Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

8129289249

PHYSICS **9702/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **8** printed pages.

DC (ST/SW) 94471/2

CAMBRIDGE International Examinations

1 A student is investigating simple harmonic motion using an electric vibrator. A plate is attached to the top of the electric vibrator. A small mass is placed on the metal plate as shown in Fig. 1.1.

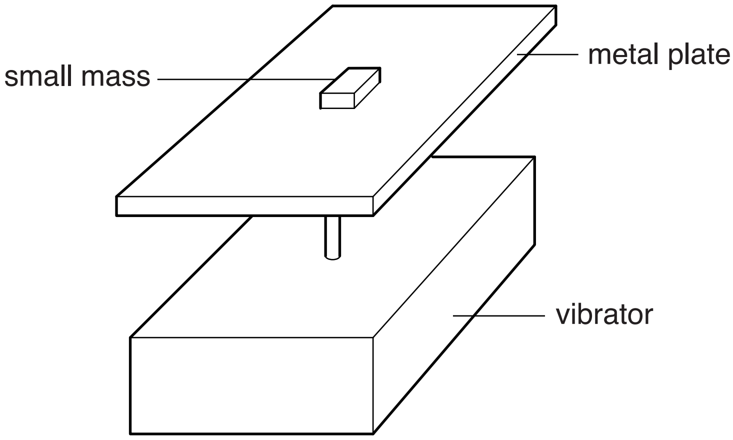

Fig. 1.1

An alternating potential difference (p.d.) is applied to the vibrator. For a given peak p.d. V, there is a maximum frequency f at which the small mass remains in contact with the plate. The contact between the small mass and plate is lost when the frequency is greater than f.

It is suggested that the relationship between f and V is

$$k = \pi^2 f^2 V$$

where k is a constant.

Design a laboratory experiment to test the relationship between f and V. 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

(a) the procedure to be followed,

(b) the measurements to be taken,

(c) the control of variables,

(d) the analysis of the data,

(e) the safety precautions to be taken.

[15]

Diagram

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[Turn over

Defining the problem	Methods of data collection	Method of analysis	Safety considerations	Additional detail

2 A student is investigating the performance of a motor vehicle.

The vehicle is driven at a constant speed v on a test track, as shown in Fig. 2.1.

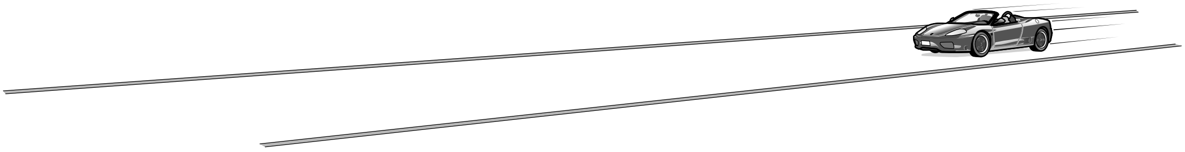


Fig. 2.1

The performance P of the vehicle is the distance travelled per unit volume of fuel, measured in kilometres per litre (km l^{-1}). This is obtained from the vehicle's computer system.

The experiment is repeated for different speeds.

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

$$P = kv^m$$

where k and m are constants.

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

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...
[1]

(b) Values of v and P are given in Fig. 2.2.

v/km h^{-1}	P/km l^{-1}	lg (v/km h^{-1})	lg (P/km l^{-1})
50	20.5 ± 0.5		
61	16.0 ± 0.5		
71	13.0 ± 0.5		
80	11.0 ± 0.5		
90	9.5 ± 0.5		
99	8.0 ± 0.5		

Fig. 2.2

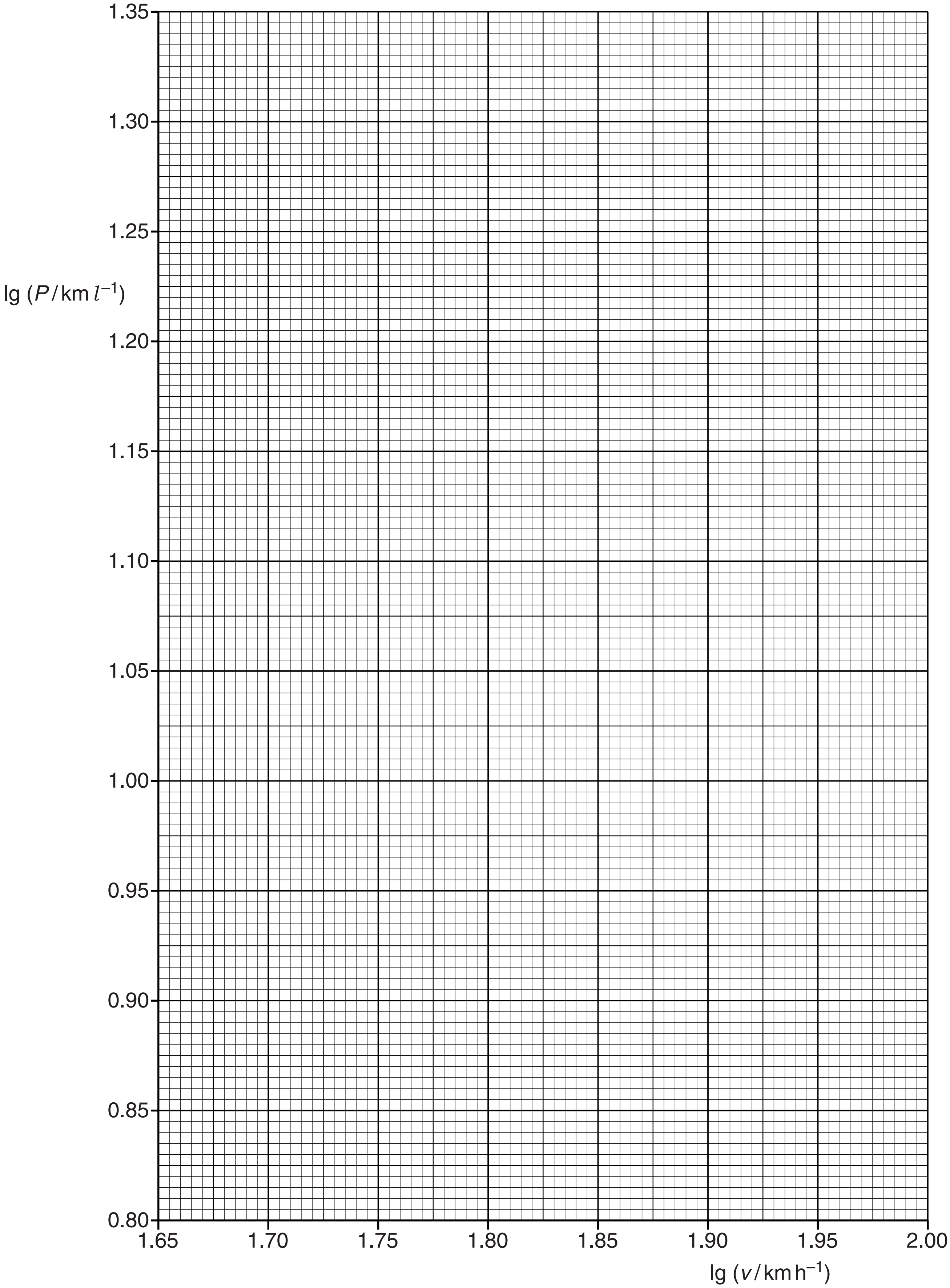
Calculate and record values of lg (v/km h^{-1}) and lg (P/km l^{-1}) in Fig. 2.2.
Include the absolute uncertainties in lg (P/km l^{-1}). [3]

(c) **(i)** Plot a graph of lg (P/km l^{-1}) against lg (v/km h^{-1}).
Include error bars for lg (P/km l^{-1}). [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 uncertainty in your answer.

gradient = ... [2]


1.35
1.30
1.25
lg (P / km l⁻¹)
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
1.65
1.70
1.75
1.80
1.85
1.90
1.95
2.00
lg (v / km h⁻¹)

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

y-intercept = ... [2]

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

k = ...

m = ...
[2]

(ii) Determine the percentage uncertainty in *k*.

percentage uncertainty in *k* = ... %
[1]