Cambridge O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER							CANDIDATE NUMBER					

* 7 3 1 1 8 1 7 0 9 7 *

PHYSICS **5054/42**

Paper 4 Alternative to Practical **October/November 2019**

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 in a laboratory investigates how the length l of a spring varies when different loads L are added to it.

He sets up a spring in a clamp with a load of 1.0 N attached to its lower end, as shown in Fig. 1.1.

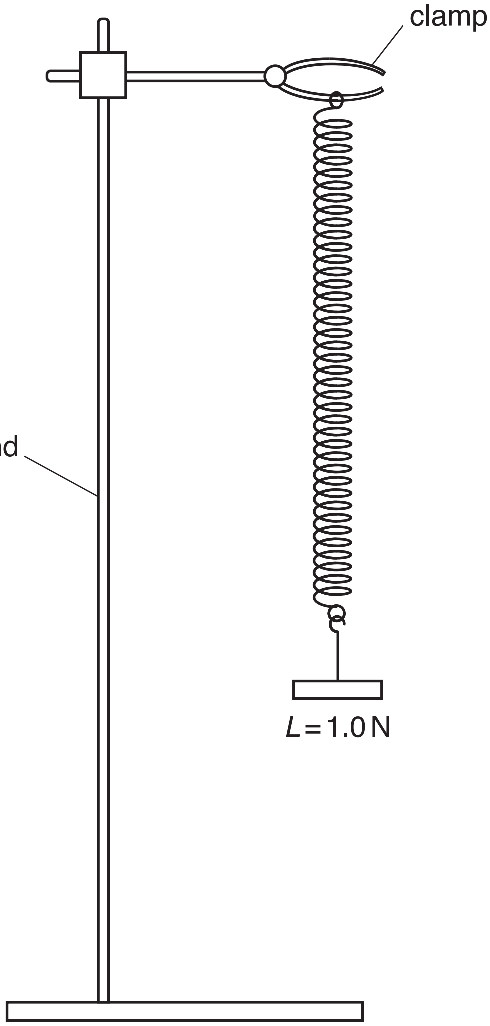

Fig. 1.1

(a) **(i)** Measure the length l of the spring shown in the diagram in Fig. 1.1. Do not include the loops at each end of the spring in your measurement.

Record your answer in Table 1.1. [1]

(ii) On the diagram in Fig. 1.1, draw a ruler in the correct position for the student to measure the length l in the laboratory. [1]

(iii) The student determines as accurately as possible the reading on the ruler at the bottom of the spring.

On Fig. 1.1, mark with an X the position of the student's eye. [1]

(b) The student varies the load and takes a series of measurements of L and l. His results are shown in Table 1.1.

Table 1.1

load L / N	spring length l / mm
1.0	
3.0	130
5.0	198
2.0	100
4.0	163

(i) State **one** way to improve the table of results.

....

.... [1]

(ii) On the grid in Fig. 1.2, plot a graph of L (y-axis) against l (x-axis). Start both axes from the origin (0,0). Draw the best-fit straight line. [4]

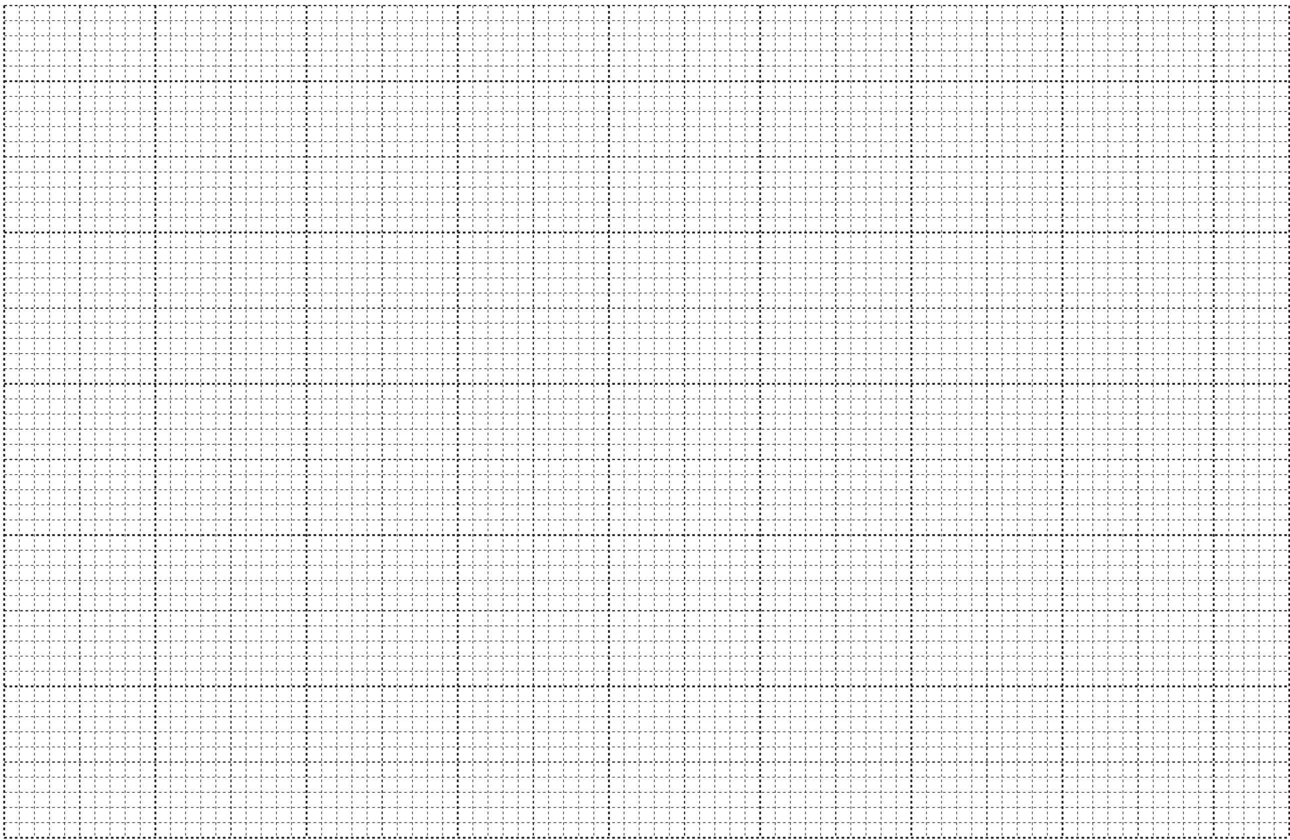

Fig. 1.2

(iii) State whether l is directly proportional to L.

Explain your answer.

....

.... [1]

(iv) Use your graph to determine the length l_0 of the unstretched spring.

Show on your graph how you did this.

l_0 = ... mm [1]

(c) **(i)** Using your graph in Fig. 1.2, determine the **extension** e of the spring for a load of 3.6 N.

e = ... mm [2]

(ii) On the axes in Fig. 1.3, sketch a graph of L against e.

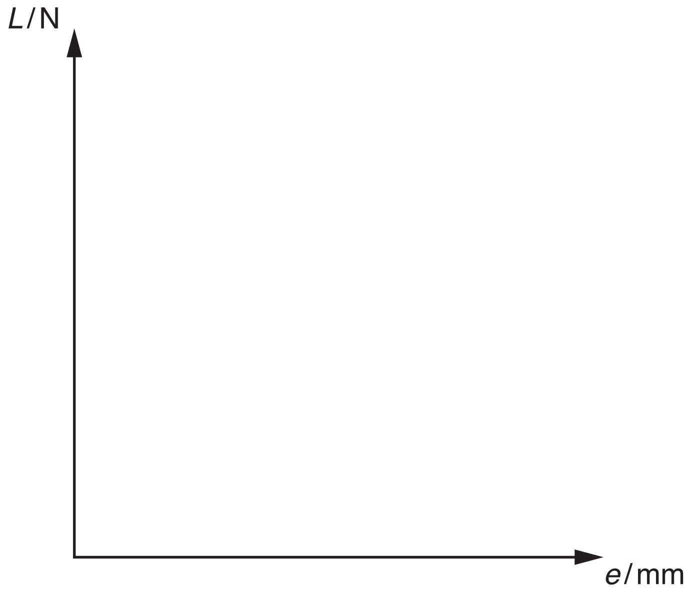

Fig. 1.3

[1]

(d) The gradient of your graph in Fig. 1.2 measures the force constant of the spring. The greater the force constant, the harder it is to stretch the spring.

A second spring has the same unstretched length but a greater force constant.

Using the same axes, draw on Fig. 1.2 a line to show how the length of this second spring changes as loads are added to it.

Label this line S. [2]

[Total: 15]

2 A student performs an experiment to measure the density of water.

(a) • She places an empty test-tube on a top-pan balance, as shown in Fig. 2.1.

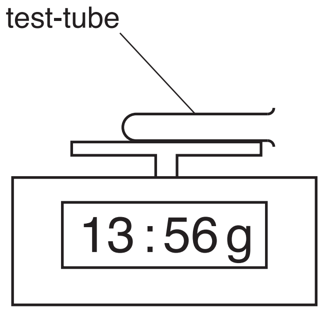

Fig. 2.1

Record the mass m of the test-tube to three significant figures.

m = ... g [1]

(b)

- She pours a volume $V_1 = 65\,cm^3$ of water into a measuring cylinder.
- She lowers the empty test-tube into the water in the measuring cylinder, so that it floats.

Fig. 2.2 shows the new reading on the measuring cylinder.

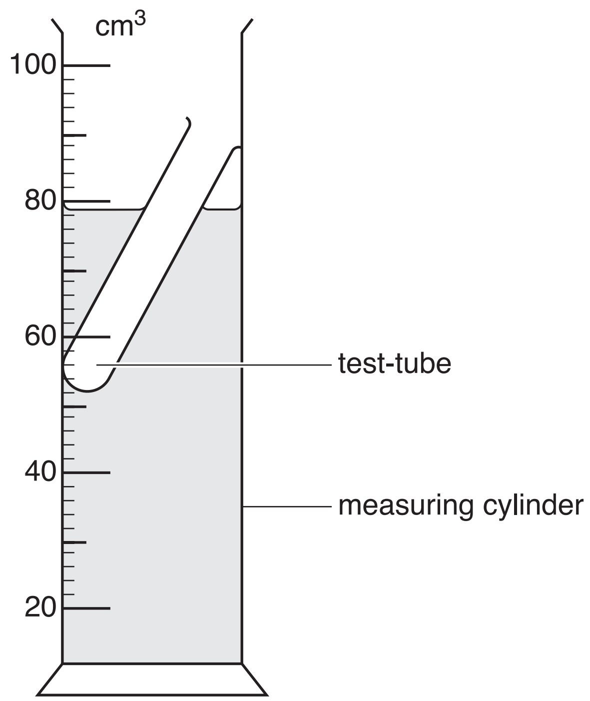

Fig. 2.2

(i) Read and record the new water level V_2 in the measuring cylinder.

V_2 = ... cm^3 [1]

(ii) Calculate the increase in the volume reading V in the measuring cylinder.

V = ...cm^3 [1]

(iii) Suggest **one** source of experimental inaccuracy in reading the scale on the measuring cylinder.

....

.... [1]

(c) Theory suggests that the density ρ of water is given by the equation:

$$\rho = m / V$$

Use your answers to **(a)** and **(b)(ii)** to calculate ρ. State the unit of your answer.

ρ = ... [2]

[Total: 6]

3 A student investigates the resistance of different lengths l of a metal wire PQ of total length 1.000 m.

- She sets up the circuit shown in Fig. 3.1.

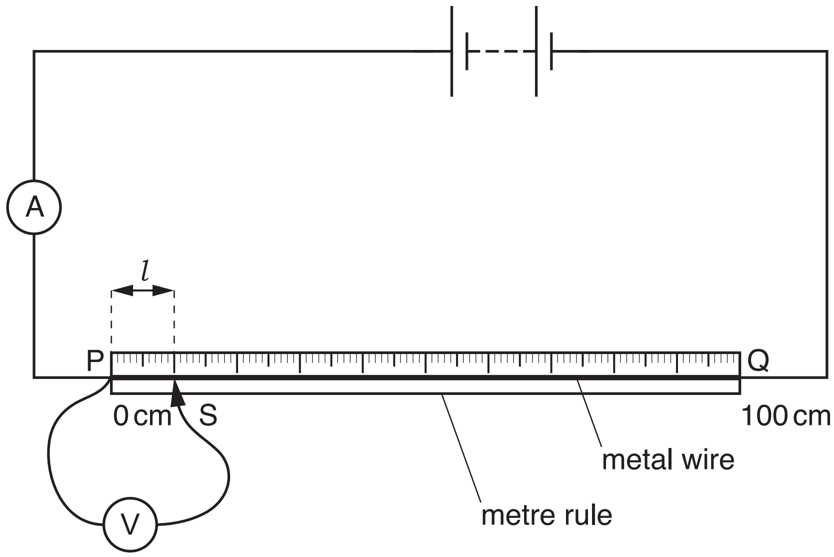

Fig. 3.1

- She places the sliding contact S a distance l = 10.0 cm from end P of the wire and records the readings on the ammeter and the voltmeter.

The reading on the voltmeter is shown in Fig. 3.2.

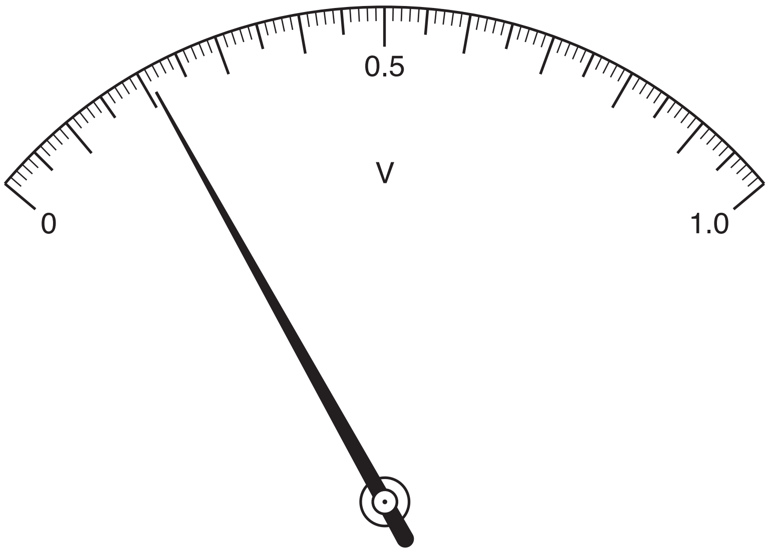

Fig. 3.2

(a) **(i)** Read the voltmeter scale and record your answer in Table 3.1. [1]

Table 3.1

length l/cm	current I/A	p.d. V/V	resistance R/Ω
10.0	0.25		
20.0	0.25	0.41	1.64
40.0	0.25	0.84	3.36

(ii) Calculate the resistance of a length $l = 10.0$ cm of the wire. Use the equation

$$R = V/I$$

Record your answer in Table 3.1. [1]

(b) • The student repeats the procedure for lengths $l = 20.0$ cm and $l = 40.0$ cm of wire and records her results in Table 3.1.

Look at the results in Table 3.1.

Within the limits of experimental error, suggest the relationship between l and R.

....

.... [2]

(c) The student notices that the wire is warm at the end of the investigation.

Describe **one** precaution that the student can take to minimise this heating effect.

....

.... [1]

[Total: 5]

4 A student investigates the refraction of light by a right-angled glass prism WXY.

He uses a ray box to direct a ray of light towards side WY of the prism, as shown in Fig. 4.1.

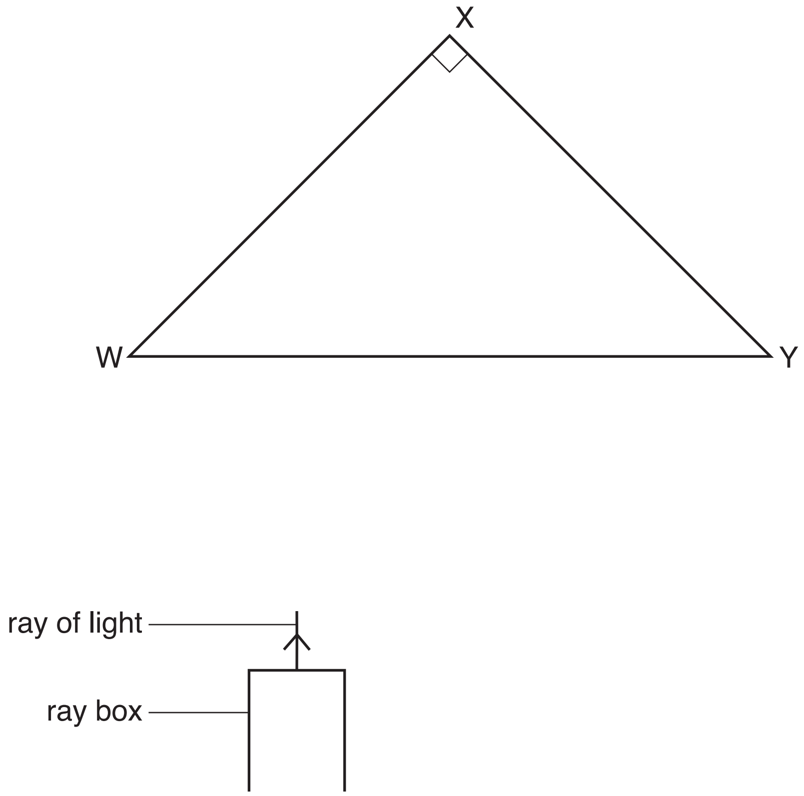

Fig. 4.1

- He places two pins P_1 and P_2 on the incident ray and marks each position with a cross.
- He places another two pins P_3 and P_4 on the emergent ray and marks each position with a cross.
- He removes the ray box.
- He draws around the outline of the prism and then removes it.

- The student uses a ruler to trace the path of the incident ray until it reaches side WX of the glass prism.
- He labels the point where the ray hits side WX with the letter Z, as shown in Fig. 4.2.

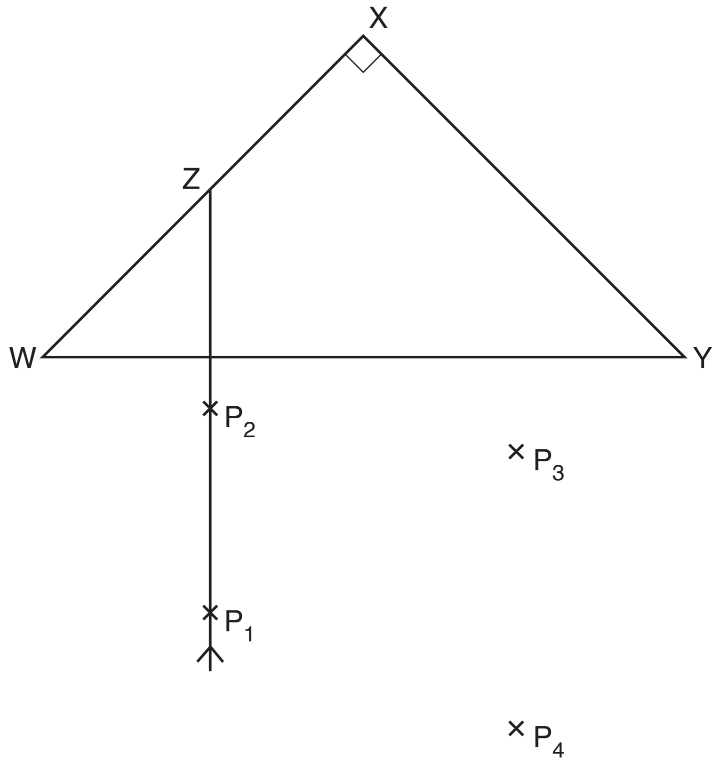

Fig. 4.2

(a) **(i)** Draw the normal to the prism at point Z. [1]

(ii) Use a ruler to draw the path of the ray from Z until after it emerges from the prism. [2]

(b) Describe the overall effect of the prism on the direction of the ray.

.... [1]

[Total: 4]

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