Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

9756497916

PHYSICS **9702/32**

Paper 3 Advanced Practical Skills 2 **May/June 2024**

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 an electrical circuit.

(a) ● Connect the circuit shown in Fig. 1.1.

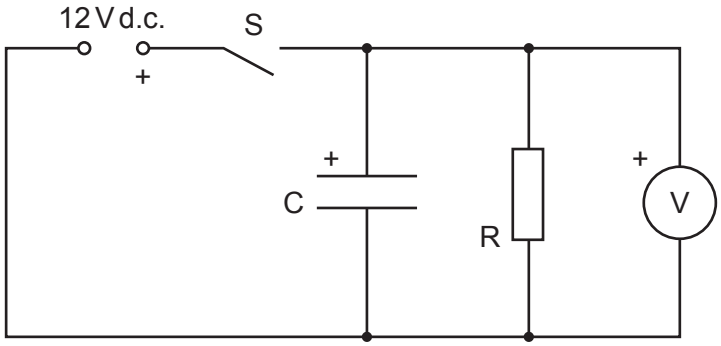


Fig. 1.1

- **Ensure that the polarities of the power supply, component C and the voltmeter are as shown in Fig. 1.1.**
- Close switch S for a short time and then open it.
- Watch the voltmeter reading as it reduces.

  When the voltmeter reading passes a value V_S of 8.00 V, start the stop-watch.

  When the voltmeter reading passes a value of 7.00 V, stop the stop-watch.
- Record the starting value V_S and the time T for the voltmeter reading to fall by 1.00 V.

V_S = ...

T = ...
[2]

(b) Choose another starting value V_S. Close S for a short time and then open it. Measure the time T for the voltmeter reading to fall by 1.00 V from the starting value V_S.

Repeat until you have six sets of values of V_S and T.

Record your results in a table. Include values of $\frac{1}{T}$ in your table.

[10]

(c) **(i)** Plot a graph of $\frac{1}{T}$ on the y-axis against V_S on the x-axis. [3]

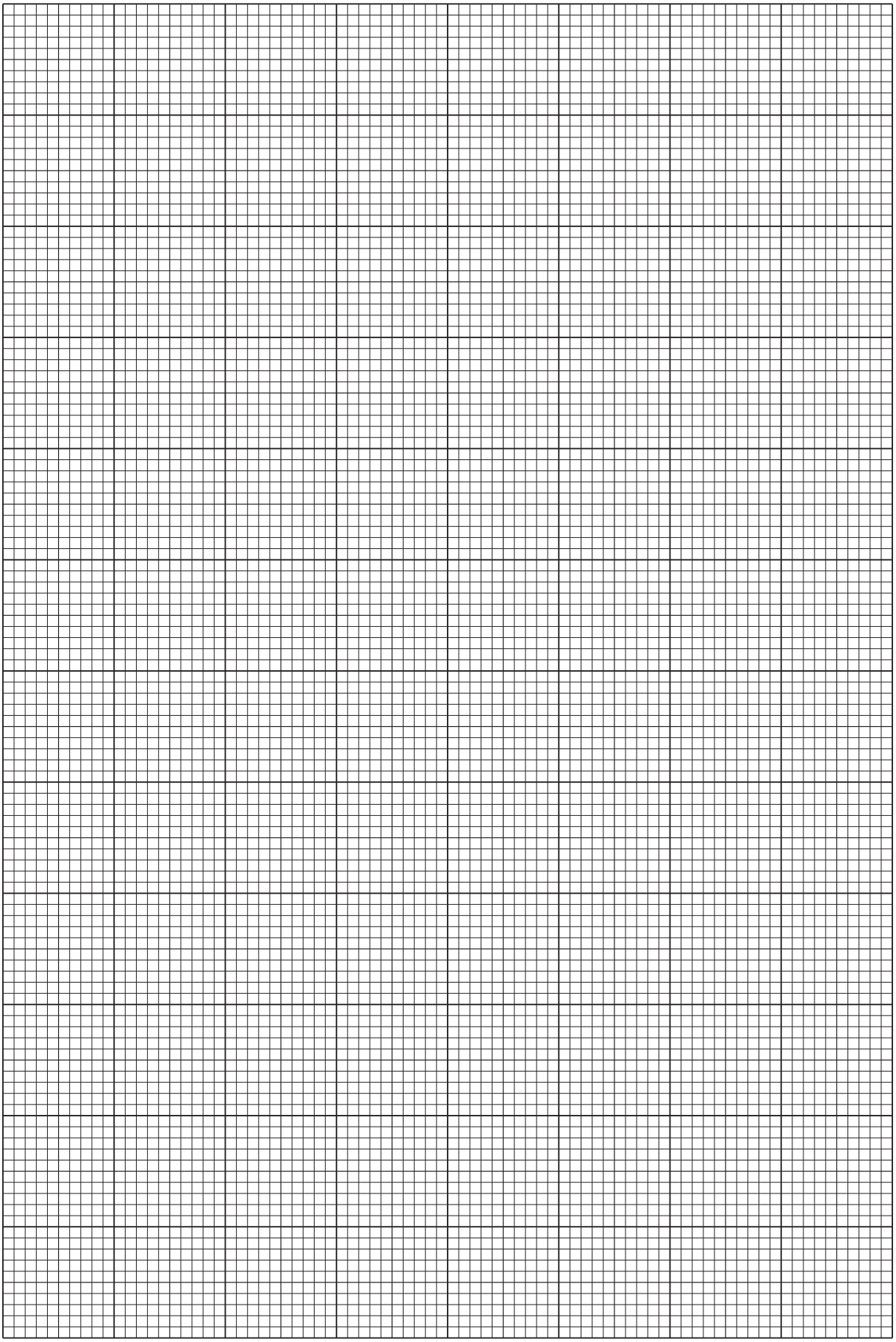
(ii) Draw the straight line of best fit. [1]

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

gradient = ...

y-intercept = ...

[2]



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

$$\frac{1}{T} = aV_S + b$$

where a and b are constants.

Using your answers in **(c)(iii)**, 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 equilibrium of a wooden rod.

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

● Adjust the apparatus so that the wooden rod is parallel to the bench and the spring is vertical.

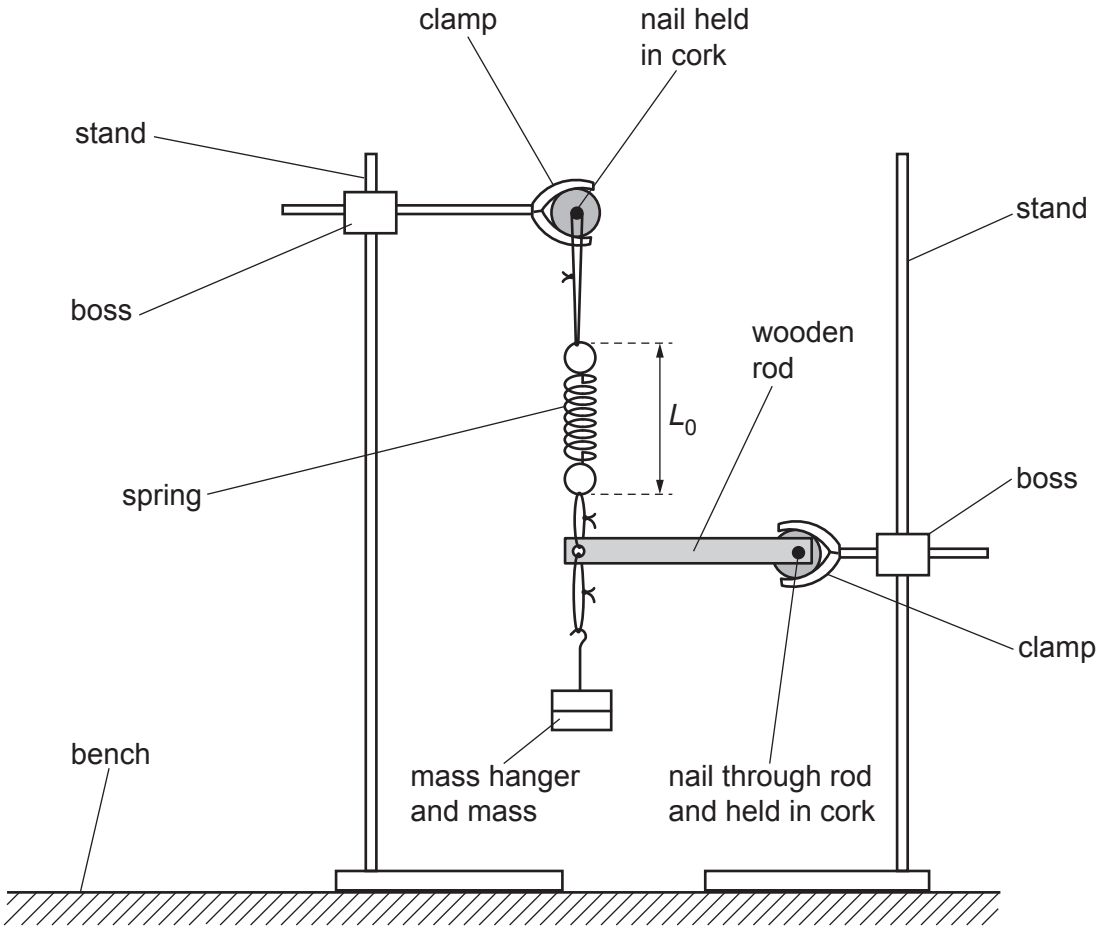


Fig. 2.1 (not to scale)

● The distance between the ends of the spring is L_0, as shown in Fig. 2.1.

Measure and record L_0.

L_0 = ... m [1]

(ii) ● Pull the mass hanger down a short distance and then release it. The mass hanger will oscillate.

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

T = ... [2]

(iii) ● Calculate the value of the spring constant k using

$$k = \frac{\alpha\pi^2}{T^2}$$

where α = 0.800 kg.

k = ... N m^{-1}

● Justify the number of significant figures that you have given for your value of k.

.....

.....

.....

[1]

(b) (i) ● Move the stand supporting the spring away from the other stand and add the plumb line, as shown in Fig. 2.2.

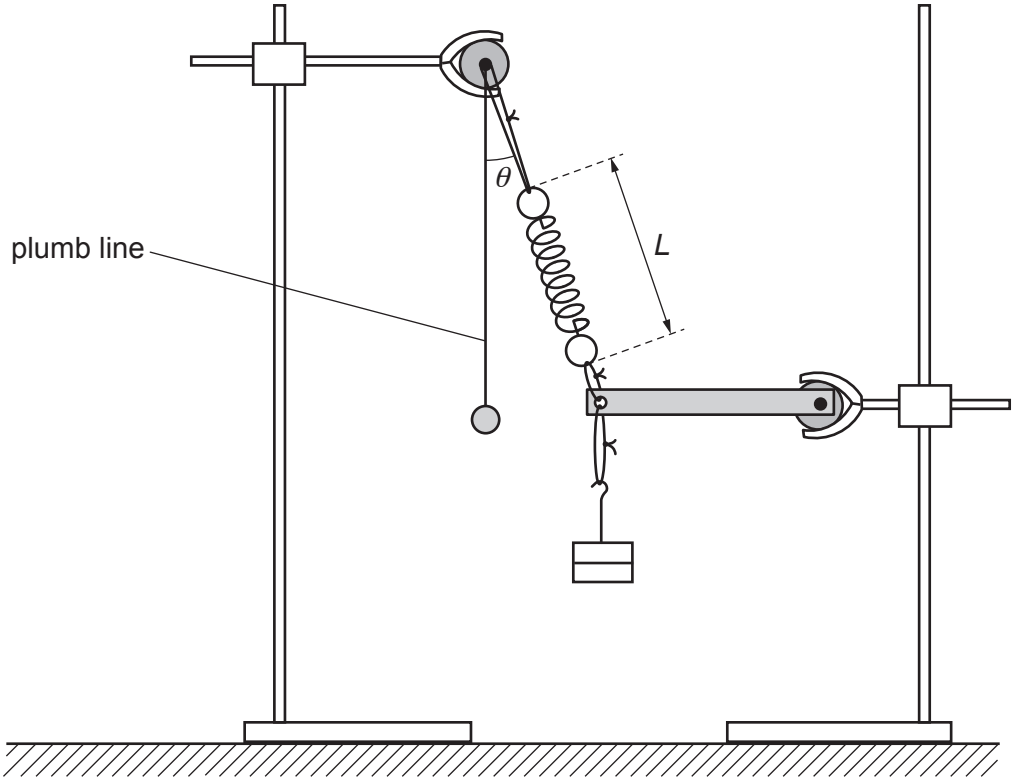


Fig. 2.2 (not to scale)

- Adjust the apparatus so that the angle θ between the spring and the vertical is approximately 20° and the wooden rod is parallel to the bench, as shown in Fig. 2.2.
- The new distance between the ends of the spring is L, as shown in Fig. 2.2.

  Measure and record L.

  L = ... m
- Measure and record θ.

  θ = ... °

[2]

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

percentage uncertainty = ...% [1]

(iii) Repeat **(b)(i)** using an angle θ of approximately 45°.

L = ... m

θ = ... °
[3]

(c) It is suggested that the relationship between L and θ is

$$k(L - L_0) + B = \frac{D}{\cos\theta}$$

where B = 2.0 N and D is a constant.

Using your data, calculate two values of D.

first value of D = ...

second value of D = ...
[1]

(d) It is suggested that the percentage uncertainty in the values of D is 10%.

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

.....

.....

.....

..... [1]

(e) (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 .....

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2 .....

.....

3 .....

.....

4 .....

.....

[4]

[Total: 20]

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