Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4589676844

PHYSICS **5054/42**

Paper 4 Alternative to Practical **October/November 2017**

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 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.

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1 A student investigates the period of a simple pendulum. The period T is the time taken for one complete oscillation of the pendulum.

She sets up the pendulum with its point of support a fixed height above the surface of the bench. She **does not change** this height, or the position of the clamp during the investigation.

A scale diagram of her experimental set-up is shown in Fig. 1.1.

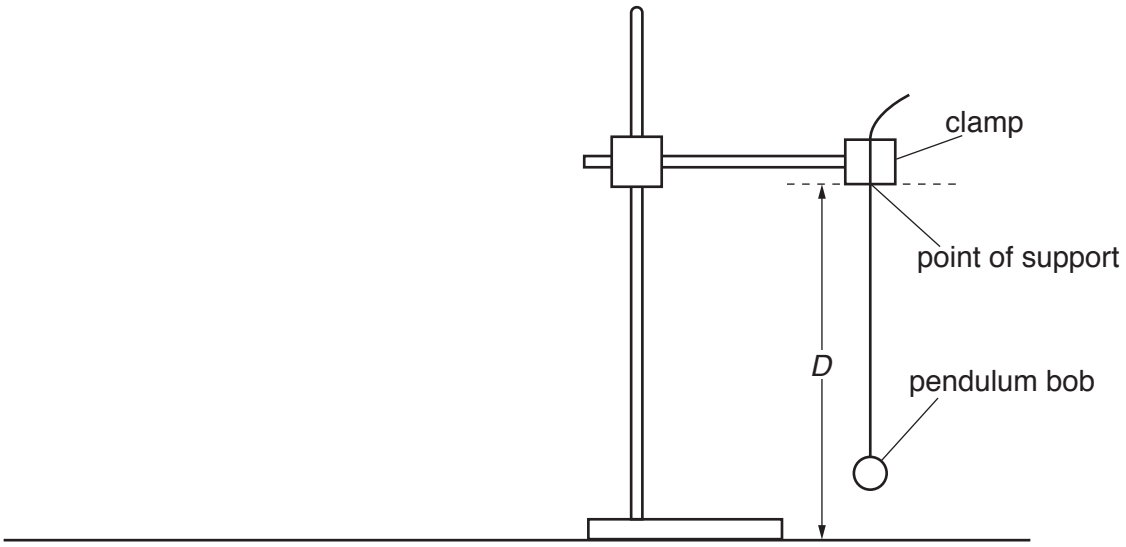


Fig. 1.1

(a) (i) Measure the distance D on Fig. 1.1 to the nearest millimetre. Record your result.

$D =$ ..... cm [1]

(ii) Fig. 1.1 is drawn to a scale of one-tenth full size.

Write down the actual height H of the point of support above the bench.

$H =$ ..... [1]

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(b) She adjusts the length of the thread until the height h of the centre of the bob above the bench is 15.0 cm. She gives the ball a small sideways displacement and releases it so that it oscillates. She records the time for 20 oscillations in the table in Fig. 1.2.

h / cm	time for 20 oscillations / s	T / s	T^2 / s^2
15.0	22.8		
20.0	20.8	1.04	1.08
25.0	18.8	0.94	0.88
30.0	16.6	0.83	0.69
40.0	10.6	0.53	0.28

Fig. 1.2

She repeats the procedure for heights h of 20.0 cm, 25.0 cm, 30.0 cm and 40.0 cm.

She uses her results to calculate the period T for one oscillation and T^2 for each set of readings.

(i) Complete the table in Fig. 1.2. [1]

(ii) Explain why measuring the time for 20 oscillations, rather than for 1 oscillation, gives a more accurate value for T.

.....

.....

.....[1]

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(c) (i) On Fig. 1.3, plot a graph of T^2/s^2 on the *y*-axis against h/cm on the *x*-axis.

Start your axes from the origin (0,0). Draw the straight line of best fit.

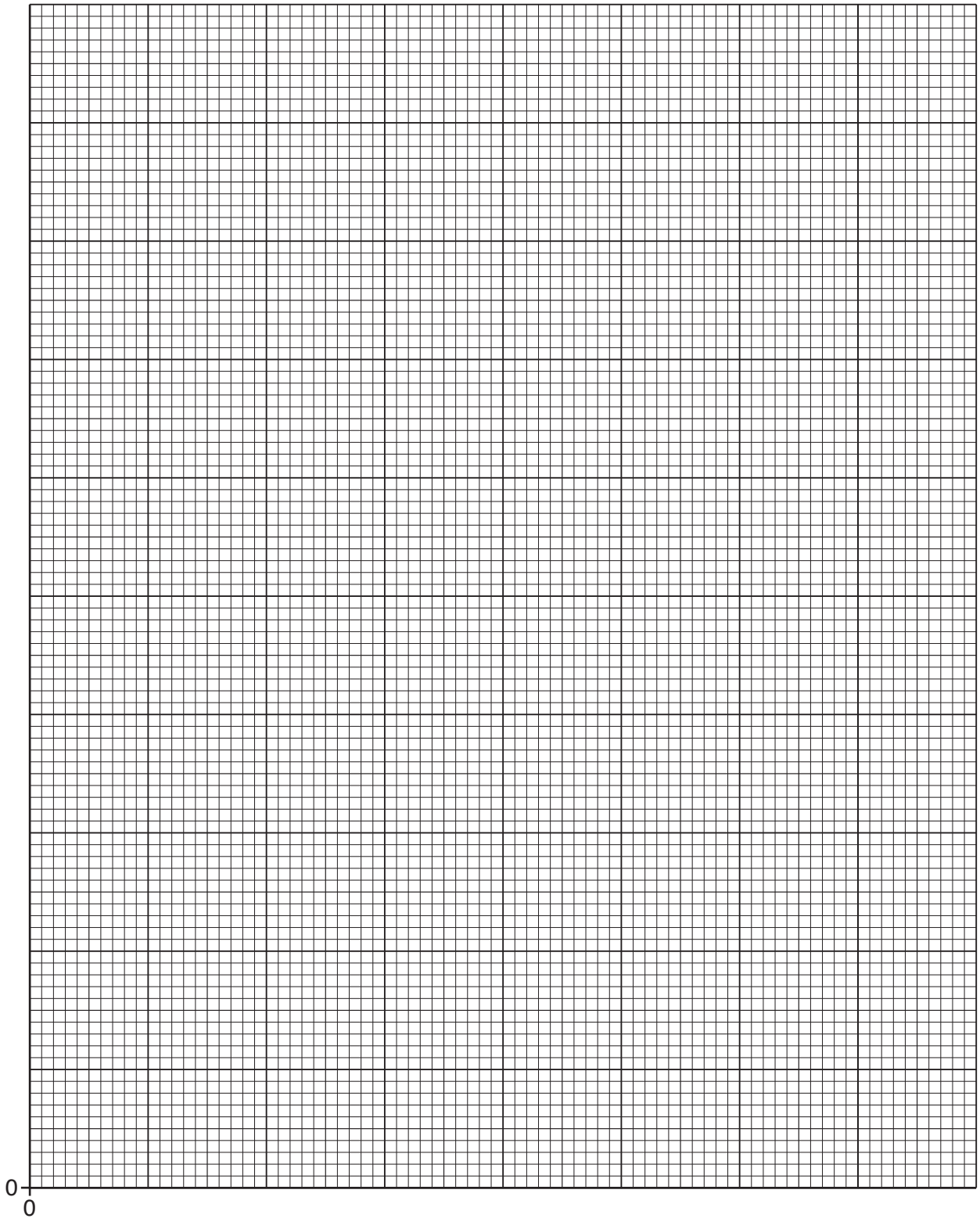


Fig. 1.3

[4]

(ii) Extend your line so that it cuts the *y*-axis.

State the value of the intercept *c* on the *y*-axis.

$c =$ ..... s^2 [1]

(iii) Calculate the gradient *m* of your line. Show your working and indicate on your graph the values you use to calculate the gradient.

$m =$ ..... s^2/cm [2]

(d) Theory suggests that *H* is given by the equation

$$H = \frac{c}{m}.$$

Use this equation to calculate *H*.

$H =$ ..... cm [1]

(e) Compare your measured value for *H* from **(a)(ii)** with your result in **(d)**.

State whether the two values agree with each other and justify your answer.

.....

.....

.....[1]

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2 A student investigates the effect of insulation on the rate of cooling of hot water in a beaker.

He pours 250 cm^3 of hot water into a beaker and places a thermometer in the water, as shown in Fig. 2.1.

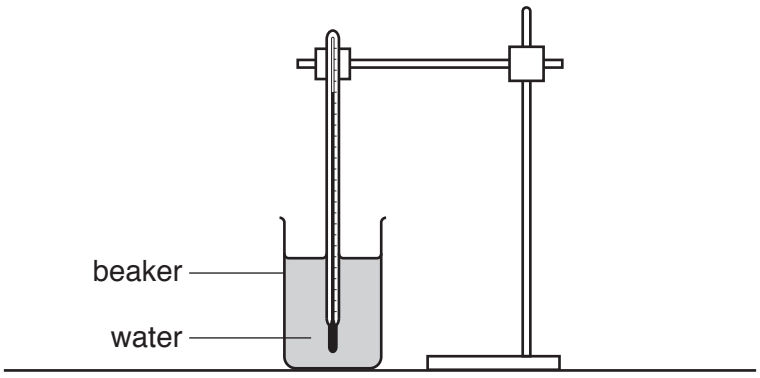


Fig. 2.1

He waits for a short time. He then starts a stopwatch as he records the temperature θ of the hot water. This is at time $t = 0$.

Fig. 2.2 shows the thermometer at $t = 0$.

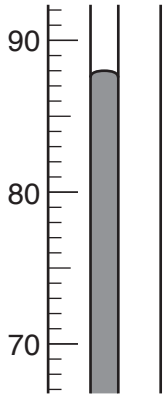


Fig. 2.2

(a) (i) Read the thermometer and record the temperature θ.

$\theta =$ ..... [1]

(ii) Explain why the student waits a short time before recording the temperature of the water at $t = 0$.

.....

.....

.....[1]

(b) The student records the temperature of the water in the beaker after 3.0 minutes.

He then pours 250 cm^3 of hot water into an identical beaker that is insulated with cotton wool, as shown in Fig. 2.3. He repeats the procedure.

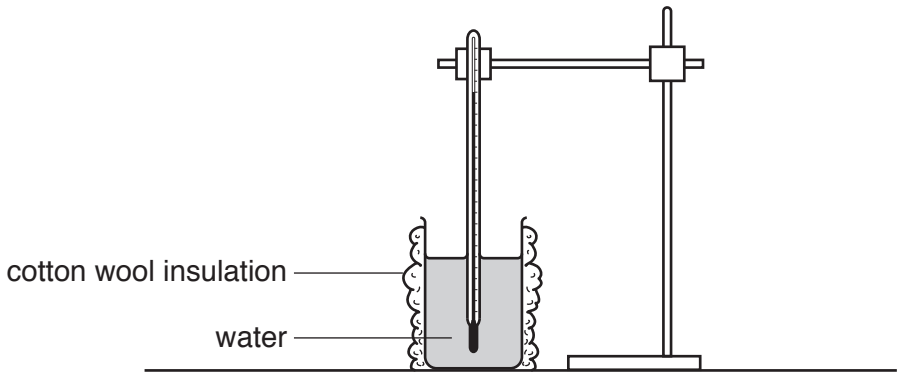


Fig. 2.3

His results are shown in the table in Fig. 2.4.

	without insulation	with insulation
time t/	temperature θ/	temperature θ/ .....
0		85
180	75	75

Fig. 2.4

(i) Complete the column headings in the table in Fig. 2.4. [1]

(ii) Add your value of θ in **(a)(i)** to the table in Fig. 2.4.

(iii) State whether the insulation has any significant effect on the rate of cooling in the first 3.0 minutes.

Justify your answer by reference to the results.

statement .....

justification .....

.....[1]

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(c) **(i)** Initially, the main cause of heat loss from the beaker is evaporation.

Suggest how the student can reduce heat loss by evaporation.

.....

..... [1]

(ii) State one other modification to the apparatus in Fig. 2.3 that reduces further the loss of heat.

.....

.....[1]

(d) State one quantity that is kept constant to make a fair comparison between the rate of cooling of the two beakers.

.....[1]

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3 A student measures the refractive index of the material of a transparent block ABCD by tracing the path of a ray of light through it.

The experiment is set up as shown in Fig. 3.1.

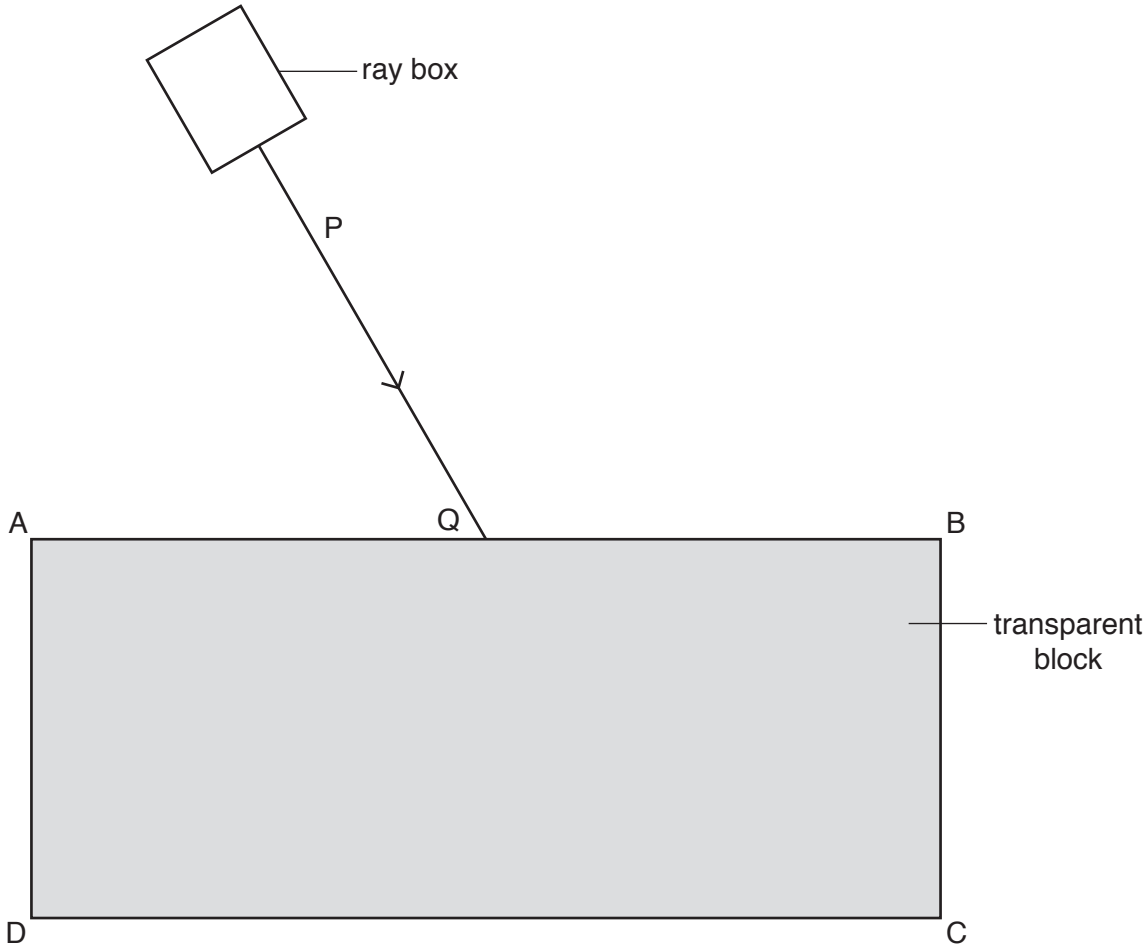


Fig. 3.1

(a) She directs a ray of light PQ from the ray box on to side AB of the block.

(i) On Fig. 3.1, draw a normal to side AB at point Q. Extend the normal so that it crosses side CD. Label the point at which the normal crosses CD with the letter R. [1]

(ii) Measure the angle of incidence α of the ray PQ on side AB.

$\alpha =$ .....[1]

(b) She marks, with crosses, two points on the emergent ray from CD, as shown on Fig. 3.1.

- On Fig. 3.1 draw a line joining the two crosses and continue this line until it meets QR.
- Label the point where the line crosses CD with the letter S and the point where it crosses QR with the letter T.
- Draw a straight line from Q to S.

(i) Measure the length *x* of QS.

$x =$ .....

(ii) Measure the length *y* of ST.

$y =$ .....

[2]

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

$$n = \frac{x}{y}.$$

Calculate *n*.

$n =$ .....[1]

4 A student investigates how the resistance of a wire depends upon its length.

He uses the equation

$$\text{resistance } R = \frac{\text{potential difference } V}{\text{current } I}.$$

The following apparatus is available:

- power supply
- ammeter
- voltmeter
- switch
- connecting leads and crocodile clips
- a length of resistance wire
- metre rule
- wire cutters.

Write a plan for the investigation.

(a) Draw a circuit diagram in the space below.

[2]

(b) Explain briefly how the student carries out the investigation.

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.....[2]

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(c) Explain how the student can use the readings to reach a conclusion.

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.....[1]

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