

PHYSICS

Paper 5 Planning, Analysis and Evaluation

You must answer on the question paper.

No additional materials are needed.

9702/52

February/March 2021

1 hour 15 minutes

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 **12** pages. Any blank pages are indicated.

- 1 A student investigates the vertical oscillations of a solid cylinder which floats in cooking oil. Fig. 1.1 shows a cylinder of radius r .

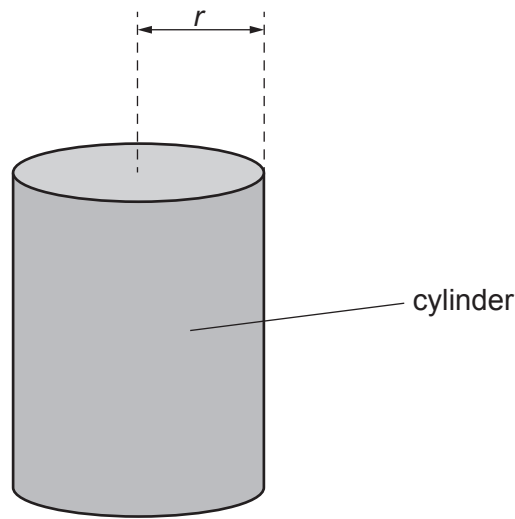


Fig. 1.1

The student places the cylinder of mass m in the oil. The cylinder is displaced vertically from its equilibrium position and released so that it oscillates. The period T of the oscillations is determined.

A number of cylinders of different mass are available.

It is suggested that the relationship between T and m is

$$T = 2\sqrt{\frac{\pi m}{\sigma K r^2}}$$

where σ is the density of the oil and K is a constant.

Design a laboratory experiment to test the relationship between T and m .

Explain how your results could be used to determine a value for K .

You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to:

- 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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- 2 A student investigates the collision of two gliders A and B on a linear air-track, as shown in Fig. 2.1.

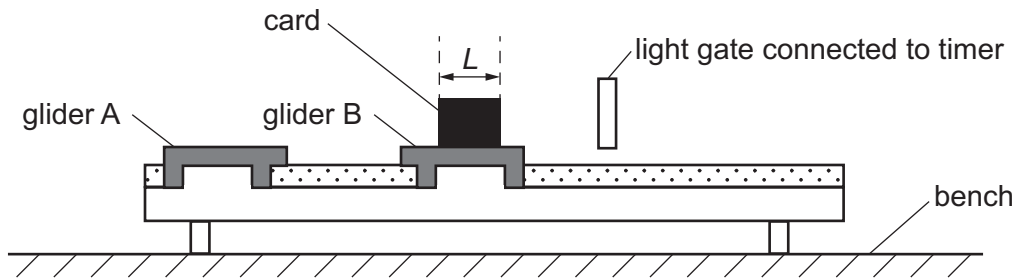


Fig. 2.1

The light gate is connected to a timer. A card of length L is attached to glider B. The mass of glider B and the card is m . Glider B is initially at rest.

The student releases glider A so that it travels at a constant velocity u towards the stationary glider B. The gliders collide and then separate.

The card on glider B passes through the light gate. The student records the time t for the card to pass through the light gate from the timer.

The student changes the mass of glider B and repeats the experiment.

It is suggested that the velocity v of glider B as it passes through the light gate and m are related by the equation

$$v = \frac{2uA}{m + A}$$

where A is the mass of glider A.

- (a) A graph is plotted of $\frac{1}{v}$ on the y -axis against m on the x -axis.

Determine expressions for the gradient and y -intercept.

gradient =

y -intercept =

[1]

(b) Values of m and t are given in Table 2.1.

Table 2.1

m/g	t/s	$\frac{1}{v}/\text{s cm}^{-1}$
271	0.23 ± 0.01	
369	0.26 ± 0.01	
490	0.31 ± 0.01	
632	0.36 ± 0.01	
741	0.40 ± 0.01	
840	0.44 ± 0.01	

Calculate and record values of $\frac{1}{v}/\text{s cm}^{-1}$ in Table 2.1 where

$$\frac{1}{v} = \frac{t}{L}$$

and $L = 5.0 \pm 0.1$ cm.

Include the absolute uncertainties in $\frac{1}{v}$. [2]

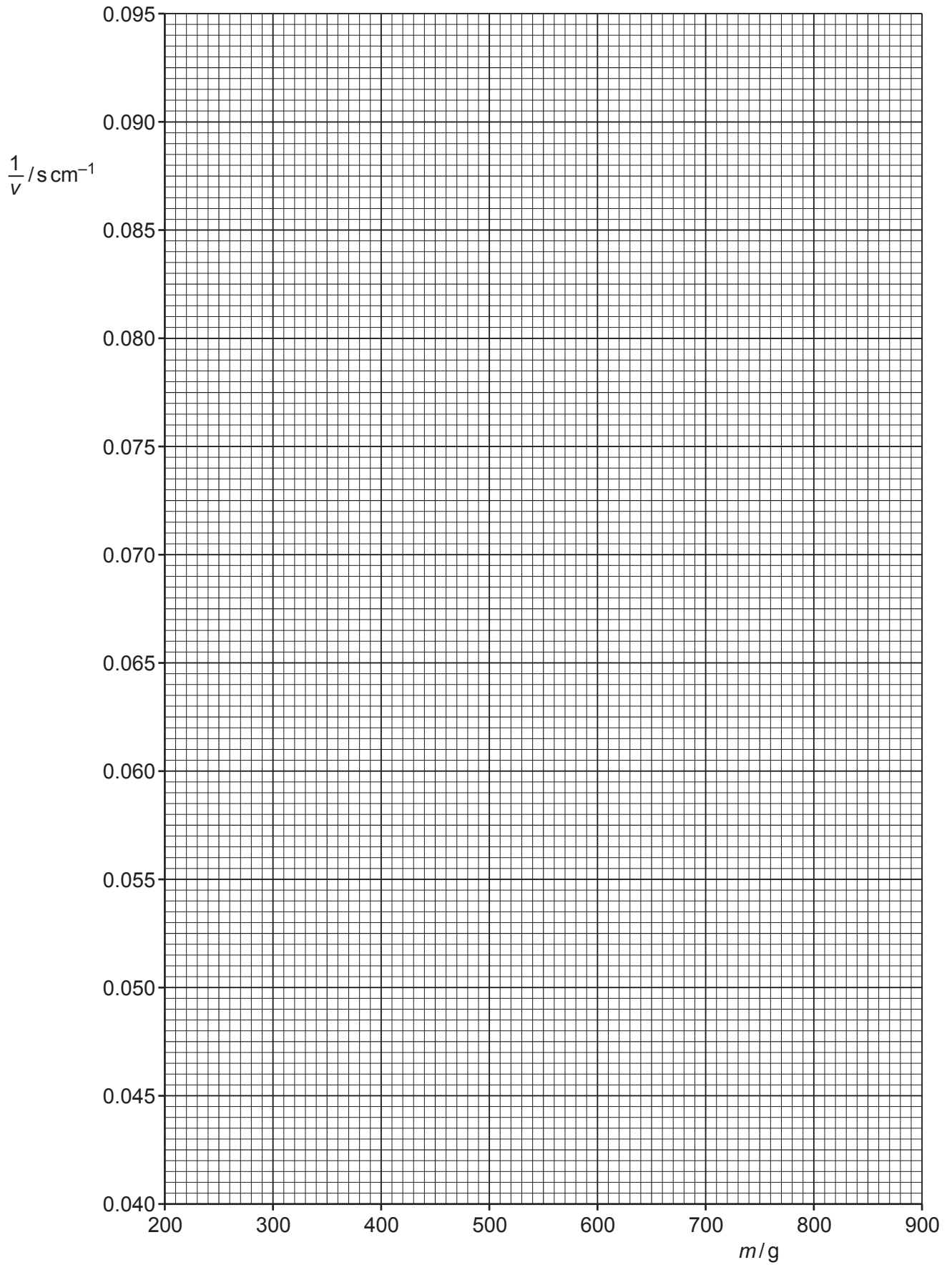
(c) (i) Plot a graph of $\frac{1}{v}/\text{s cm}^{-1}$ against m/g .

Include error bars for $\frac{1}{v}$. [2]

(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

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

gradient = [2]



- (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 (a), (c)(iii) and (c)(iv), determine values of u and A . Include appropriate units.

u =

A = [2]

- (ii) Determine the percentage uncertainty in A .

percentage uncertainty in A = % [1]

- (e) The experiment is repeated. Determine the mass m of glider B and the card when t has a value of 0.50 s.

m = g [1]

[Total: 15]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.