



## Cambridge O Level

CANDIDATE  
NAME

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**PHYSICS**

**5054/04**

Paper 4 Alternative to Practical

**For examination from 2023**

SPECIMEN PAPER

**1 hour**

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **18** pages. Any blank pages are indicated.



- 1 A student investigates the effect of varying the amount of light reaching a light-dependent resistor (LDR).

She sets up the apparatus as shown in Fig. 1.1.

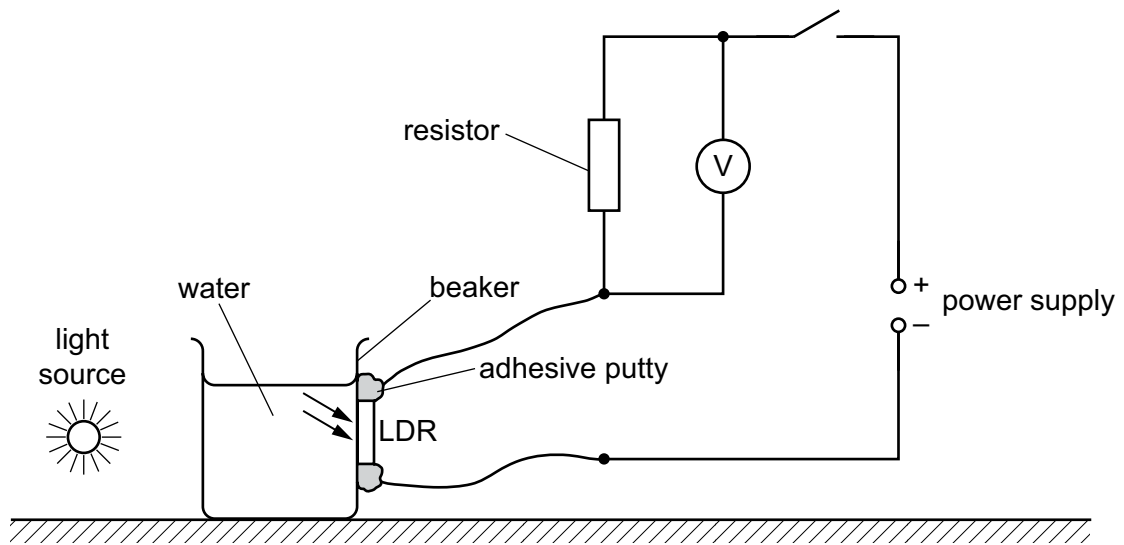


Fig. 1.1

- (a) (i) Fig. 1.2 shows the reading on the voltmeter when the light source is turned on and the switch is closed.

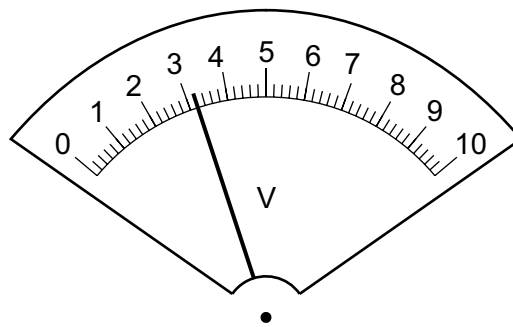


Fig. 1.2

Record the reading on the voltmeter on the answer line and in the first row of Table 1.1 on page 4.

voltmeter reading = ..... V [1]

- (ii) The student uses a syringe to add 2 cm<sup>3</sup> of a coloured liquid to the water in the beaker and stirs the mixture.

Explain why the student must stir the two liquids together.

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

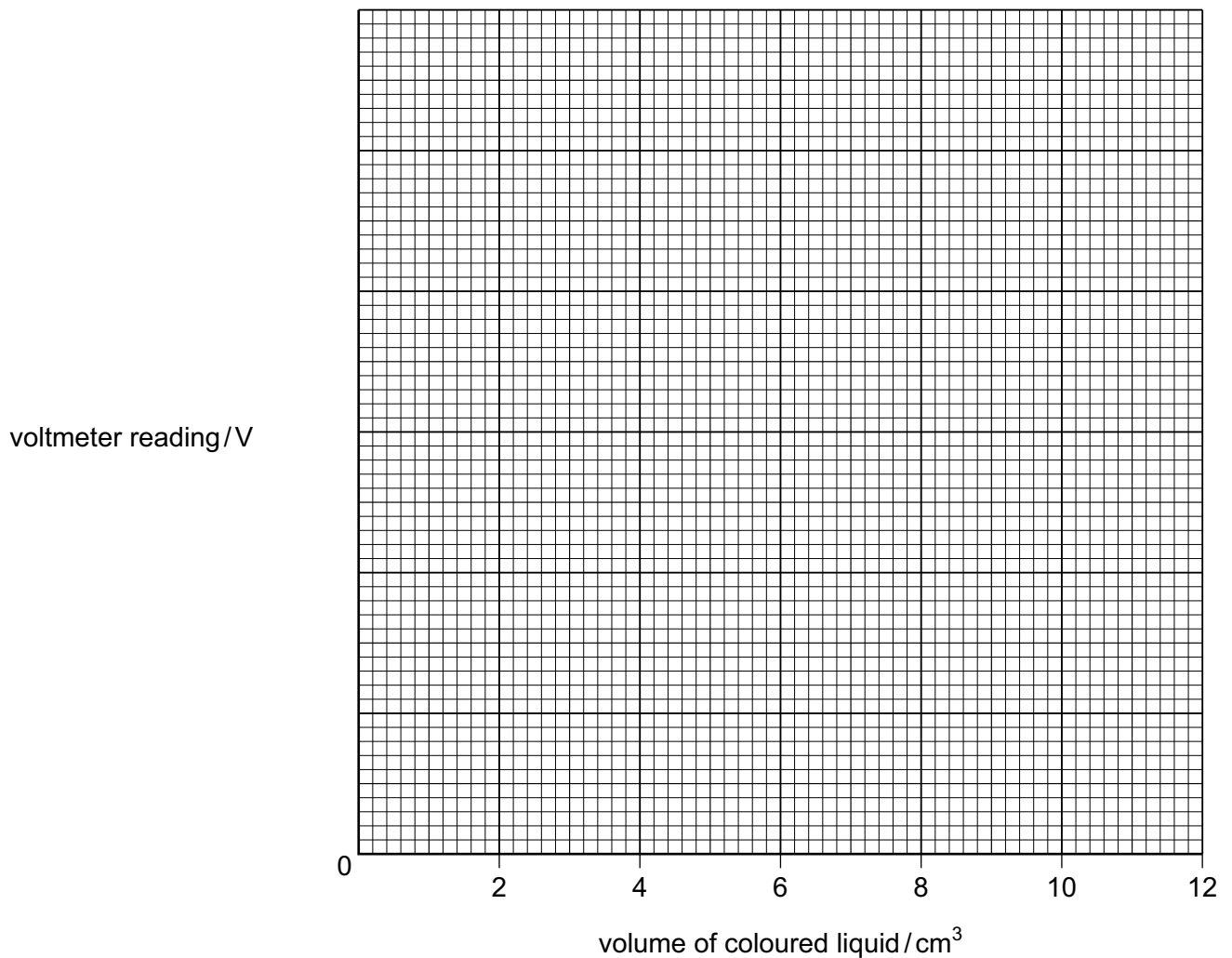
- (b) The student continues to add  $2 \text{ cm}^3$  of coloured liquid to the water at a time, recording each new voltmeter reading in Table 1.1.

**Table 1.1**

volume of coloured liquid / $\text{cm}^3$	voltmeter reading / V
0	
2	2.4
4	2.2
6	1.8
8	1.6
10	1.5
12	1.4

On Fig. 1.3, plot a graph of the voltmeter reading against the volume of coloured liquid.

Draw the best-fit curve.



**Fig. 1.3**

[2]

- (c) (i) Draw a tangent to the curve at  $5 \text{ cm}^3$ . [1]
- (ii) Calculate the gradient of the tangent.

Show your working and indicate on the graph the values that you use.

gradient = ..... [2]

- (d) Describe **one** precaution taken to ensure that the reading from a voltmeter is accurate.

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

- (e) Another student performs the same experiment. He calculates a gradient which is slightly different to the value you obtained in (c)(ii).

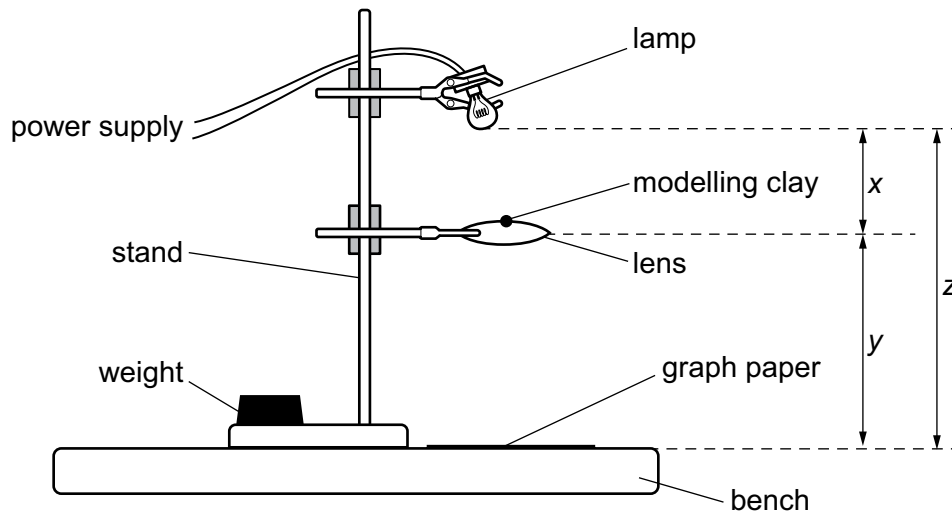
Suggest **two** variables that are difficult to control that may result in different gradients.

1 .....  
.....  
2 .....  
..... [2]

[Total: 10]

2 A student investigates the effect of two lenses on the size of a shadow.

He sets up the apparatus as shown in Fig. 2.1.



**Fig. 2.1**

The student uses a small lamp connected to a 3 V power supply.

He attaches the clamp holding the lamp to the highest position on the stand. In this position, the distance  $z$  between the lamp and the bench is 56.5 cm.

He places one of the glass lenses in the jaws of a clamp at a distance  $x = 20$  cm below the lamp.

(a) Describe **two** precautions he takes to ensure the apparatus is set up safely.

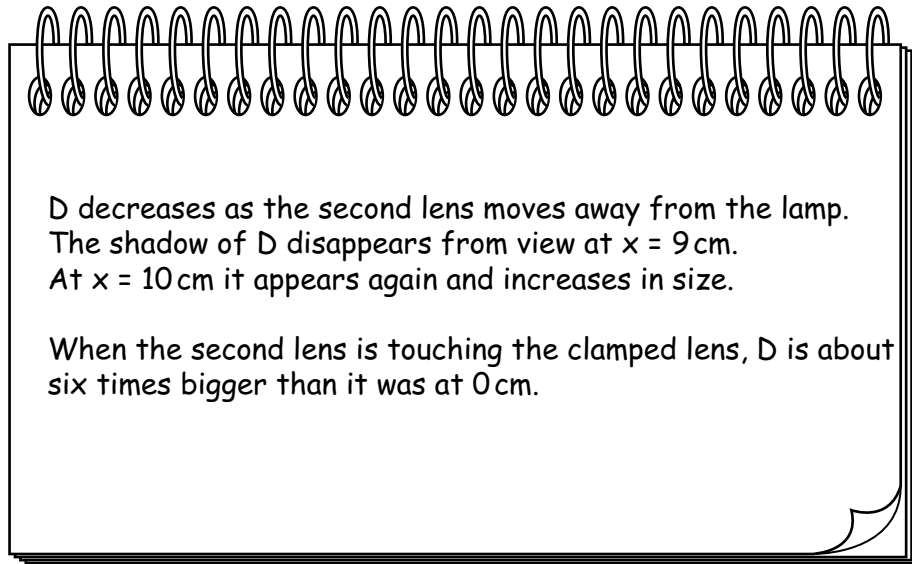
- 1 .....
- .....
- .....
- .....
- 2 .....
- .....
- .....
- .....

[2]

- (b) The student switches on the lamp. The lamp light and the modelling clay produce a shadow on the graph paper.

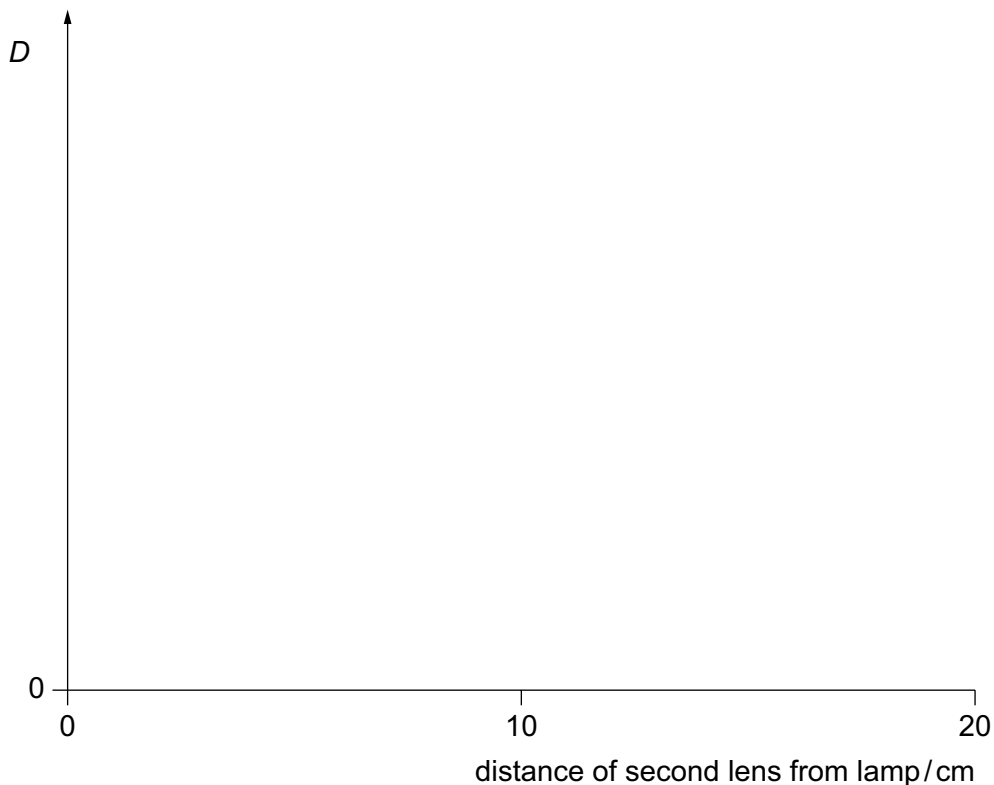
He holds a second lens under the lamp. When this lens is touching the lamp, the diameter  $D$  of the shadow of the modelling clay on the graph paper is 2 mm.

The student moves the second lens down towards the clamped lens. He observes the change in  $D$ . He records his observations as shown in Fig. 2.2.



**Fig. 2.2**

Use the student's observations to sketch a graph on Fig. 2.3 showing how  $D$  changes with increasing  $x$ .



**Fig. 2.3**

[2]

- (c) (i) The student removes the modelling clay from the clamped lens.

He keeps the lamp at the top of the stand. He can see an image of the lamp on the graph paper on the bench.

He adjusts the position of the clamped lens until the image is as small and bright as possible.

He finds that he **cannot** position the clamped lens so that the image seen on the graph paper is in focus.

The image is as small and bright as possible when  $x = 27.6$  cm.

Calculate  $y$ .

$$y = \dots\dots\dots \text{ cm [2]}$$

- (ii) A student suggests that the focal length  $f$  of the lens can be calculated by using the equation

$$f = \frac{xy}{x+y}$$

where  $x$  and  $y$  are determined for a focused image.

Calculate the value of  $f$  using this equation, where  $x = 27.6$  cm and  $y$  is the value calculated in (c)(i).

Show your working.

$$f = \dots\dots\dots \text{ cm [2]}$$

- (d) (i) State why the arrangement of the apparatus shown in Fig. 2.1 **cannot** be used to accurately determine the focal length  $f$ .

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

- (ii) Suggest how the arrangement of the apparatus can be changed in order to **accurately** determine the focal length of the clamped lens.

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

[Total: 10]



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3 A student investigates the oscillation of masses attached to a metre rule.

She attaches two 100 g masses to the end of the metre rule. The diameter and width of one of the masses are shown in Fig. 3.1.

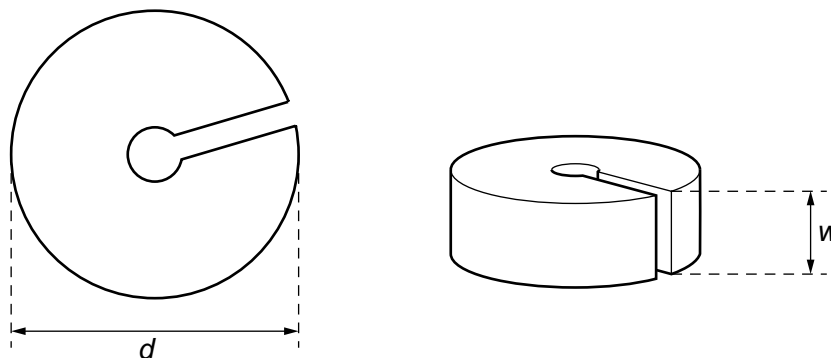


Fig. 3.1

(a) On Fig. 3.1, measure the lengths  $d$  and  $w$ .

$d = \dots\dots\dots$  unit =  $\dots\dots$

$w = \dots\dots\dots$  unit =  $\dots\dots$

[1]

(b) The student sticks the pair of masses together and secures them to the end of the metre rule using adhesive putty.

Part of the scale at the end of the rule is covered by the masses, as shown in Fig. 3.2.

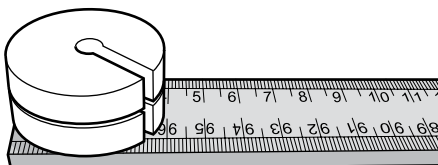


Fig. 3.2

(i) Describe a method to determine the position of the centre of the masses on the metre rule.

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

(ii) Suggest why the student does **not** attach the masses to the lower side of the metre rule.

..... [1]

- (iii) The other end of the metre rule is attached to the bench as shown in Fig. 3.3.

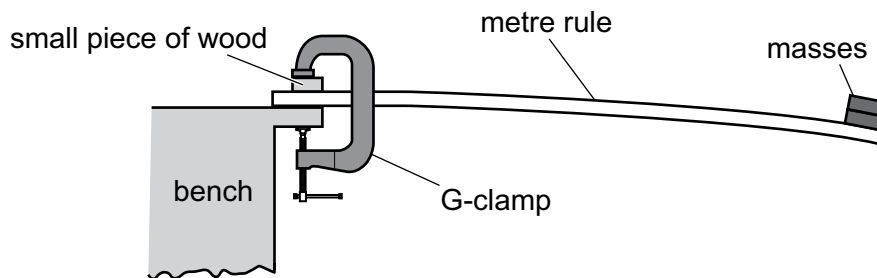


Fig. 3.3

The edge of the bench is at the 10.0 cm mark on the metre rule.

Determine the distance  $L$ , along the rule, from the edge of the bench to the point on the rule directly below the centre of the masses. Use your value of  $d$  from part (a).

Show your working.

$$L = \dots\dots\dots \text{ cm [2]}$$

- (c) The student lifts the free end of the metre rule until the rule is approximately horizontal.

Then she releases the rule and observes the masses oscillating.

She measures the time taken for 20 oscillations. She repeats the procedure once more and records the times shown:

10.56 s

10.51 s

- (i) Determine the time  $t$  for **one** oscillation.

Show your working.

$$t = \dots\dots\dots \text{ s [2]}$$

- (ii) The student repeats her experiment for four more values of  $L$  by moving the masses along the top surface of the metre rule.

In Table 3.1, record your value of  $L$  from (b)(iii) and your value of  $t$  from (c)(i).

Add an appropriate unit to the heading of each column.

**Table 3.1**

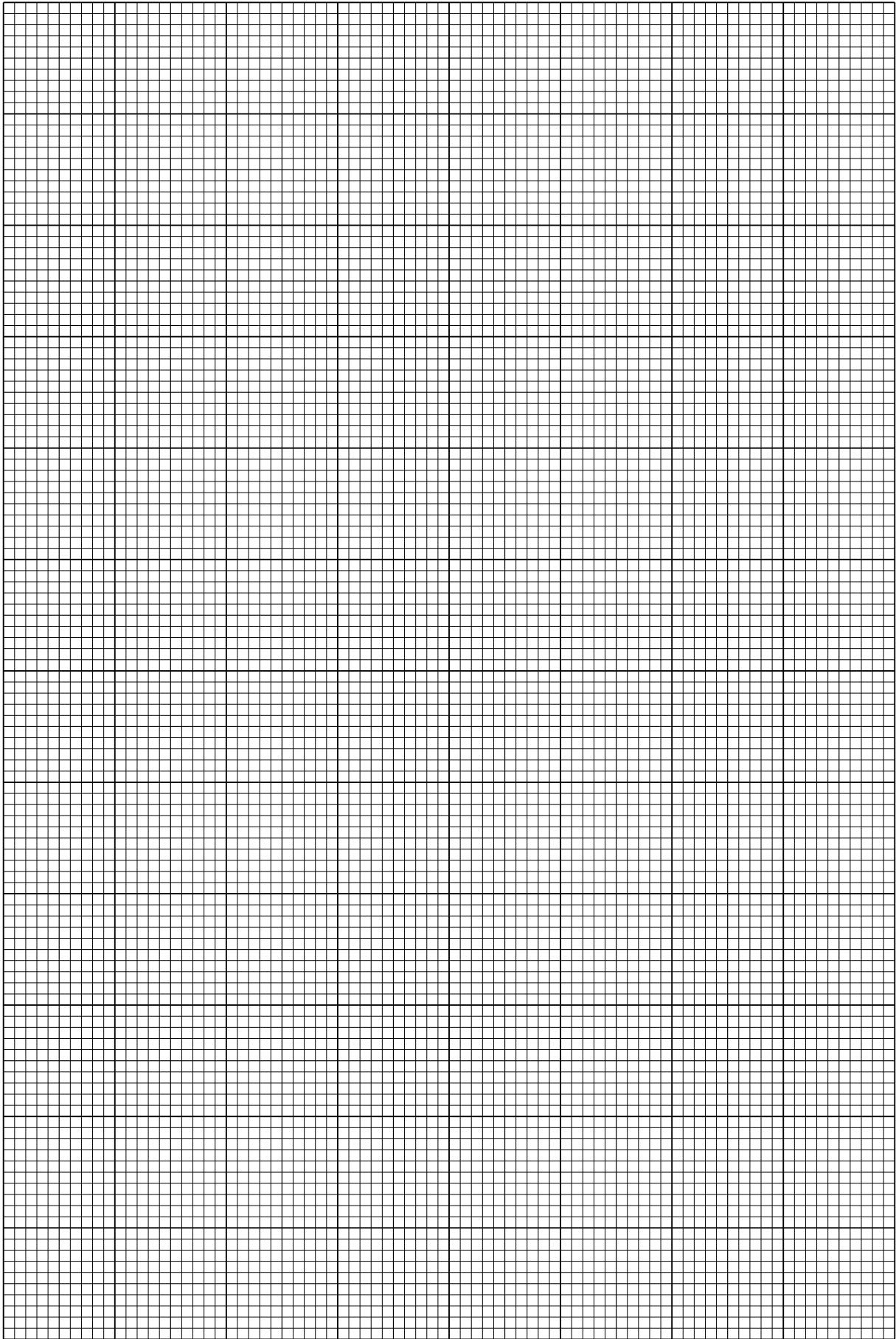
$L / \dots\dots\dots$	$t / \dots\dots\dots$
$\dots\dots\dots$	$\dots\dots\dots$
80	0.46
70	0.42
50	0.27
40	0.22

[1]

- (iii) On the grid, plot a graph of  $t$  on the  $y$ -axis against  $L$  on the  $x$ -axis.

You do **not** need to start your graph from the origin (0, 0).

Draw the straight line of best fit.



[4]

(iv) Use the graph to estimate the value of  $t$  when  $L = 60$  cm.

$t = \dots\dots\dots$  s [1]

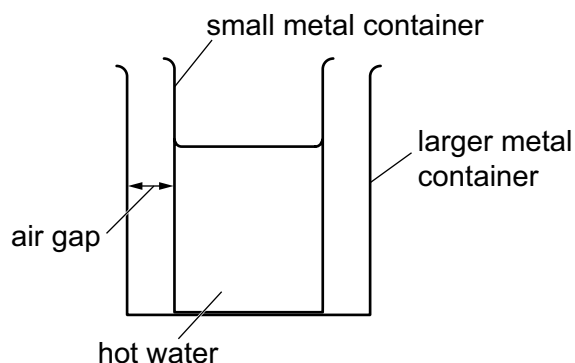
(d) Explain why it is **not** practical for the student to reduce the value of  $L$  to less than 40 cm.

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

[Total: 14]



- 4 A student places a small metal container inside a larger metal container, as shown in Fig. 4.1. There is an air gap between the two containers. The student investigates the effect of the size of the air gap on the rate of cooling of hot water.



**Fig. 4.1**

Plan an experiment to investigate the effect of the size of the air gap between the small metal container and larger metal containers on the rate of cooling of hot water.

The following apparatus is available:

- a small metal container
- a number of metal containers of different diameters (all larger than the small container)
- a thermometer
- a stopwatch
- a measuring cylinder
- a supply of hot water.

You can also use other apparatus and materials that are usually available in a school laboratory.

You are **not** required to do this investigation.

In your plan, you should:

- explain briefly how to carry out the investigation
- state the key variables to control
- draw a table, or tables, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how to use your readings to reach a conclusion.

A diagram is **not** required but you may draw one if it helps your explanation.





