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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

PHYSICS **5054/04**

Paper 4 Alternative to Practical **October/November 2007**

1 hour

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.

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.

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1	
2	
3	
4	
Total	

This document consists of **9** printed pages and **3** blank pages.

SPA (MML 13330 4/06) T25359/3

UNIVERSITY *of* CAMBRIDGE International Examinations

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1 A student uses the apparatus shown in Fig. 1.1 to measure the terminal velocity of a metal sphere falling through oil.

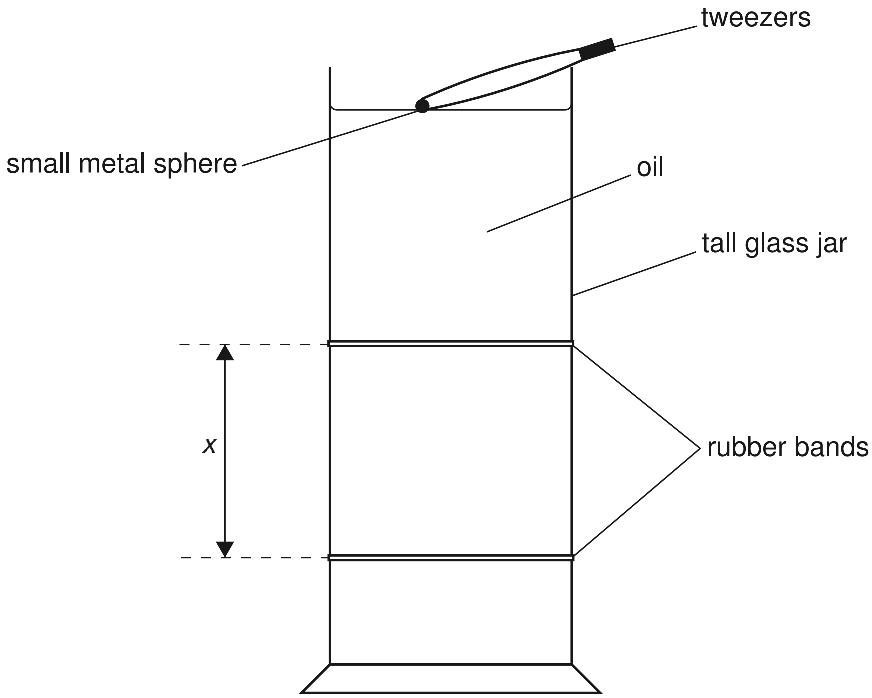

Fig. 1.1

Tweezers hold the small metal sphere below the surface of the liquid before it is released. As the sphere falls, it reaches terminal velocity.

To measure the steady velocity of the sphere, a student measures the time t it takes to fall a distance x.

(a) Suggest a reason why the student does **not** measure x from the surface of the oil.

....

.... [1]

(b) The student places two rubber bands around the jar as shown in Fig. 1.1.

Explain how the rubber bands make measuring the time more accurate.

....

.... [1]

(c) The student moves the lower rubber band and repeats the experiment for different values of x.

The results obtained are shown in the table.

x/cm	t/s
40.0	8.64
20.0	4.30

State and explain whether the results show that the sphere is travelling at a steady velocity between the rubber bands.

....

.... [2]

(d) On Fig. 1.1,

(i) mark the position of the student's eye when starting the stopwatch, [1]

(ii) draw a ruler in position to measure the distance x. [1]

(e) The experiment is repeated for spheres with different diameters d.

The results are shown below.

diameter d of sphere / mm	time t to fall 40.0 cm / s	terminal velocity v / cm/s
1.0	8.64	4.6
1.5	3.78	
2.0	2.20	
3.0	0.96	

(i) Use the data to complete the table. Give your values to one decimal place. [3]

(ii) Use the data in the table to show that v is **not** directly proportional to d.

....

....

.... [2]

Question 1 continues on page 4

(iii) Another student repeats the experiment to check one of the values of the terminal velocity.

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Tick **three** boxes to show what must be the same in both experiments.

diameter of the sphere	
distance between the rubber bands	
metal used for sphere	
ruler	
stopwatch	
type of oil	

[2]

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2 Fig. 2.1 shows a long vertical wire passing through a horizontal white card. The apparatus is used to show the shape of the magnetic field around the wire.

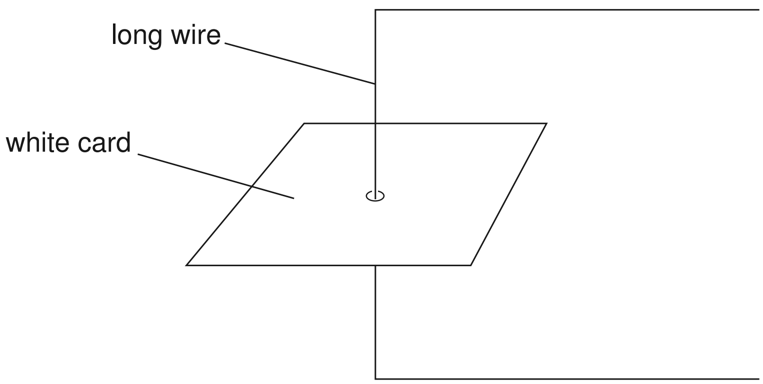

Fig. 2.1

(a) Complete Fig. 2.1 to show a circuit that provides a current in the wire. The circuit should allow the current to be varied and measured. [2]

(b) The student sprinkles iron filings on the card to show the shape of the magnetic field.

Give a reason for each of the following.

(i) The current needs to be large.

....

.... [1]

(ii) The student must tap the card.

....

.... [1]

(iii) The student uses small iron filings.

....

.... [1]

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3 Fig. 3.1 on page 7 shows a rectangular glass block used in a light experiment.

The path of a ray of light incident on one face of the glass block is marked with pins P_1 and P_2. The path of the emergent ray after passing through the block is marked by pins P_3 and P_4.

(a) **(i)** On Fig. 3.1, draw a straight line of length 20 cm that passes through P_1 and P_2. Label the ends of the line X and Y. [1]

(ii) On Fig. 3.1, draw lines to show the emergent ray and the path of the ray inside the glass block. [1]

(iii) On Fig. 3.1, mark the distance *d* between the line XY and the emergent ray. [1]

(iv) Measure *d*.

d = ... [1]

(b) Use Fig. 3.1 to measure the thickness *t* of the glass block.

t = ... [1]

(c) The refractive index *n* of the glass is given by the equation

$$n \approx \frac{t}{t - 2d}.$$

Calculate the refractive index of the glass.

$n \approx$ .... [1]

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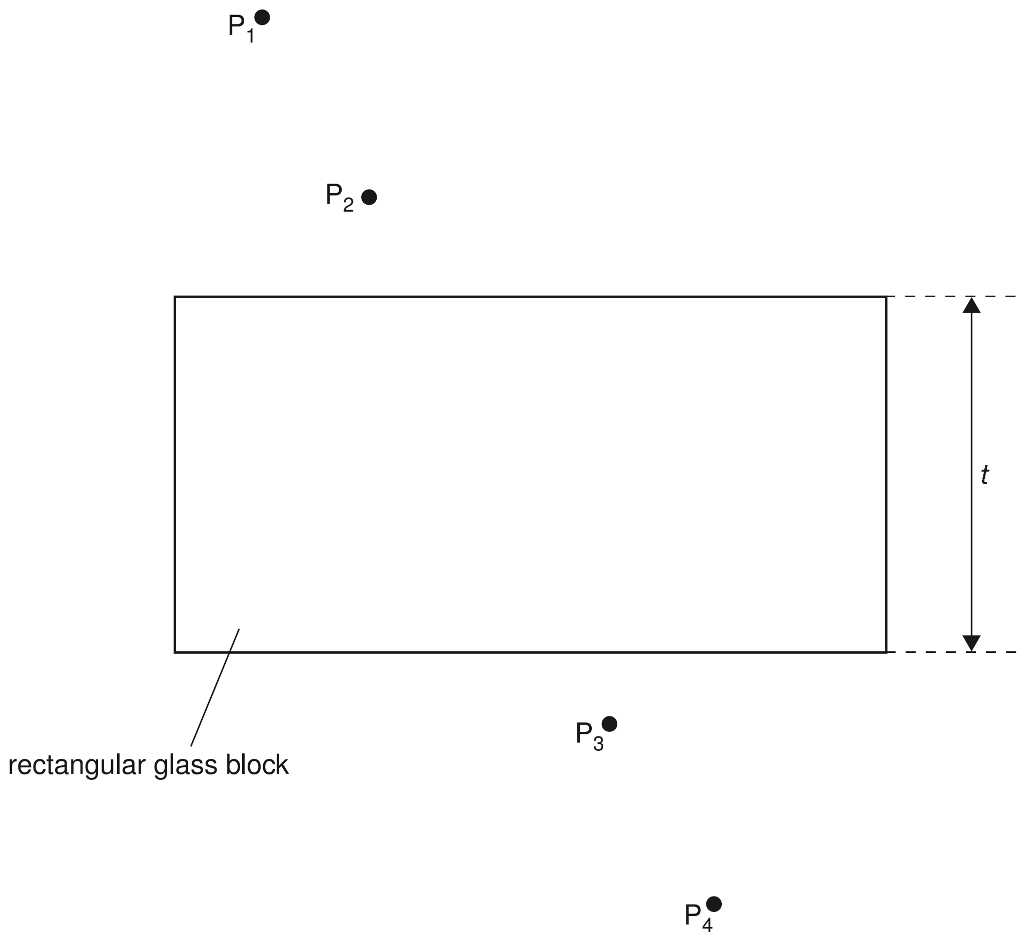

Fig. 3.1

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4 A student investigates the distance travelled by a block of wood along a bench when the block is fired by a rubber band.

Fig. 4.1 shows the block of wood being fired.

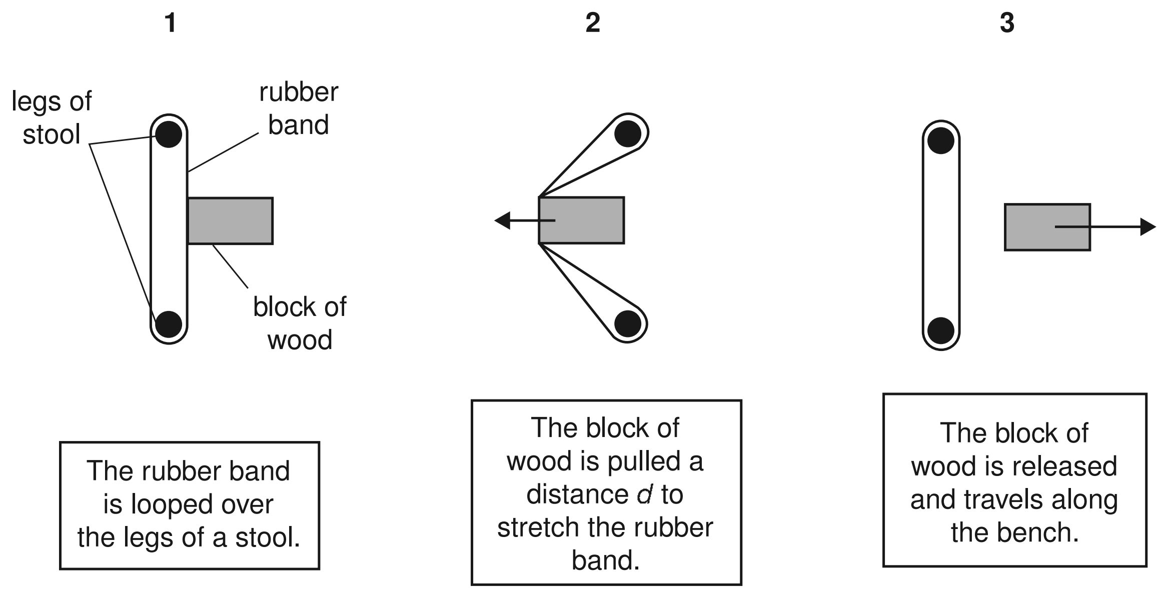

Fig. 4.1

The distance d is varied and the distance D travelled by the block along the bench is measured for each value of d.

The student records the results in a table.

distance d/cm	distance D/cm
5.0	13.3
6.0	20.9
7.0	28.7
8.0	39.6
9.0	51.8
10.0	62.5

(a) Explain why $D = 0$ when $d = 0$.

....

.... [1]

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(b) On the grid below, plot a graph of *d* on the *x*-axis against *D* on the *y*-axis. Start both axes from the origin. Draw a curve of best fit through the points. [4]

(c) Suggest one practical way to make the measurement of *D* accurate.

....

.... [1]

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