CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

10646062 51

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2026**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

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. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages.

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1 Two identical springs, each with a spring constant k, are attached to each other. The spring combination is attached to a wooden block and a string. The string is also attached to the spindle of a d.c. motor, as shown in Figure 1.1.

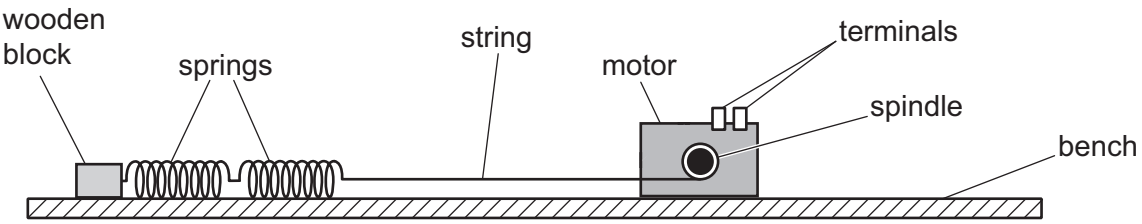

Figure 1.1

The terminals of the motor are connected to a capacitor of capacitance C.

The capacitor is initially charged by applying a potential difference V across it. The capacitor is then discharged through the motor.

As the spindle of the motor turns, the string wraps around the spindle causing the spring combination to extend. The maximum extension of the spring combination is e.

It is suggested that e is related to C by the relationship

$$\frac{ke^2}{2} = \beta CV^2$$

where β is a constant.

Plan a laboratory experiment to test the relationship between e and C.

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine a value for β.

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

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Diagram

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2 A student places a tube and a loudspeaker into an oven as shown in Figure 2.1.

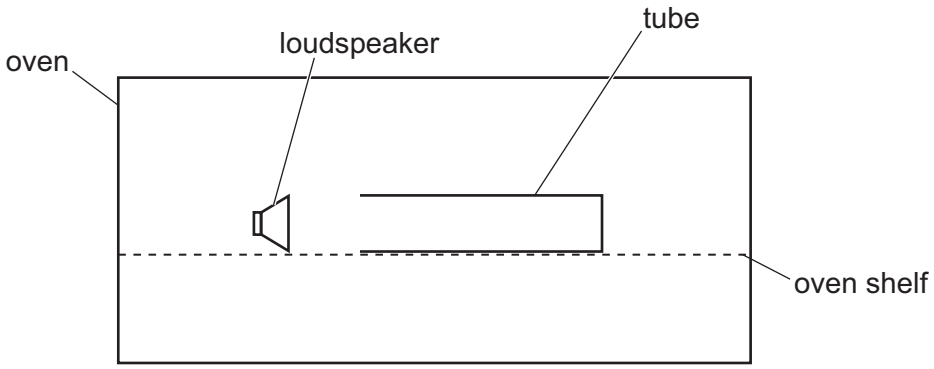

Figure 2.1

The loudspeaker is connected to a signal generator. The frequency of the signal generator is adjusted until the tube produces a loud sound.

This sound from the tube is detected by a microphone which is connected to an oscilloscope. The frequency of this sound is determined from the oscilloscope.

The speed v of sound in air is determined using the length of the tube and the frequency.

The temperature of the air in the oven, measured in °C, is t. The absolute temperature T is calculated using the expression

$T = t + 273$.

The experiment is repeated for different temperatures of air in the oven.

It is suggested that v and T are related by the equation

$$v = T^n \sqrt{\frac{\gamma R}{M}}$$

where R is the molar gas constant, M is the molar mass of air and n and γ are constants.

(a) A graph is plotted of lg v on the y-axis against lg T on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

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(b) Values of t, T, v and lg T are given in Table 2.1.

Table 2.1

t/°C	T/K	v/m s^{-1}	lg (T/K)	lg (v/m s^{-1})
16	289	339 ± 2	2.461	
24	297	346 ± 2	2.473	
33	306	351 ± 2	2.486	
44	317	357 ± 2	2.501	
53	326	361 ± 3	2.513	
64	337	370 ± 3	2.528	

Calculate and record values of lg (v/m s^{-1}) in Table 2.1. Include the absolute uncertainties in lg (v/m s^{-1}). [2]

(c) **(i)** Plot a graph of lg (v/m s^{-1}) against lg (T/K). Include error bars for lg (v/m s^{-1}). [2]

(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]

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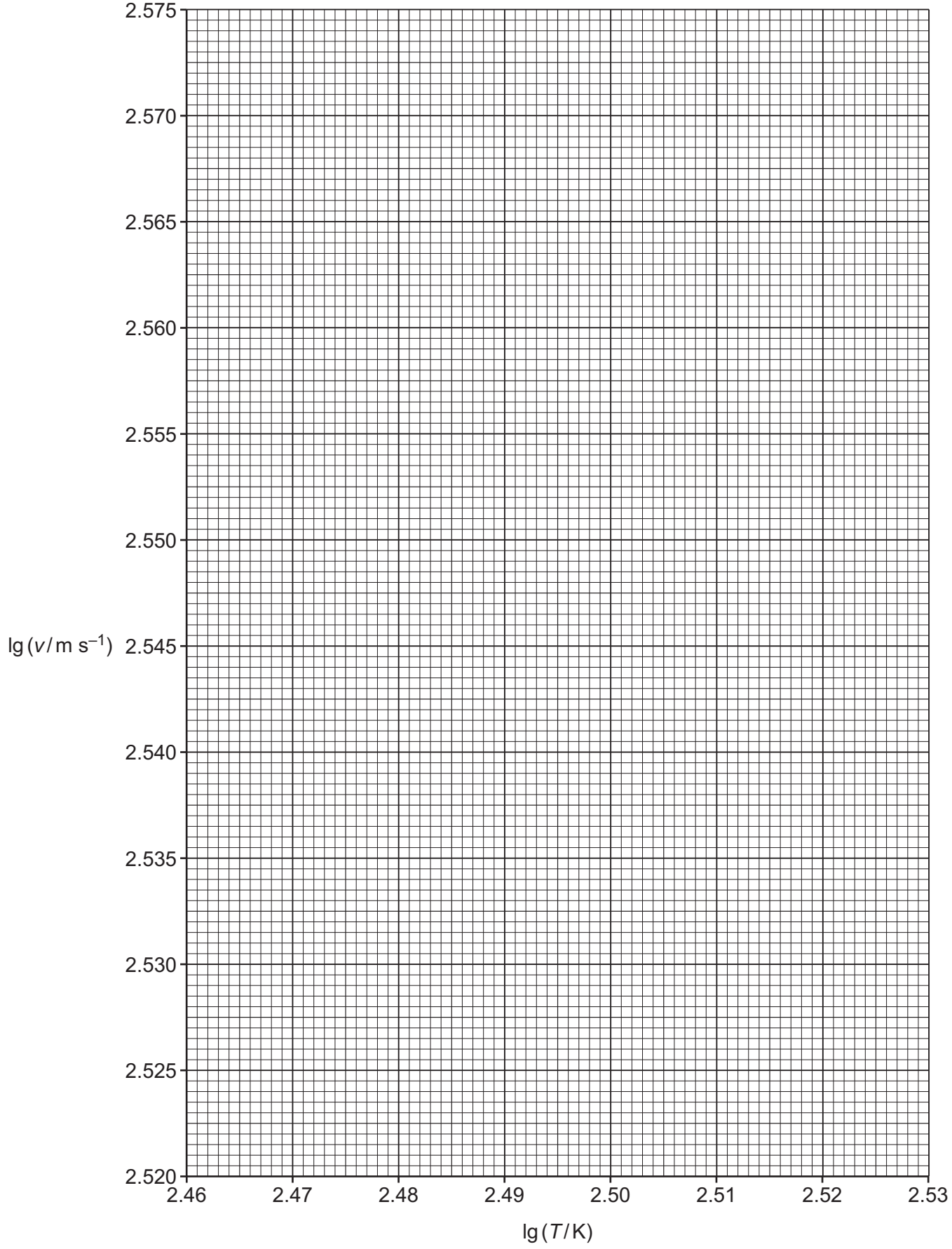

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(iv) Determine the *y*-intercept of the line of best fit. Include the absolute uncertainty in your answer.

y-intercept = ... [2]

(d) (i) Using your answers to **2(a)**, **2(c)(iii)** and **2(c)(iv)**, determine the values of n and γ. You need not be concerned with units.

Data: $M = 0.029\,\text{kg mol}^{-1}$
$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$

n = ...

γ = ...
[2]

(ii) Determine the percentage uncertainty in n.

percentage uncertainty in n = ... [1]

(e) The experiment is repeated inside a freezer where the temperature of the air is –12 °C. Determine the speed v of sound in air at this temperature.

v = ... m s^{-1} [1]

[Total: 15]

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