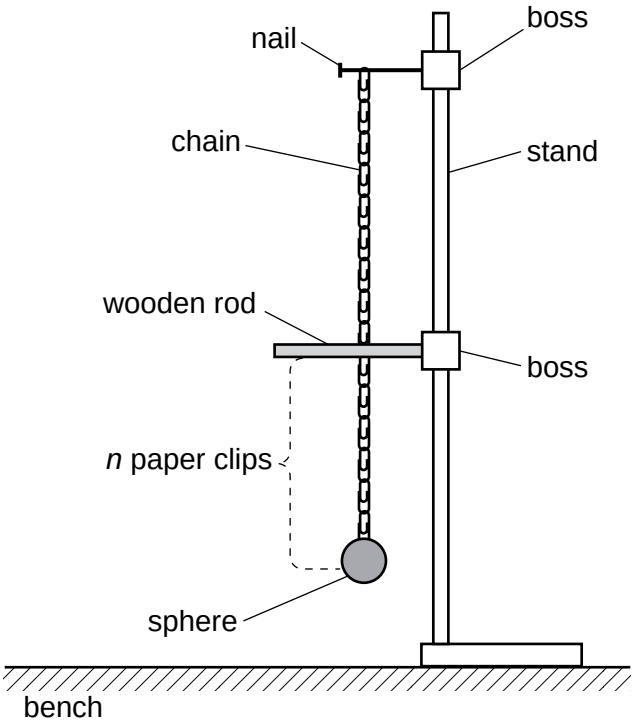


Fig. 1.2

- Suspend the chain from the nail.
- Position the wooden rod so that the chain, when hanging vertically, just touches the rod. The number *n* of paper clips below the rod should be equal to 6.
- Move the sphere towards you through a distance of approximately 10 cm. Release the sphere. The chain will oscillate and hit the rod during these oscillations.
- Determine the period *T* of the oscillations.

T = ... [2]

(c) Change n by moving the wooden rod vertically and determine T. Repeat until you have six sets of values of n and T.

Record your results in a table. Include values of $\sqrt{n}$ to three significant figures in your table.

[8]

(d) **(i)** Plot a graph of T on the y-axis against $\sqrt{n}$ on the x-axis. [3]

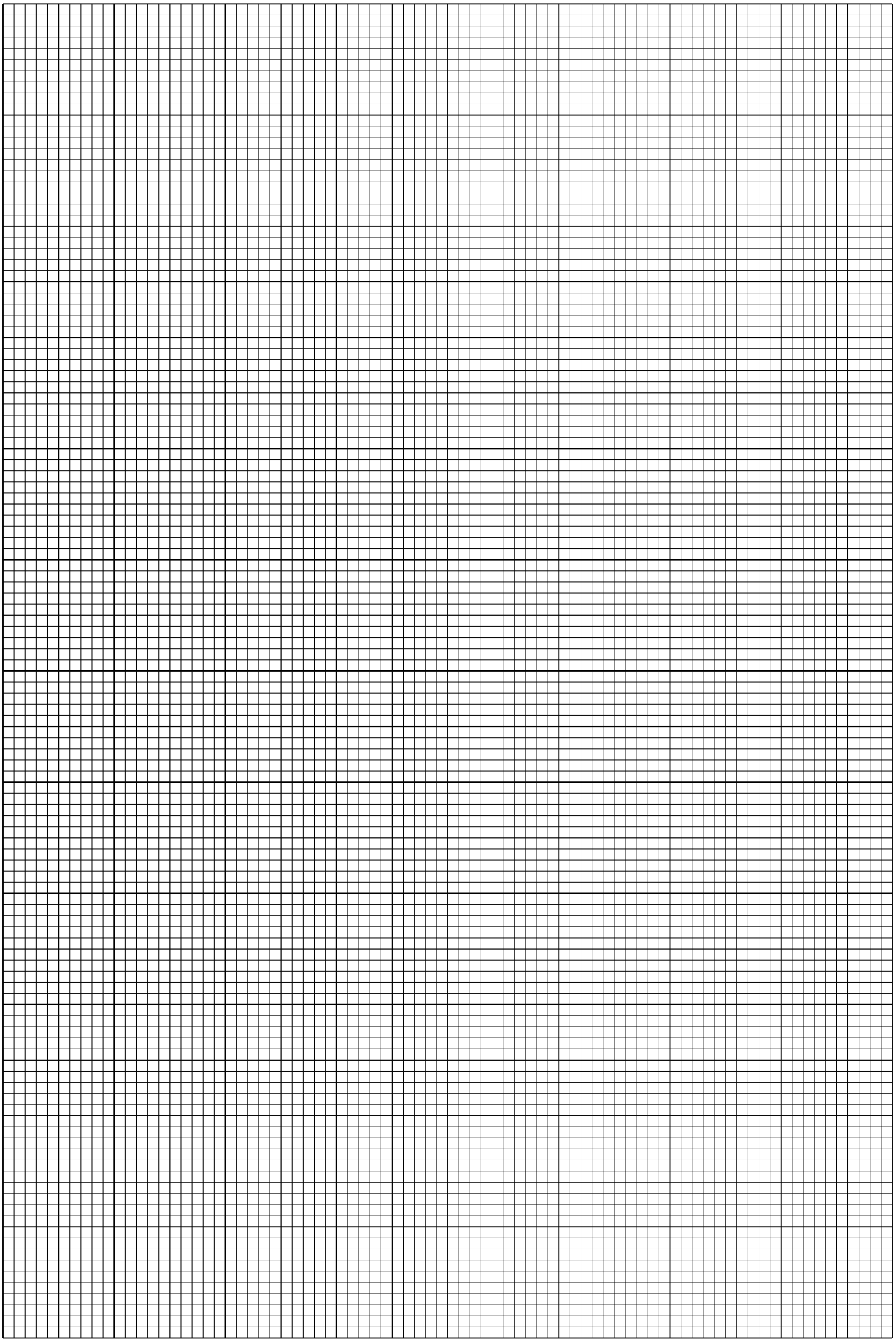
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



(e) It is suggested that the quantities T and n are related by the equation

$$T = P\sqrt{n} + Q$$

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

$$P = \pi\sqrt{\frac{L}{g}}$$

where g is the acceleration of free fall.

Use your values in **(a)** and **(e)** to determine a value for g.
Give an appropriate unit.

g = ... [1]

[Total: 20]

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

2 In this experiment, you will investigate the potential difference across a current-carrying wire.

You have been provided with a wooden strip with wires attached.

(a) The wire attached between A and B has a diameter *D*.

(i) Without detaching the wire from the board, measure and record *D*.

D = ... [1]

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

percentage uncertainty = ...% [1]

[Turn over

(b) • Set up the circuit shown in Fig. 2.1.

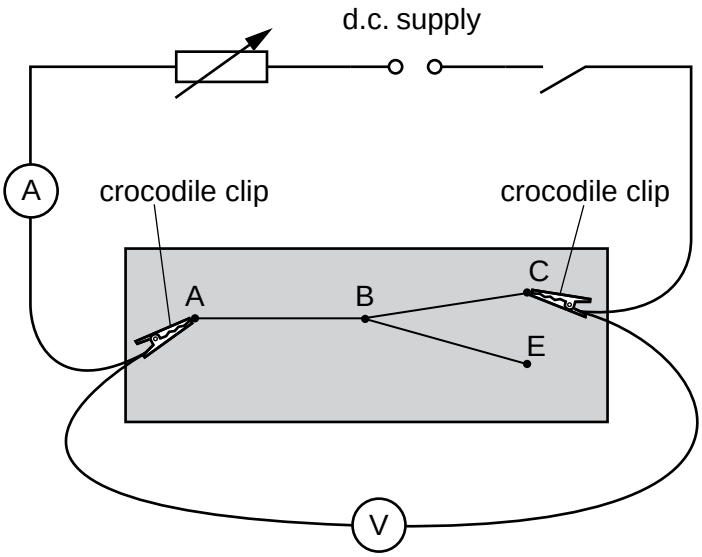


Fig. 2.1

- Connect the crocodile clips to A and C.
- Adjust the rheostat to approximately the middle of its range.
- Close the switch.
- Record the ammeter reading.

ammeter reading = ...

- Record the voltmeter reading *V*.

V = ...

- Open the switch.

[2]

(c) (i) The wire attached between B and C has a diameter d.

Measure and record d.

$d =$ ..... [1]

(ii) Calculate G where

$$G = \frac{D^2 + d^2}{D^2 d^2}.$$

$G =$ ..... [1]

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

.....

.....

..... [1]

(d)
- Disconnect the crocodile clip from C and connect it to E.
- Close the switch.
- Adjust the rheostat so that the ammeter reading is as close as possible to the reading in **(b)**.
- Record the voltmeter reading *V*.

V = ...

- Open the switch.

[2]

(e) The wire attached between B and E has diameter *d*.

- Measure and record *d*.

d = ...

- Calculate *G*.

G = ...
[1]

(f) It is suggested that the relationship between V and G is

$$V = kG$$

where k is a constant.

Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(g) It is suggested that the percentage uncertainty in the values of k is 5%.

Using this uncertainty, explain whether your results support the relationship in **(f)**.

.....

.....

.....

..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

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]