



Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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PHYSICS

9702/32

Paper 3 Advanced Practical Skills 2

May/June 2021

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. Any blank pages are indicated.

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

- 1** In this experiment, you will investigate the patterns produced by overlaid grids.
- (a)** Grid A is the grid of parallel, equally spaced lines shown in Fig. 1.1.

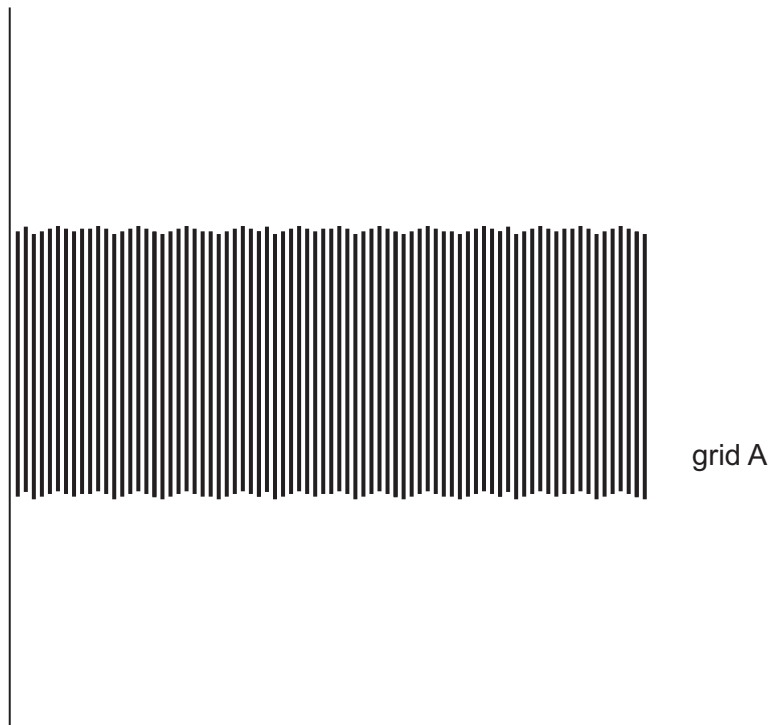


Fig. 1.1

Take measurements to determine the average spacing s_A between the centres of the lines on grid A.

$s_A = \dots\dots\dots$ mm [2]

(b) You have been provided with a second grid (labelled grid B) printed on a transparent sheet.

- Place grid B on top of grid A in Fig. 1.1.
- Turn grid B so that there is a small angle G between the grids. A pattern of fringes will be produced, as shown in the example in Fig. 1.2.

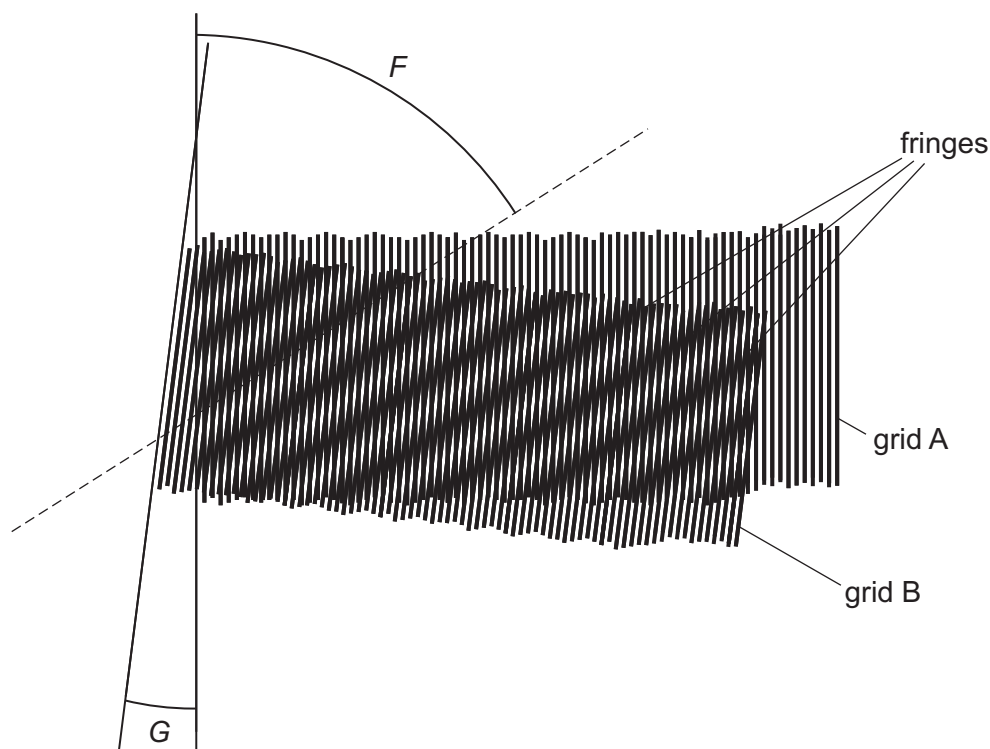


Fig. 1.2

- Do not take measurements from Fig. 1.2.

Measure and record your value of G from Fig. 1.1.

$G = \dots\dots\dots^\circ$

- The fringes make an angle F with grid A, as shown in Fig. 1.2.

Measure and record your value of F from Fig. 1.1.

$F = \dots\dots\dots^\circ$
[1]

- (c) Rotate grid B and repeat (b) until you have six sets of values of G and F .

Use values of G in the range 0° to 20° .

Record your results in a table. Include values of $\sin F$ and $\sin(F - G)$ in your table.

[8]

- (d) (i) Plot a graph of $\sin(F - G)$ on the y -axis against $\sin F$ on the x -axis.

[3]

- (ii) Draw the straight line of best fit.

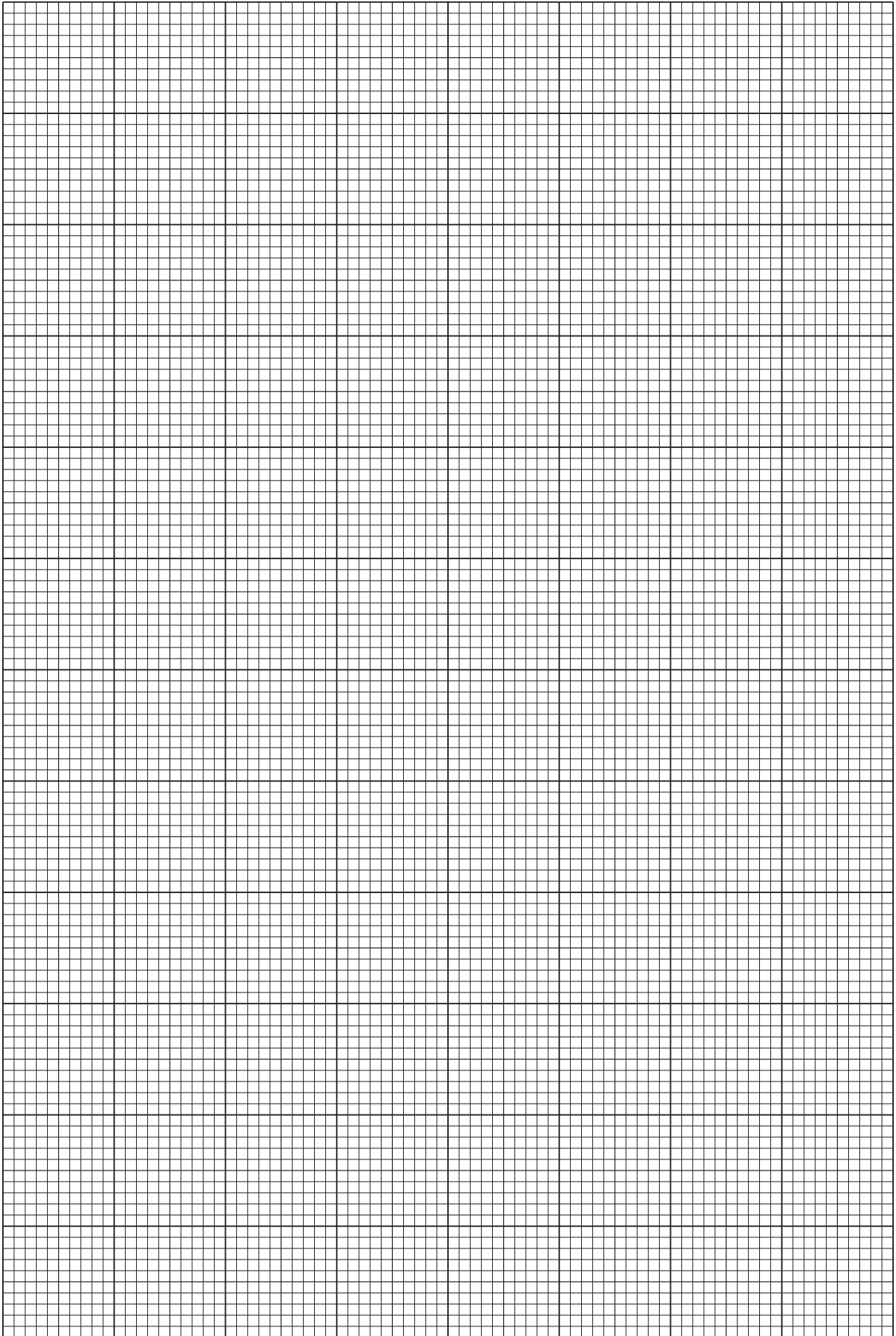
[1]

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

gradient =

y -intercept =

[2]



- (e) It is suggested that the quantities F and G are related by the equation

$$\sin(F - G) = p \sin F + q$$

where p and q are constants.

Use your answers in (d)(iii) to determine the values of p and q .

$$p = \dots\dots\dots$$

$$q = \dots\dots\dots$$

[2]

- (f) The constant p is related to the spacing of the lines of grids A and B by

$$p = \frac{s_B}{s_A}$$

where s_B is the line spacing of grid B.

Use your values of p and s_A to calculate s_B .

$$s_B = \dots\dots\dots \text{mm} \quad [1]$$

[Total: 20]

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

2 In this experiment, you will investigate the oscillations of a mass on a spring.

- (a) (i) • Set up the apparatus as shown in Fig. 2.1 using the 50 g mass hanger.

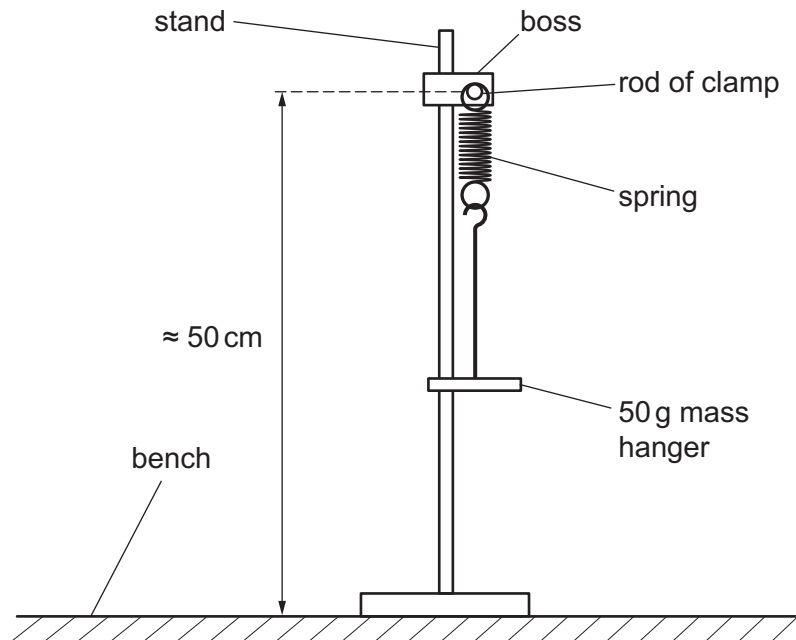


Fig. 2.1

- Pull the mass hanger down by approximately 1 cm. Release it so that it oscillates vertically, with no swinging motion.
- Take measurements to find the period T_V of these oscillations.

$T_V = \dots\dots\dots$ [2]

- (ii) • Ensure that the mass hanger has stopped moving.
- Push the mass hanger approximately 1 cm away from you. Release it so that it swings towards and away from you, with as little vertical oscillation as possible.
 - Take measurements to find the period T_S of these oscillations.

$T_S = \dots\dots\dots$ [1]

- (b) Repeat (a) with a total mass of 150g suspended from the spring.

$$T_V = \dots\dots\dots$$

$$T_S = \dots\dots\dots [2]$$

- (c) It is suggested that the quantity $T_S^2 - T_V^2$ is independent of the mass suspended from the spring.

- (i) Using your data, calculate two values of $T_S^2 - T_V^2$.

$$\text{first value of } T_S^2 - T_V^2 = \dots\dots\dots$$

$$\text{second value of } T_S^2 - T_V^2 = \dots\dots\dots [1]$$

- (ii) Justify the number of significant figures you have given for your values of $T_S^2 - T_V^2$.

.....

 [1]

- (iii) Explain whether your results in (c)(i) support the suggestion.

.....

.....

.....

..... [1]

- (d) (i) • Remove the masses from the spring and the spring from the rod.
 • Measure and record the length x_1 of the spring, as shown in Fig. 2.2.

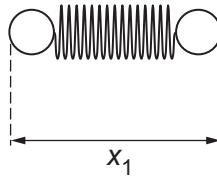


Fig. 2.2

$x_1 = \dots\dots\dots$ cm [1]

- (ii) Estimate the percentage uncertainty in your value of x_1 . Show your working.

percentage uncertainty = $\dots\dots\dots$ [1]

- (iii) Measure and record the length x_2 of the mass hanger, as shown in Fig. 2.3.

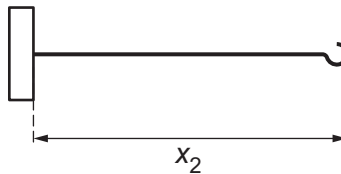


Fig. 2.3

$x_2 = \dots\dots\dots$ cm [1]

- (iv) Using your first value of $T_S^2 - T_V^2$, calculate g using

$$g = \frac{4\pi^2(x_1 + x_2)}{T_S^2 - T_V^2}.$$

$g = \dots\dots\dots$ [1]

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

1.
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2.
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3.
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4.
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[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.
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3.
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4.
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[4]

[Total: 20]

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