UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2012**

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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
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.

For Examiner's Use	
1	
2	
Total	

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

1 Two identical light sources are viewed from a distance, as shown in Fig 1.1. When the angle θ between the light sources is large, they are seen as separate.

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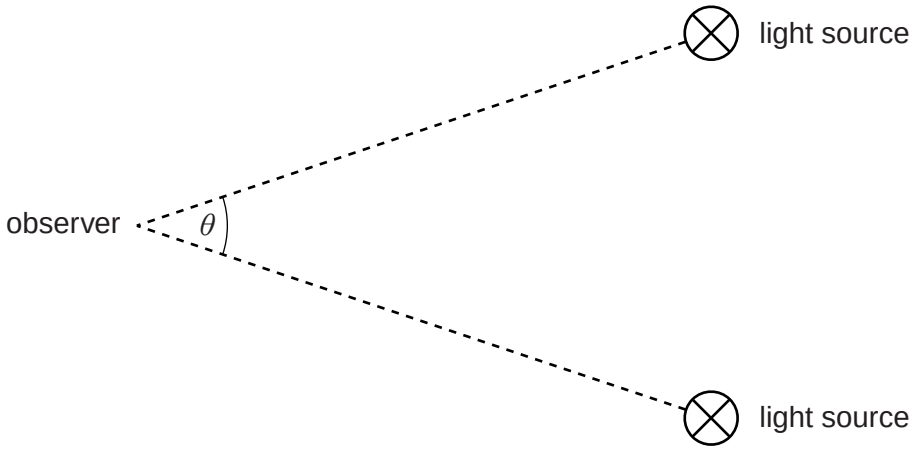

Fig 1.1 (not to scale)

The sources are moved closer together. At a particular angle θ_1 the two sources appear as a single source.

It is suggested that θ_1 is directly proportional to the wavelength λ of the light from the sources.

Design a laboratory experiment using two light sources to test the relationship between θ_1 and λ. 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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For Examiner's Use	Defining the problem	Methods of data collection	Method of analysis	Safety considerations	Additional detail

2 A trolley is attached to springs, as shown in Fig 2.1. When the trolley is displaced and then released, the trolley oscillates.

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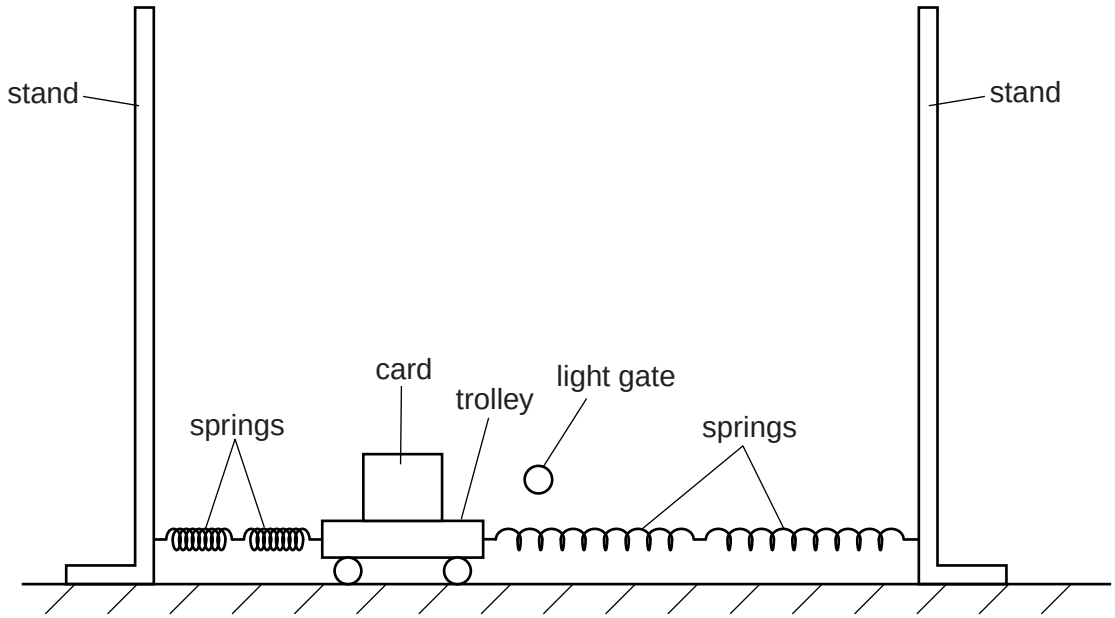


Fig. 2.1

A student investigates how the maximum speed v of a trolley varies with the total mass M of the trolley.

The maximum speed is determined using the time t taken for the card to pass through a light gate connected to an electronic timer. The length of the card is 5.0 ± 0.1 cm.

Question 2 continues on the next page.

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

$$v = A\sqrt{\frac{k}{M}}$$

where A is the initial displacement and k is the spring constant of the springs.

(a) A graph is plotted of v^2 on the y-axis against $1/M$ on the x-axis. Determine an expression for the gradient in terms of A and k.

gradient = ... [1]

(b) Values of M and t are given in Fig. 2.2.

M / kg	t / s	$(1/M)$ / kg^{-1}	v^2 / m^{2}s^{-2}
0.75	0.046 ± 0.002		
1.25	0.058 ± 0.002		
1.75	0.068 ± 0.002		
2.25	0.078 ± 0.002		
2.75	0.086 ± 0.002		
3.25	0.092 ± 0.002		

Fig. 2.2

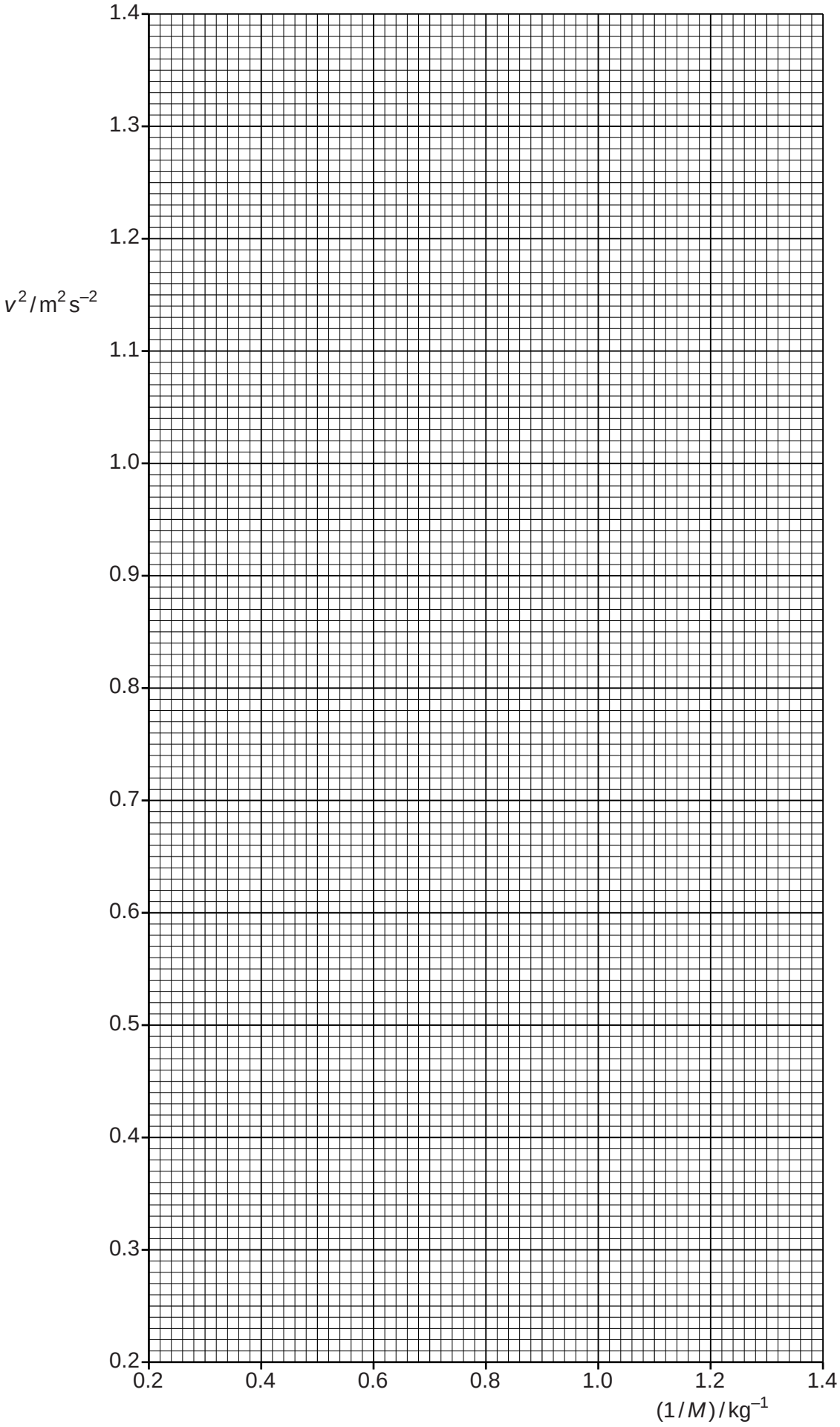
Calculate and record values of $(1/M)$ / kg^{-1} and v^2 / m^{2}s^{-2} in Fig. 2.2. Include the absolute uncertainties in v^2. [3]

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



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(d) **(i)** The value of A is 0.200 ± 0.005 m. Using your answer to **(c)(iii)**, determine a value for k. Include an appropriate unit in your answer.

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k = ... [2]

(ii) Determine the percentage uncertainty in your value of k.

percentage uncertainty = ... % [1]

(e) The experiment is repeated using the same springs and a trolley with total mass 0.75 kg. The initial displacement is 0.100 ± 0.005 m. Determine the maximum speed of the trolley. Include the absolute uncertainty in your answer.

v = ... m s^{-1} [2]