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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME M BC

CENTRE NUMBER

CANDIDATE NUMBER

* 5 4 1 3 5 1 2 0 8 4 *

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2024**

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 or correction fluid.
- 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.

DC (SL/CB) 329812/1

[Turn over

1 A spring is attached to a strong cylindrical magnet of length *L* and cross-sectional area *A*. The magnet is placed on thin card on top of a magnetic sheet on the bench, as shown in Fig. 1.1.

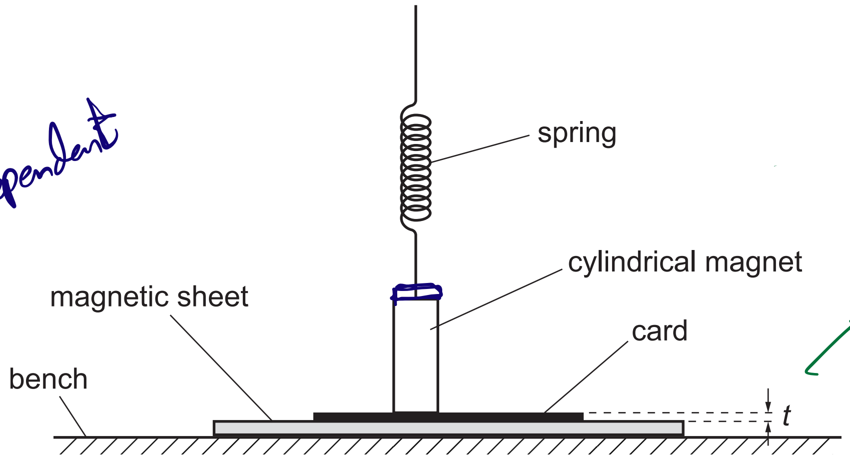


Fig. 1.1

The thickness of the card is *t*. The magnetic flux density at one of the poles of the magnet is *B*.

A force is applied upwards to the spring. The extension of the spring when the magnet just leaves the card is *s*.

It is suggested that *s* is related to *t* by the relationship

$$ks = \frac{ALBZ}{t}$$

where *k* is the spring constant of the spring and *Z* is a constant.

Plan a laboratory experiment to test the relationship between *s* and *t*.

Draw a diagram showing the arrangement of your equipment.

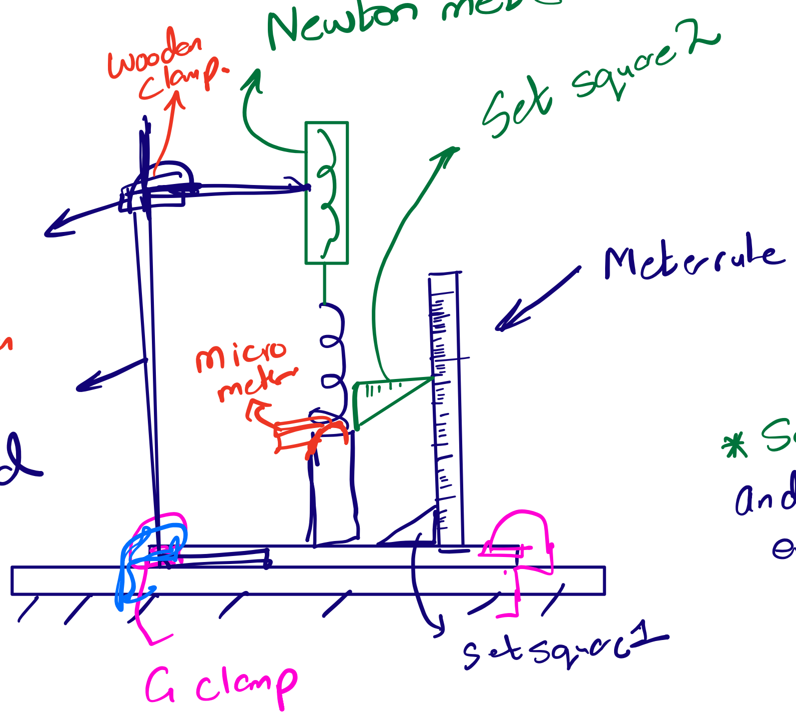
Explain how the results could be used to determine a value for *Z*.

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.

Diagram

* Whenever we are dealing with a magnet make sure instruments are labled as wooden.



* Same diagram and how everything is to be measured

* Safety: do not reach

→ Indendent variable = thickness of the card (t)
→ Dependent variable = extention of the spring. (s)
Control Variables = Area of magnet (A), Length of magent (L) Spring constant (k), (magnetic flux density (F)
Vary t and measure s

* Set up the experiment as shown in the diagram.
→ thickness of the card is to be measured by the micrometer. use 10 different thickness.
→ Measure extension of the spring by the meter rule first measure orignal length then
→ Ext = SL - OL
→ Measure diameter by vernier calliper / micrometer and apply $\frac{\pi d^2}{4}$ to get Area.

→ to Find magnetic flux density use the Hall probe.

→ * Put is close to the magnet and change its angles until maximum reading is there.

→ Newton meter is used to measure the force,

Analysis: * S to be plotted on y axis $\frac{1}{t}$ to be plotted on x axis.

* graph should be straight line passing from the origin (0, 0).

gradient $= \frac{ALbZ}{k}$

$\frac{(grad)\,k}{A\,L\,B} = Z$ to calc Z

* Spring constant should be measured attach a load and note extension use $\frac{F}{x} = k$ to find k.

* Set square is used to keep scale perpendicular, second set square is used to keed distance constant

* Note values of thickness from different parts and take average.

* Repeat Experiment few times and average the values.

* Measure readings on eye level to reduce chance of parallex error.

→ Safety.

→ Use G clamp for holding spring so it doesn't fall and cause destruction, keep mettalic things away,

→ Spring should be attached properly so that magnet dosen't fall on hand

→ wear gloves when dealing with sharp edges.

[15]

2 A student investigates the resonant frequency of a metal rod. The metal rod of length L is suspended from two rubber loops. A sensitive microphone with a cone is positioned at one end of the rod. The microphone is attached to an oscilloscope, as shown in Fig. 2.1.

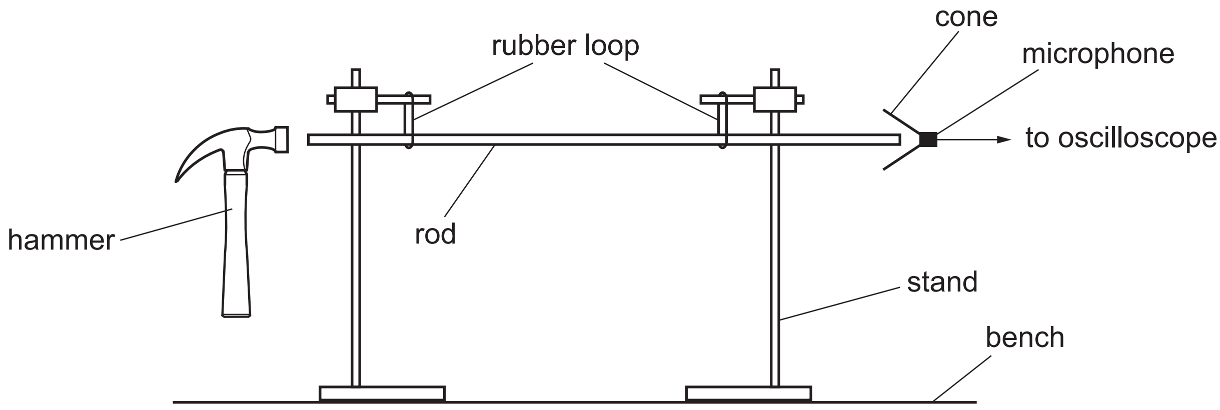


Fig. 2.1 (not to scale)

The rod is hit gently with a hammer.

The period T of the trace produced on the oscilloscope is determined.

The experiment is repeated for different values of L.

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

$$T = \frac{2L^n}{C}$$

where C and n are constants.

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

Determine expressions for the gradient and y-intercept.

gradient = n

y-intercept = $\lg 2 - \lg C = \lg\left(\frac{2}{C}\right)$

[1]

(b) Values of L and T are given in Table 2.1.

* For quantities with uncertainty lg values will also be written in uncertainties

* For quantities whose uncertainties are not given in lg forms uncertainties are not required

Table 2.1

L / cm	T / 10^{-5} s	lg (L / cm)	lg (T / 10^{-5} s)
54	24 ± 1	1.732	1.38 ± 0.02
70	32 ± 1	1.845	1.51 ± 0.01
86	39 ± 1	1.934	1.59 or 1.591 ± 0.01
108	49 ± 2	2.033	1.69 or 1.690 ± 0.02
140	64 ± 2	2.146	1.81 or 1.806 ± 0.01
167	74 ± 2	2.222	1.87 or 1.869 ± 0.01

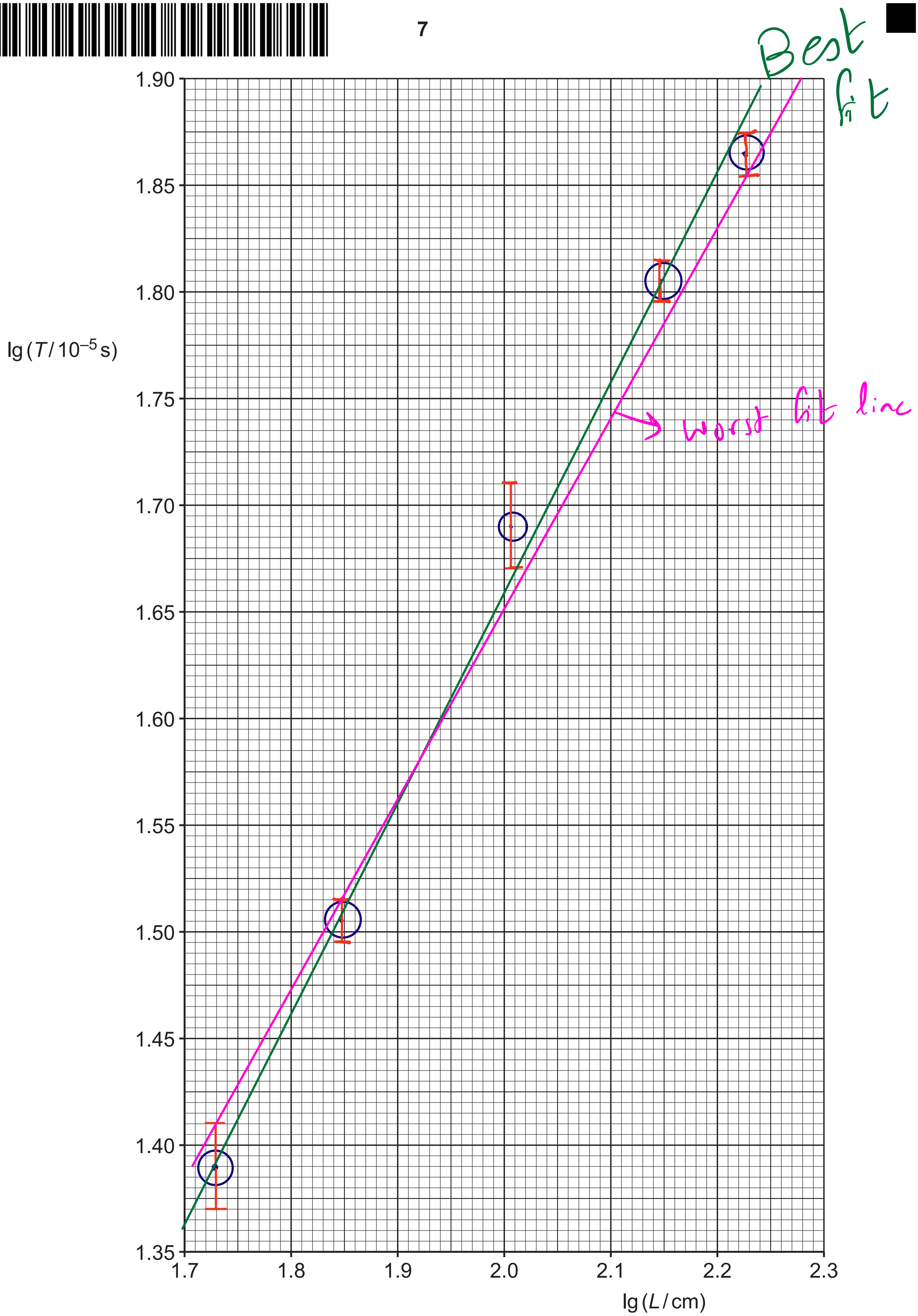
Calculate and record values of lg (L / cm) and lg (T / 10^{-5} s) in Table 2.1.
Include the absolute uncertainties in lg T. [2]

(c) (i) Plot a graph of lg (T / 10^{-5} s) against lg (L / cm). Include error bars for lg T. [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 = 1.02 ± 0.09 [2]


1.90
1.85
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
lg (T / 10⁻⁵ s)
1.7
1.8
1.9
2.0
2.1
2.2
2.3
lg (L / cm)
Best fit
worst fit line

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

$y = mx + c$

$y = 1.02x + c$

$y = 0.93x + c$

y-intercept = ... [2]

(d) Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of *n* and *C*. Include the absolute uncertainties in your values. You need not be concerned with units.

n = grad

n = 1.02 ± 0.09

C = ...
[3]

(e) The experiment is repeated. Determine the length *L* of the rod that gives a value of *T* of 0.10 ms.

L = ... cm [1]

[Total: 15]