Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6064263521

PHYSICS **5054/31**

Paper 3 Practical Test **October/November 2014**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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.
For each of the questions in Section A, you will be allowed to work with the apparatus for a maximum of 20 minutes. For the question in Section B, you will be allowed to work with the apparatus for a maximum of 1 hour.

You are expected to record all your observations as soon as these observations are made.
An account of the method of carrying out the experiments is **not** required.

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.

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1	
2	
3	
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Total	

This document consists of **12** printed pages.

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Section A

Answer **all** the questions in this section.

1 *In this experiment, you will determine the density of a wooden block.*

You are provided with

- a block of wood with a small hook,
- a 30 cm ruler,
- a spring,
- a stand, two bosses and two clamps,
- a 200 g mass,
- a set square.

(a) Fig. 1.1 shows a diagram of the block of wood.

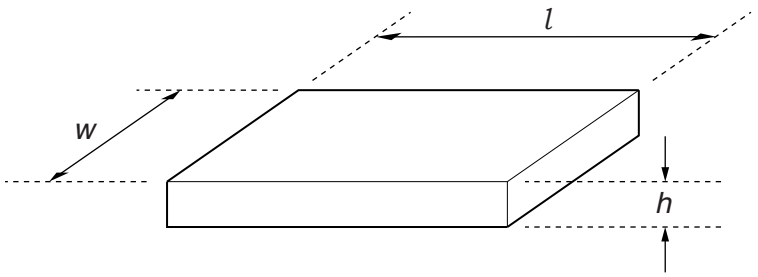


Fig. 1.1

Take measurements to determine average values for the length l, the width w and the height h of the wooden block.

l = ...

w = ...

h = ...

[1]

(b) Set up the apparatus as shown in Fig. 1.2. Clamp the 30 cm ruler vertically with the 30.0 cm end of the ruler in contact with the bench.

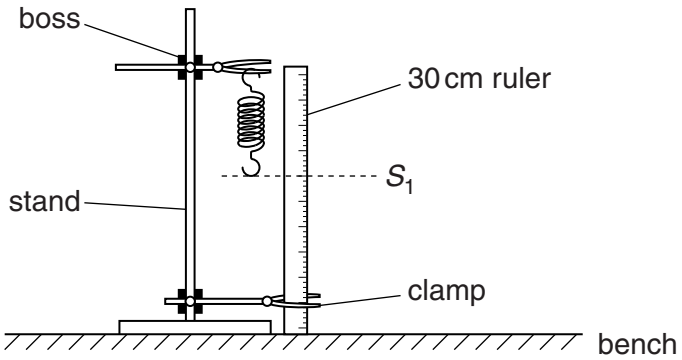


Fig. 1.2

Adjust the boss holding the spring so that the lower end of the spring is between the 5 cm and 10 cm marks on the ruler.

(i) Record the scale reading S_1 on the ruler at the lower end of the spring.

S_1 = ...

(ii) Suspend the 200 g mass from the spring and record the new scale reading S_2 at the lower end of the spring.

S_2 = ...

(iii) Calculate the extension e of the spring using $e = S_2 - S_1$.

e = ...
[1]

(c) Remove the 200 g mass and suspend the block of wood from the spring.
Record the new scale reading S_3 at the lower end of the spring. Hence determine the new extension e_N of the spring.

S_3 = ...

e_N = ...
[1]

(d) Calculate

(i) the mass M of the block of wood using the equation

$$M = \frac{200\, e_N}{e} \text{ gram}$$

M = ...

(ii) the density ρ of the wood from which the block is made using the equation

$$\rho = \frac{M}{lwh}.$$

ρ = ...
[2]

[Total: 5]

2 *In this experiment, you will investigate the deviation of a ray of light passing through a block.*

You are provided with

- a rectangular block,
- an illuminated slit,
- a 30 cm ruler,
- a protractor.

(a) Fig. 2.2 is on page 5 of your question paper. On Fig. 2.2,

(i) draw a normal to the line XY at the point M, above and below the line XY,

(ii) draw a line from M towards the top left of the page at an angle of 60° to the normal. Label this line L.

(iii) Extend this line from M to the right-hand edge of the page. Label this line L′.

[1]

(b) Place the block on Fig. 2.2, with one of its long sides on the line XY. The top left-hand corner of the block should be at X, as shown in Fig. 2.1.

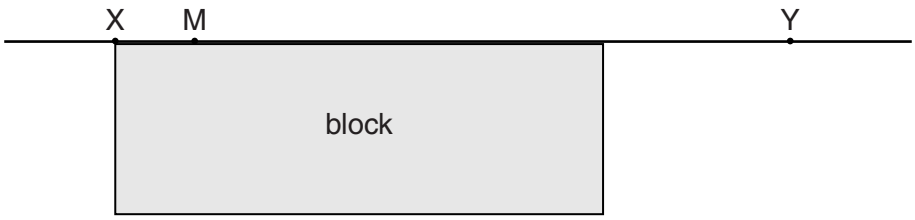


Fig. 2.1

(c) **(i)** On Fig. 2.2, draw the outline of the block.

(ii) Position the illuminated slit so that a ray of light passes along the line L from the top left of the page towards M.

(iii) On Fig. 2.2, mark and label two points P_1 and P_2 on the ray that leaves the block. You should choose the position of these two points so that the position of the ray can be accurately drawn. [1]

(d) **(i)** Remove the block. Draw a line through P_1 and P_2 to touch the outline of the block at a point. Label this point N.

(ii) Draw a straight line from M to N.

(iii) Measure the length l of the line MN.

l = ...

(iv) Measure the perpendicular distance d between the line L′ and the line through P_1 and P_2.

d = ...

(v) Calculate $\frac{d}{l}$.

$\frac{d}{l}$ = ...

[3]



Fig. 2.2

[Total: 5]

3 *In this experiment, you will determine the frictional force opposing the motion of a block of wood up a ramp.*

You are provided with

- a ramp with a stop close to its upper end,
- a pulley arrangement,
- a block of wood labelled A, with a small hook,
- a 10 g slotted mass hanger, nine 10 g slotted masses and two 100 g slotted masses,
- string passing over the pulley, with loops attached to the block and the mass hanger,
- a stopwatch,
- a metre rule,
- a set square.

(a) The ramp has been set up for you as shown in Fig. 3.1. Do not adjust the slope of the ramp.

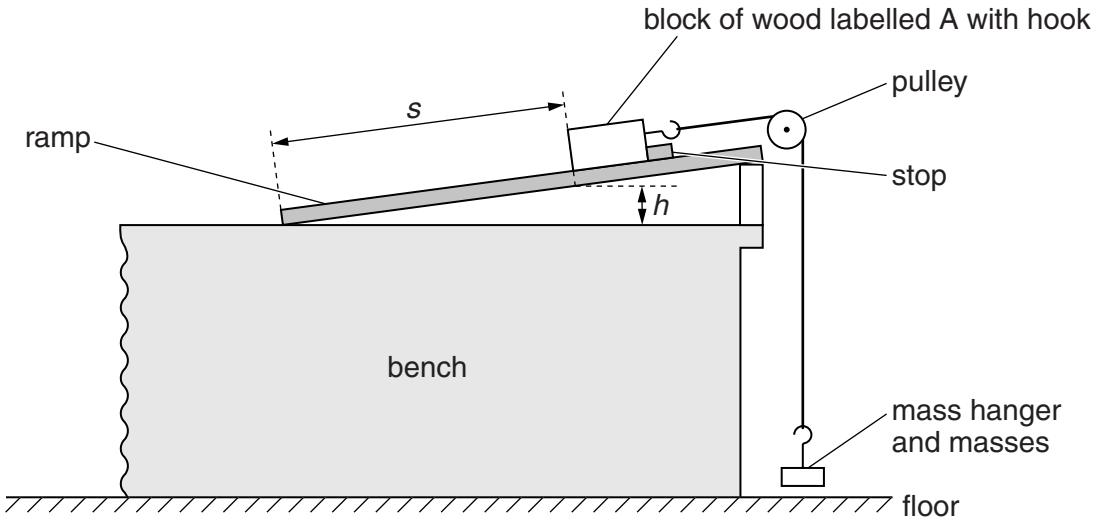


Fig. 3.1

Position the block A so that it touches the stop at the top of the ramp, as shown in Fig. 3.1. Add all the masses to the mass hanger to ensure that A remains in contact with the stop. Measure the vertical height *h* and the distance *s* along the ramp, as shown in Fig. 3.1. Give your answers in metres.

h = ... m

s = ... m
[1]

(b) Remove all masses from the mass hanger. Place A at the bottom of the ramp as shown in Fig. 3.2.

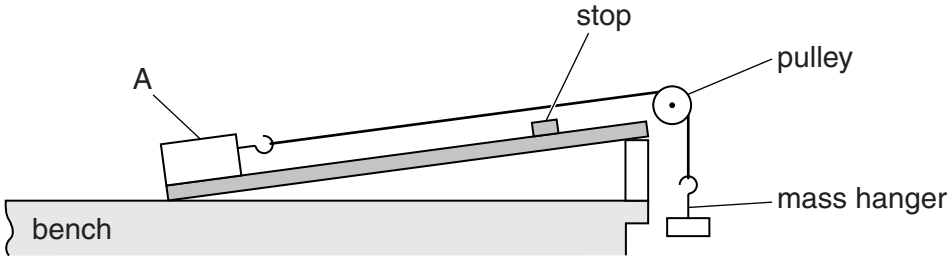


Fig. 3.2

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(i) Place sufficient slotted masses on the mass hanger to ensure that, when released, A **accelerates** up the ramp, taking a time of between 1 s and 2 s to reach the stop. Record the total mass m of the mass hanger and the slotted masses. Also record the mass M of A that is written on the label. Give your answers in kg.

$m =$ ..... kg

$M =$ ..... kg

(ii) Return A to the bottom of the ramp and hold it in position. Without changing m, determine the average time t taken for A to reach the stop when released.

$t =$ .....
[2]

(c) Calculate

(i) the potential energy E_1 lost by the falling mass using $E_1 = mgs$, where the gravitational field strength g is 10 N/kg,

$E_1 =$ .....

(ii) the potential energy E_2 gained by A using $E_2 = Mgh$,

$E_2 =$ .....

(iii) the final velocity v of the block using $v = \frac{2s}{t}$,

$v =$ .....

(iv) the total kinetic energy E_K of the block and falling mass using

$$E_K = \frac{1}{2}(M + m)v^2$$

$E_K =$ .....

(v) the average frictional force F opposing the motion of the block using

$$F = \frac{E_1 - E_2 - E_K}{s}.$$

$F =$ .....
[2]

[Total: 5]

Section B

4 *In this experiment, you will determine the resistance of a resistor.*

You have been provided with a circuit consisting of

- a cell,
- a resistor X,
- a length of resistance wire attached to a metre rule,
- two crocodile clips,
- a switch.

The circuit is shown in Fig. 4.1.

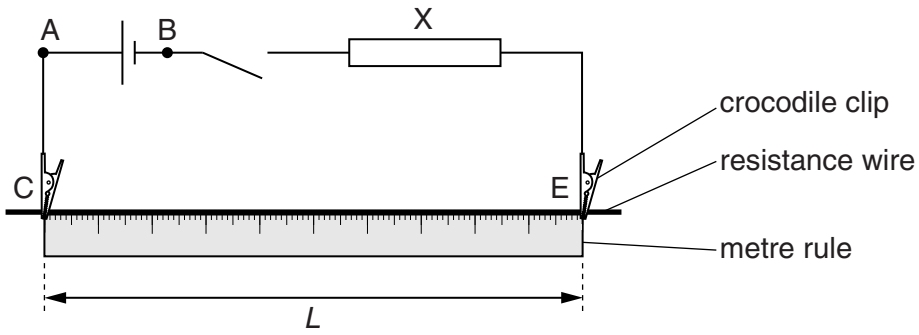


Fig. 4.1

You are also provided with

- a voltmeter,
- a jockey or sliding contact to connect one side of the voltmeter to the wire,
- connecting leads,
- a card giving the resistance R of a 100.0 cm length of the resistance wire.

(a) Use the additional connecting leads to connect the voltmeter between points A and B, shown in Fig. 4.1.

(i) With the switch open, record the reading V_0 on the voltmeter.

V_0 = ...[1]

(ii) Record the total length L of resistance wire between the points C and E. Give your answer in cm.

L = ...cm

(iii) In this experiment the ratio $\frac{V_0}{L} = K$ V/cm. Calculate the value of K.

K = ...
[1]

(b) Disconnect the voltmeter from points A and B. Connect one terminal of the voltmeter to point C and the other terminal to the sliding contact.

(c) **(i)** Touch the sliding contact onto the resistance wire at a point D, a distance l = 90.0 cm from C. This is shown in Fig. 4.2.

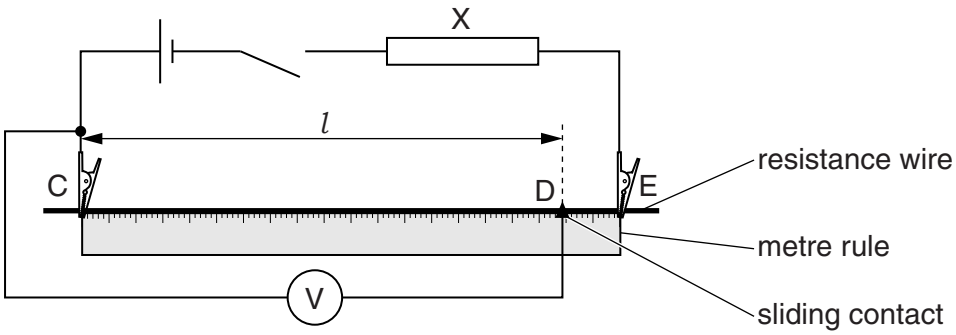


Fig. 4.2

(ii) Close the switch and record the reading V on the voltmeter. Use sufficient force on the sliding contact to ensure that a good connection is made.

V = ...[1]

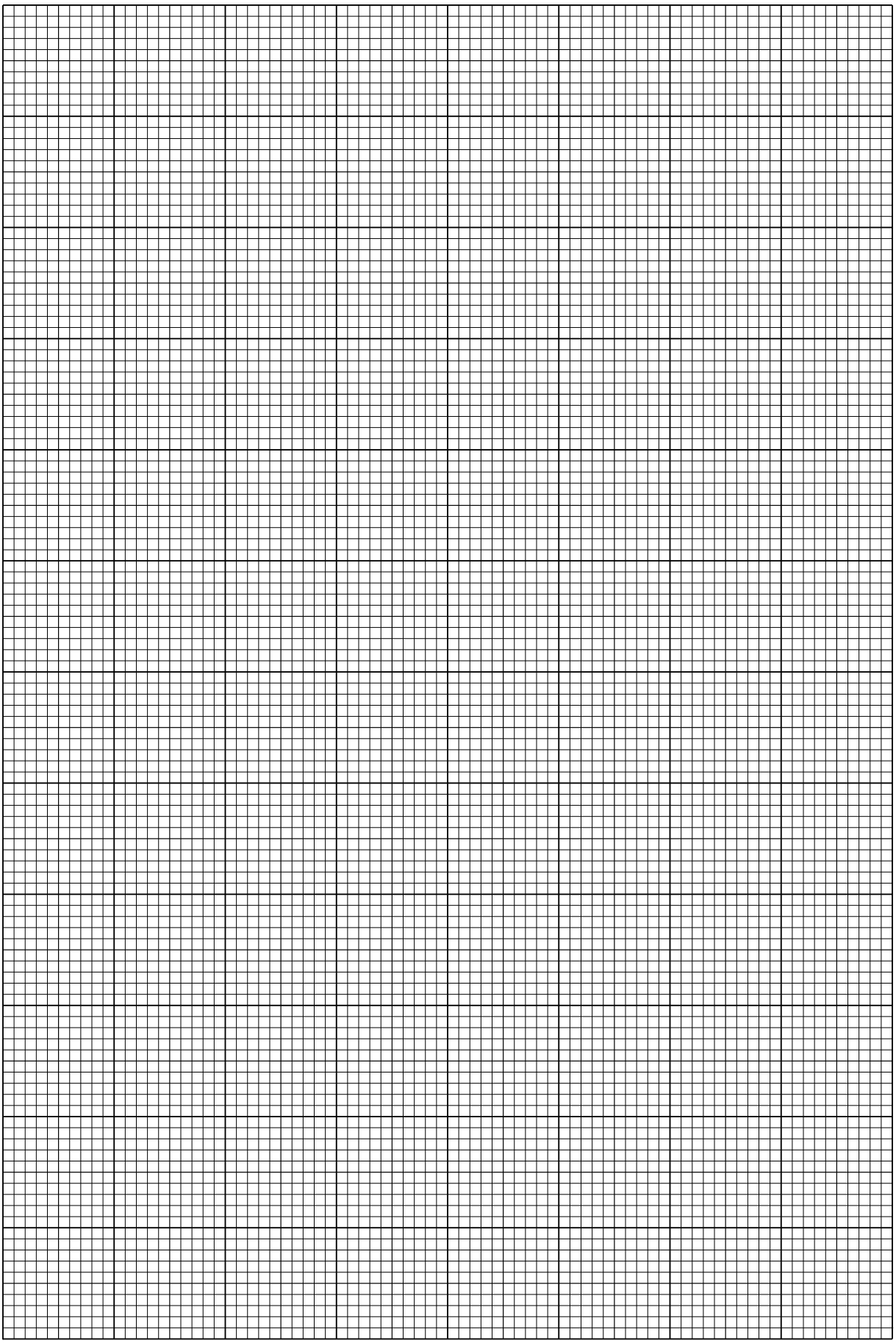
(d) By placing the sliding contact at different positions on the wire, repeat **(c)** for a wide range of values of l. Record your results for l and V in Fig. 4.3. Include the results from **(c)** in Fig. 4.3.

Fig. 4.3 [4]

(e) Using the grid opposite, plot a graph of V/V against l/cm. Draw the straight line of best fit through your points. [4]

This question continues on page 12.

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[Turn over

(f) Determine the gradient G of the line of best fit.

G = ...[2]

(g) The resistance R_X of X may be found using the equation

$$R_X = R\left(\frac{K}{G} - 1\right)$$

where R is the resistance of the resistance wire, which is given on the card.

(i) Record R.

R = ...

(ii) Using your answers to **(a)(iii)**, **(f)** and **(g)(i)**, calculate R_X.

R_X = ...
[2]

[Total: 15]

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