



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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**PHYSICS**

**5054/41**

Paper 4 Alternative to Practical

**October/November 2010**

**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.

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



1 A student performs an experiment to measure an elastic property of wood.

(a) A metre rule is clamped with its 10.0 cm mark at the edge of a bench, as shown in Fig. 1.1.

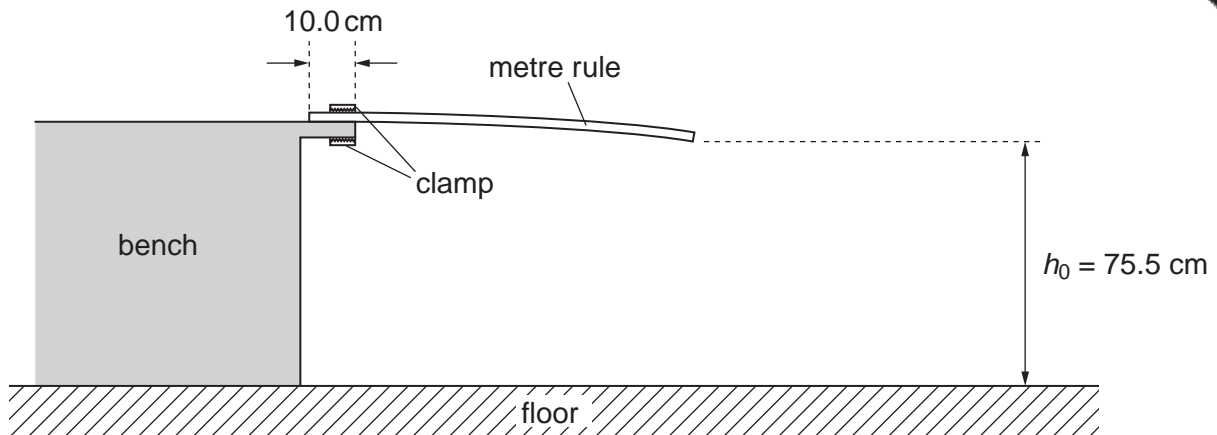


Fig. 1.1

(i) On Fig. 1.1, draw a second rule positioned to measure the height  $h_0$  above the floor of the free end of the clamped metre rule. [1]

(ii) On Fig. 1.1, draw the position of the eye of the student when measuring  $h_0$ . [1]

(b) A mass  $m$  is hung from the 95.0 cm mark on the clamped metre rule, as shown in Fig. 1.2.

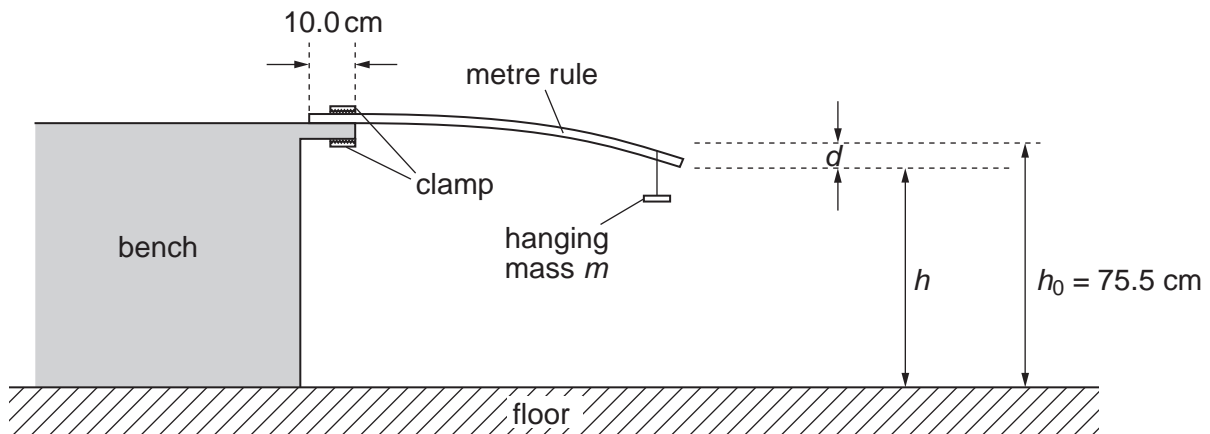


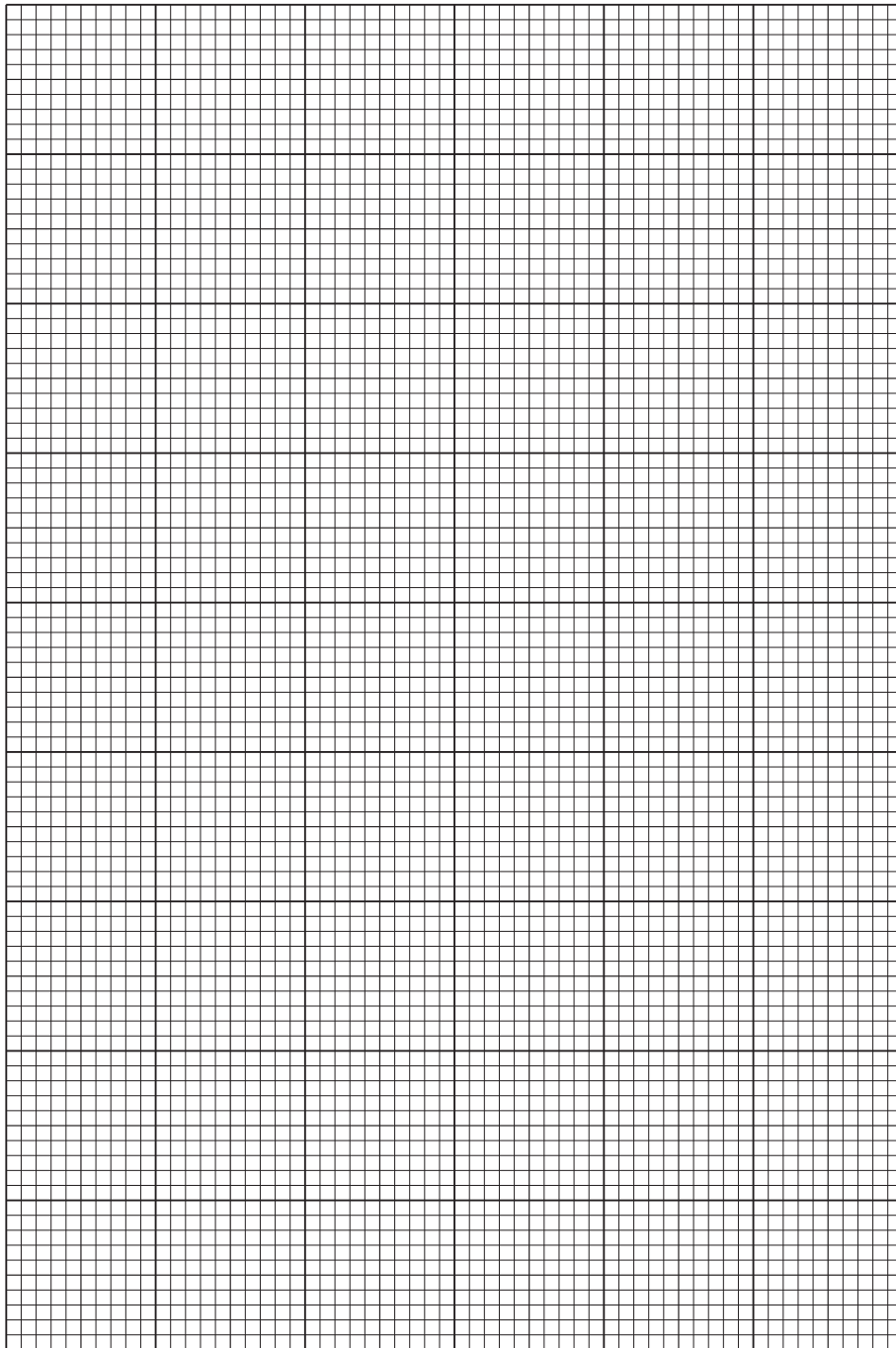
Fig. 1.2

The end of the rule moves down a distance  $d$ , where  $d = h_0 - h$ .

The student takes readings of  $h$  for different values of  $m$ . Values of  $m$  and  $h$  are recorded in the table of Fig. 1.3.

| $m/g$ | $h/cm$ | $d/cm$ |
|-------|--------|--------|
| 20.0  | 75.0   |        |
| 40.0  | 74.2   |        |
| 60.0  | 73.4   |        |
| 80.0  | 72.7   |        |
| 100.0 | 72.0   |        |
| 120.0 | 71.2   |        |

- (i) Complete Fig. 1.3 to show the values of  $d$ .
- (ii) On Fig. 1.4, plot the graph of  $d/\text{cm}$  on the  $y$ -axis against  $m/\text{g}$  on the  $x$ -axis. Start your graph from the origin and draw the straight line of best fit.



**Fig. 1.4**

[4]

- (iii) Explain how the graph shows that  $d$  is not directly proportional to  $m$ .

.....

..... [1]

- (c) (i) Find the gradient of your graph. Show your working clearly.

gradient = ..... [2]

- (ii) Use information from (b) to find the length  $L$  along the clamped metre rule from the edge of the bench to the point where the hanging mass is attached.

$L = \dots\dots\dots$  [1]

- (iii) The elastic property  $E$  of the wood is given by the relationship

$$E = \frac{0.72 \times L^3}{\text{gradient}}.$$

Calculate the value of  $E$ .  
You do not need to give the unit of your answer.

$E = \dots\dots\dots$  [1]

- 2 A group of students measures the speed of a wave along a slinky spring.

A teacher and a student hold the ends of a slinky spring stretched along a bench, as shown in Fig. 2.1.

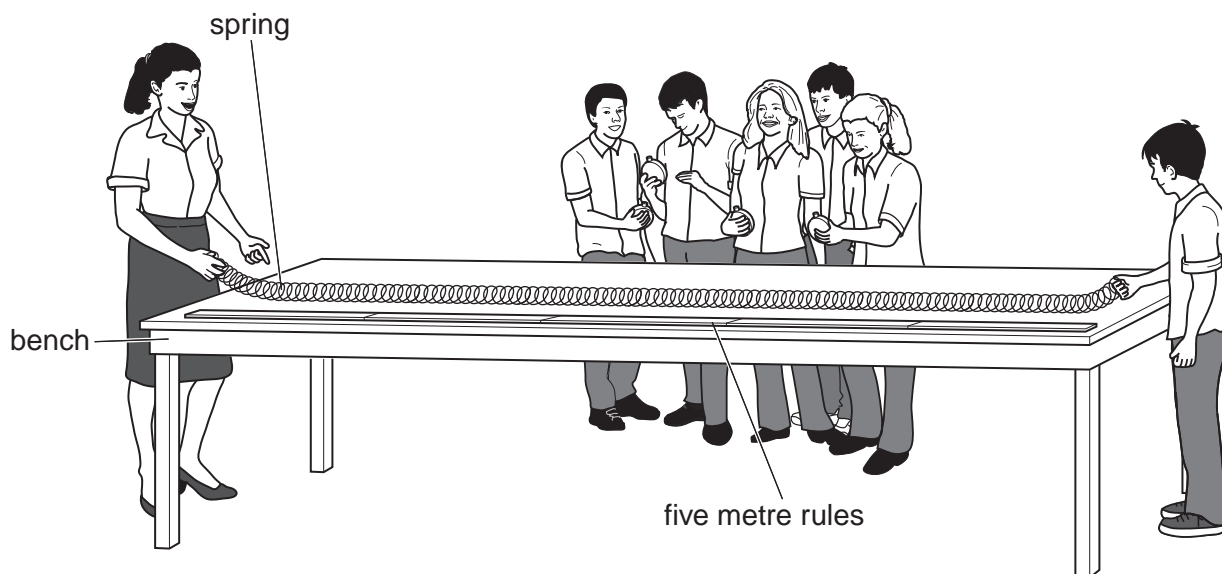


Fig. 2.1

The teacher moves one end of the spring to make a wave pulse travel along the spring. Five metre rules are placed end-to-end alongside the spring. Five students with stopwatches stand together near the centre of the spring to measure the time  $t$  taken by the wave pulse to travel the distance of 5.0 m.

- (a) The five students record the following values for  $t$ , measured in seconds.

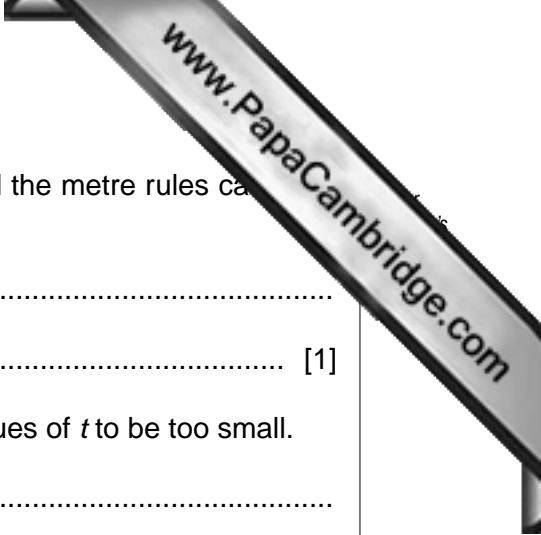
1.71    1.64    1.78    1.75    1.67

- (i) Find the average time  $t_{av}$  for the wave to travel 5.0 m along the spring.

$$t_{av} = \dots\dots\dots [1]$$

- (ii) Calculate the average speed  $v_{av}$  of the wave pulse along the spring. Give your answer to a suitable number of significant figures.

$$v_{av} = \dots\dots\dots [2]$$



(b) (i) Explain why, in practice, the position of the students and the metre rules cause a parallax error.

.....  
..... [1]

(ii) Explain why this parallax error causes the measured values of  $t$  to be too small.

.....  
..... [1]

(iii) Explain one other reason why the times recorded by the students are not all exactly the same.

.....  
..... [1]

(iv) Describe how the students could measure the time  $t$  more accurately.

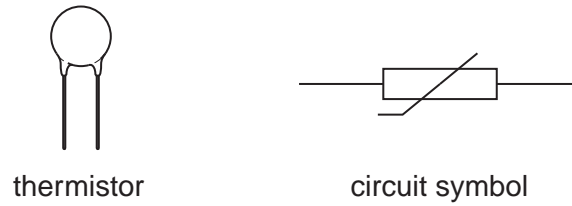
.....  
.....  
.....  
..... [2]

(c) One student suggests that the speed of a slower wave pulse can be measured more accurately.  
Suggest a method of making a wave pulse travel more slowly along the spring.

.....  
.....  
..... [1]

- 3 The variation of the resistance of a thermistor with temperature is investigated.

Fig. 3.1 shows one type of thermistor and its circuit symbol.



**Fig. 3.1**

- (a) In the space below, draw the circuit diagram of a circuit used to measure the resistance of the thermistor.

[2]

- (b) Explain, with the aid of a diagram, how the temperature of the thermistor may be measured and varied from room temperature to  $90^{\circ}\text{C}$ .

.....  
 .....  
 ..... [3]

- (c) A student measures the resistance of the thermistor at different temperatures and plots a graph of resistance against temperature.  
 Explain why the resistance must be measured at more than two different temperatures.

.....  
 ..... [1]

- 4 A student investigates pressure using a pencil and two blocks of modelling clay.

The pencil is pushed gently into the clay. The pencil leaves a dent. The flat end of the pencil is used first and then the pointed end. This is shown in Fig. 4.1.

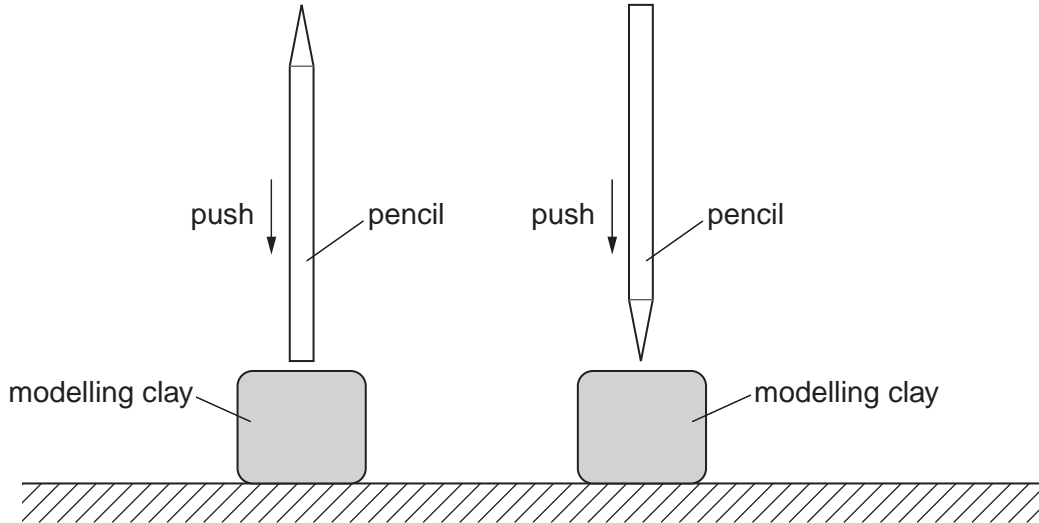


Fig. 4.1

- (a) Describe a simple method for pushing the pencil gently into the clay with the same force each time. You may use a diagram in your answer.

.....

.....

.....

..... [2]

- (b) On Fig. 4.1, draw the side view of the dent produced in each piece of clay when the pencil is pushed gently into the clay with the same force each time. [1]

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