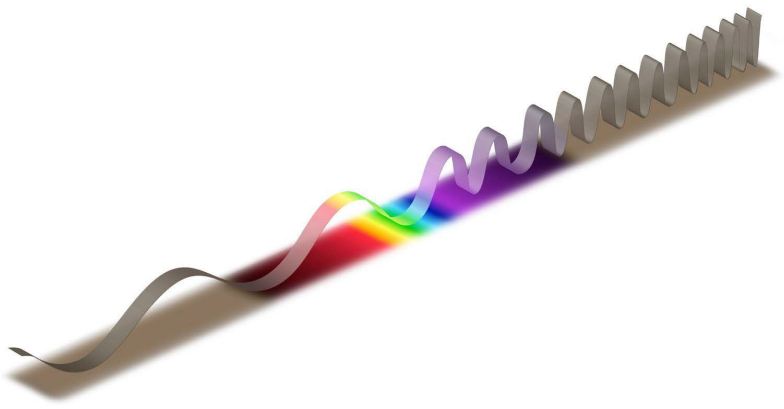
Cambridge Assessment International Education

Specimen Paper Answers
Paper 4: Alternative to Practical

Cambridge O Level Physics

5054

For examination from 2023



Version 1

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Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge O Level Physics 5054, and to show examples of very good answers.

In this booklet, we have provided answers for all questions with examiner comments. These exercises require candidates to answer questions on experimental skills and candidates are awarded maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

Each question and answer is followed by an examiner comment on the candidates answer. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could improve their answers and avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at **www.cambridgeinternational.org./support**

2023 Specimen Paper 4 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub www.cambridgeinternational.org/support

Assessment at a glance

The syllabus for Cambridge O Level Physics 5054 is available at www.cambridgeinternational.org

All candidates take three papers. Candidates will be eligible for grades A* to E.

Paper 1: Multiple Choice		And	Paper 2: Theory	
1 hour 40 Marks 40 four-option multiple-choice questions Externally assessed	30%		1 hour 45 minutes 80 Marks Short-answer and structured questions Externally assessed	50%

Practical assessment

Paper 3: Practical Test		Or	Paper 4: Alternative to Practical	
1 hour 30 minutes 40 Marks Questions will be based on the experimental skills in Section 4 Externally assessed	20%		1 hour 40 Marks Questions will be based on the experimental skills in Section 4 Externally assessed	20%

Question 1

Question 1(a)(i)

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.

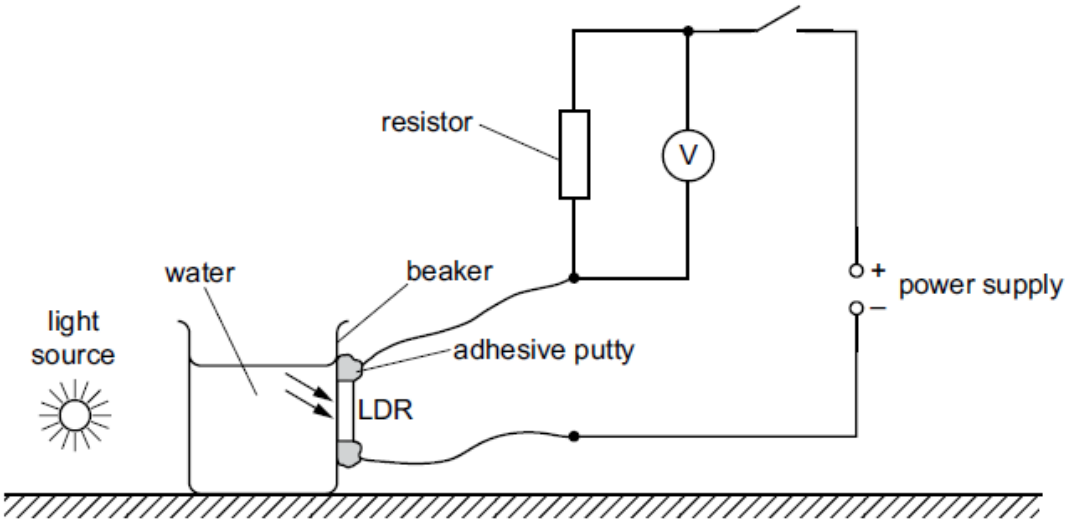


Fig. 1.1

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

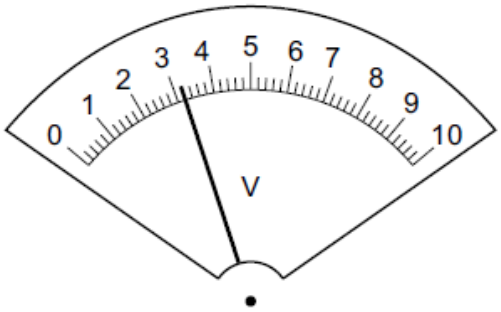


Fig. 1.2

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

voltmeter reading = ... 3.2 ✓ ..... V [1]

Mark awarded = 1 out of 1

Examiner comment

This response is the correct answer. This response scores 1 mark.

Common mistakes

Candidates will sometimes count one division from 3 and give the answer 3.1 without considering what a division is worth.

Question 1(a)(ii)

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

Explain why the student must stir the two liquids together.

To make the colour spread out evenly. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

This response is the correct answer. This response scores 1 mark.

Question 1(b)

(b) The student continues to add 2 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 / 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.

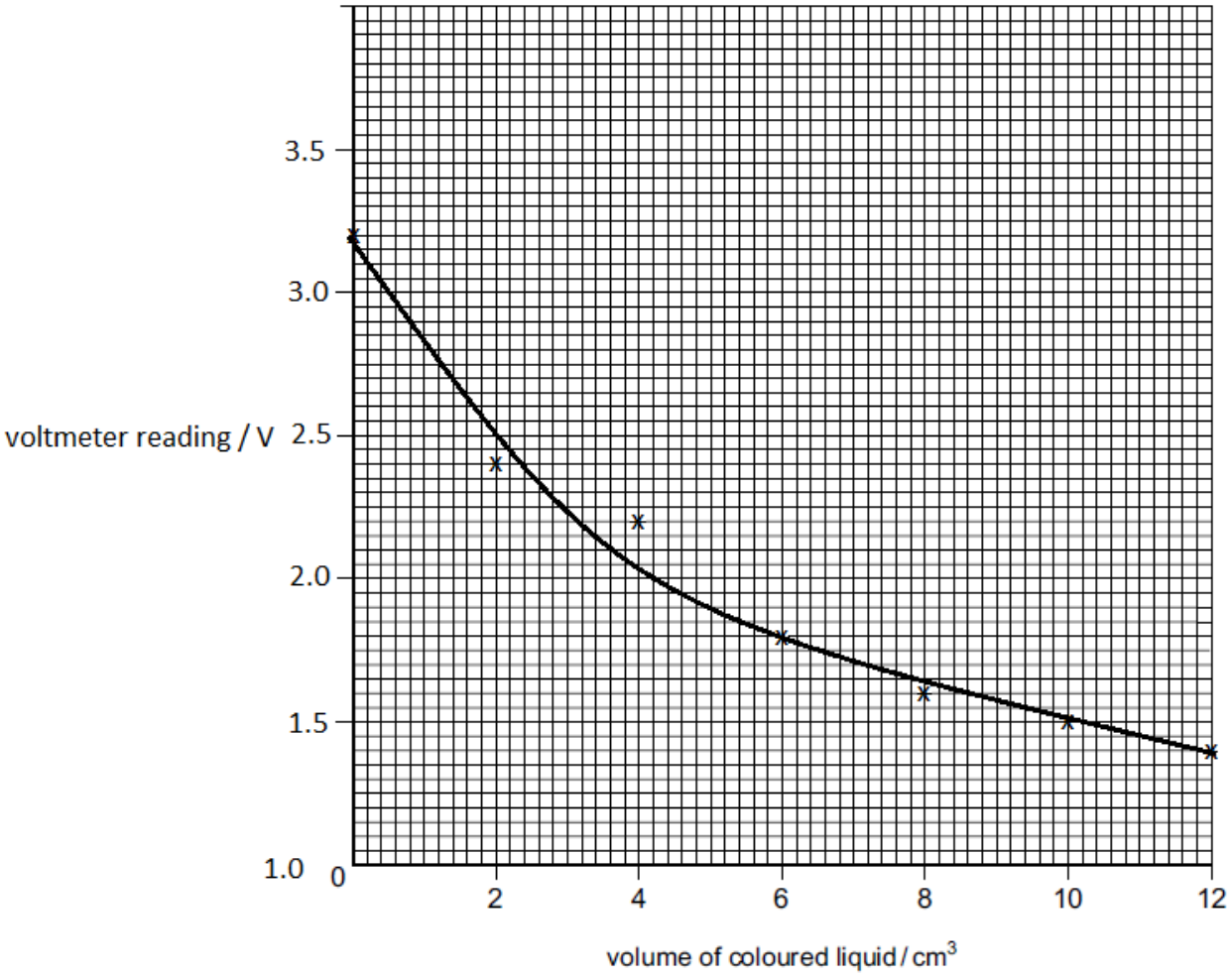


Fig. 1.3 [2]

Mark awarded = 2 out of 2

Examiner comment

All the values from the table are correctly plotted. The curve of best fit has the points balanced between being above and below the curve. This response scores 2 marks.

Common mistakes

The vertical axis does not need to begin at zero.

Question 1(c)(i)

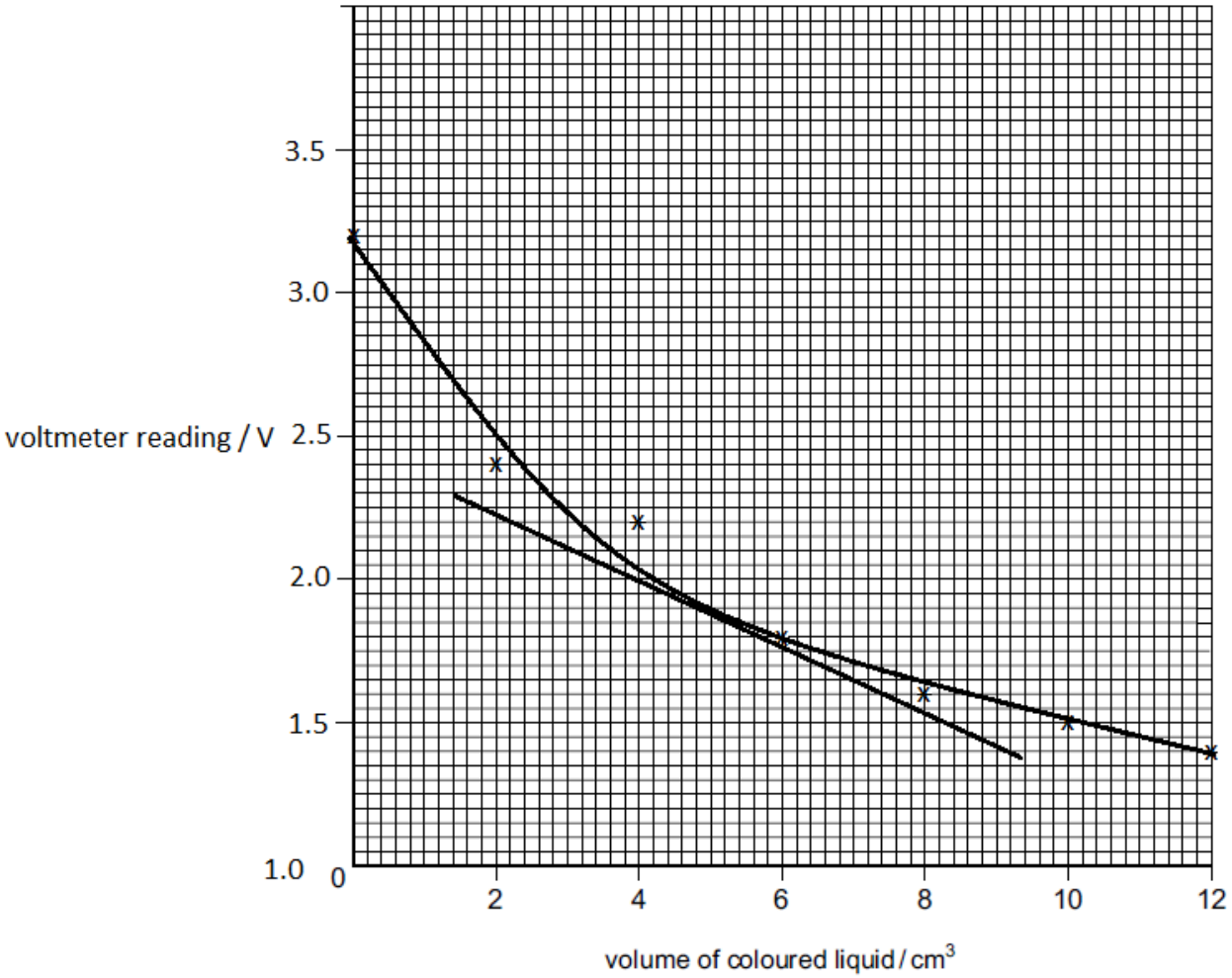


Fig. 1.3 [2]

(c) (i) Draw a tangent to the curve at 5 cm^3. [1]

Mark awarded = 1 out of 1

Examiner comment

Tangent drawn to line at 5 cm³. This response scores 1 mark.

Question 1(c)(ii)

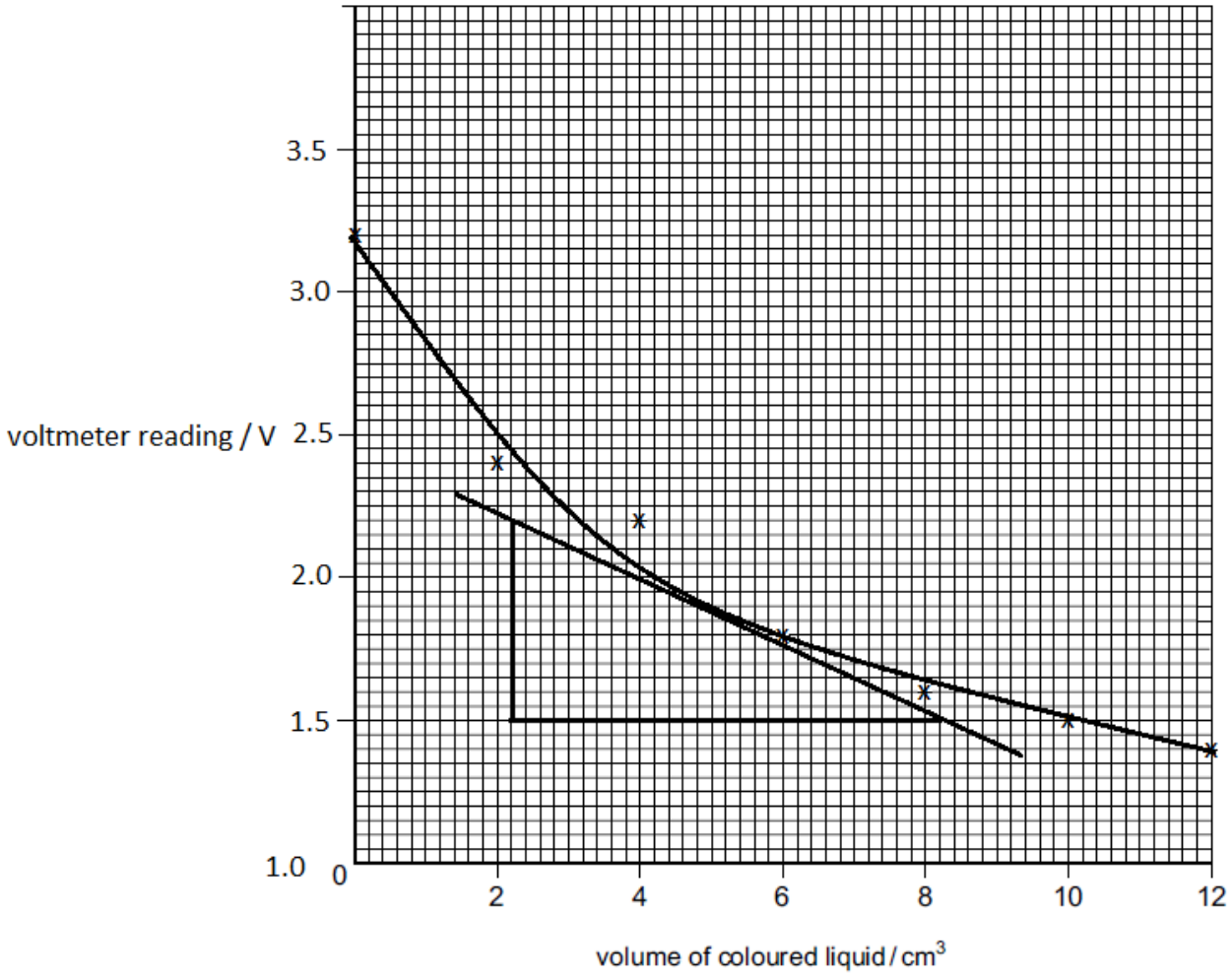


Fig. 1.3 [2]

(c) (i) Draw a tangent to the curve at 5 cm^3. [1]

(ii) Calculate the gradient of the tangent.

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

$$\frac{\Delta y}{\Delta x} = \frac{2.20 - 1.50}{2.2 - 8.2} = \checkmark$$

gradient = ... -0.12 ✓ ..... [2]

Mark awarded = 2 out of 2

Examiner comment

Two pairs of (x,y) values read correctly from the tangent line with $\Delta x > 5$. This response scores 2 marks.

Common mistakes

Candidates sometimes take points that are too close together: they should be encouraged to use as large a triangle as possible. Candidates sometimes adjust their line to go through a plotted point rather than taking the time to read a more appropriate point using the scale. This frequently ends up with answers to calculations outside the allowed range.

Question 1(d)

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

Check for zero error on the voltmeter. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

This response gives one of the correct answers on the mark scheme. This response scores 1 mark.

Question 1(e)

(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 *The amount of daylight entering the room might not be the same.* ✓

2 *The distance between the light bulb and the LDR might not be the same.* ✓

[2]

Mark awarded = 2 out of 2

Examiner comment

This response gives two of the correct answers on the mark scheme. This response scores 2 marks.

Total mark awarded = 10 out of 10

Question 2

Question 2(a)

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.

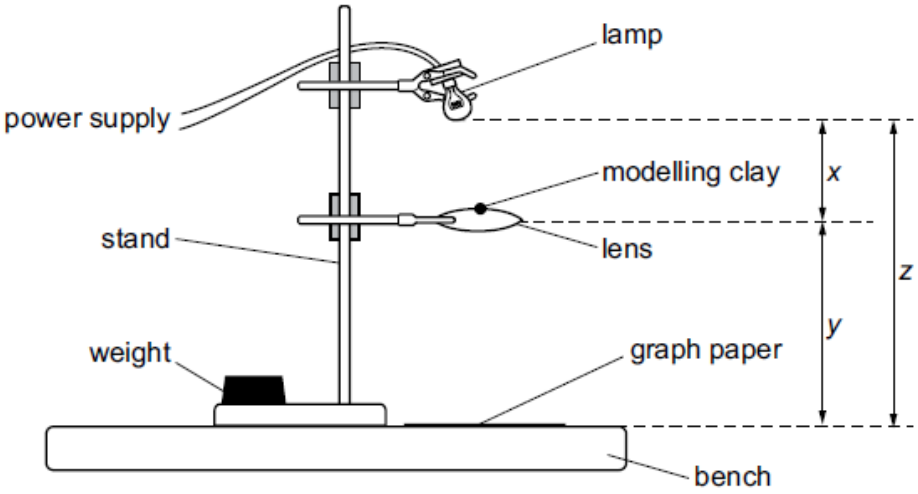


Fig. 2.1

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 *The weight is placed on the clamp to stop it falling over.* ✓

2 *The apparatus is not hanging over the edge of the bench where it could be knocked over.* ✓

[2]

Mark awarded = 2 out of 2

Examiner comment

This response gives two of the ideas on the mark scheme. It also goes on to explain why both precautions are needed. This response scores 2 marks.

Vitamin C content would be acceptable on x axis with horizontal bars drawn.

Question 2(b)

(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.

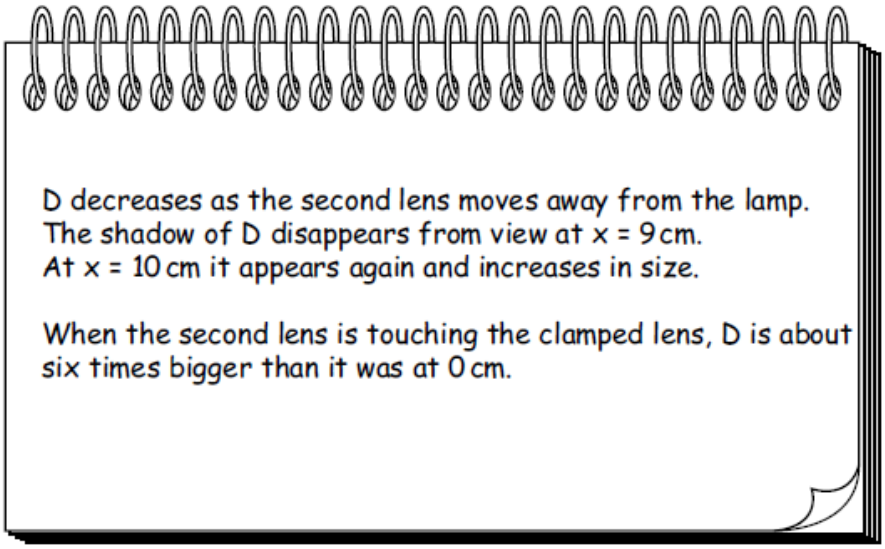


Fig. 2.2

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

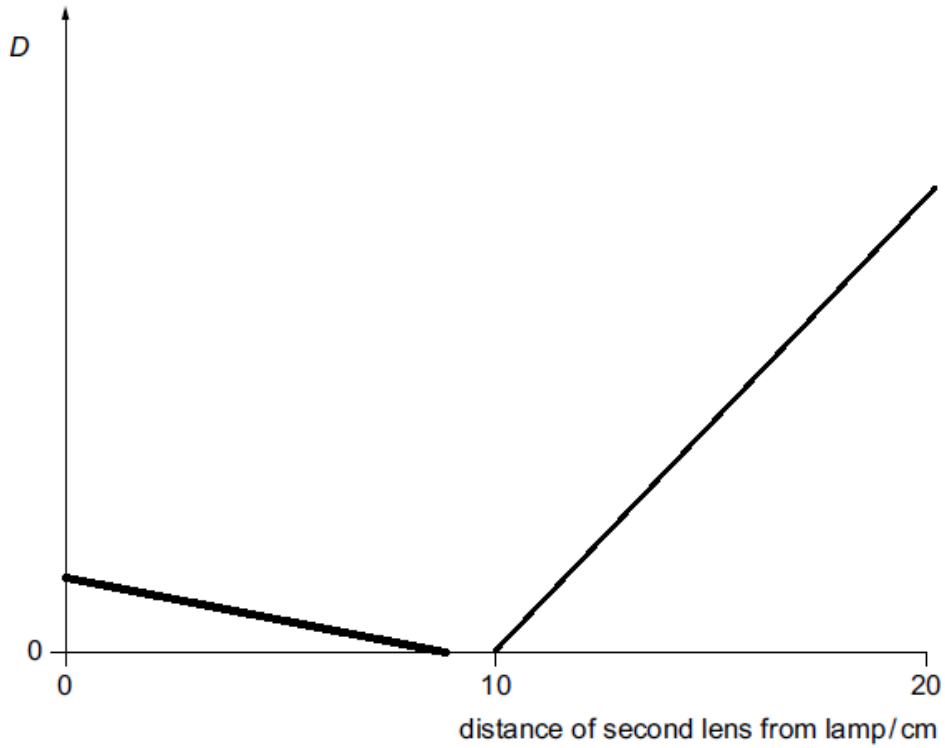


Fig. 2.3 [2]

Mark awarded = 2 out of 2

Examiner comment

This question requires a sketch graph. There is no need to place a scale on the vertical axis, but the lines should be qualitatively correct in comparison with each other. This response scores 2 marks.

Question 2(c)(i)

(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.

$z = x + y$

$56.5 = 27.6 + y$ ✓

y = 28.9 ✓ cm [2]

Mark awarded = 2 out of 2

Examiner comment

Correct calculation and answer. This response scores 2 marks.

Question 2(c)

(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.

$f = \frac{27.6 \times 28.9}{27.6 + 28.9} =$ ✓

f = 14.1 ✓ cm [2]

Mark awarded = 2 out of 2

Examiner comment

Substitution of distances from (c)(i) and evaluation. This response scores 2 marks.

Question 2(d)(i)

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

It is not possible to get a sharp image. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate is correct.

Question 2(d)(ii)

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

Use a taller stand so the lamp can be moved further from the paper. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate is correct.

Total mark awarded = 10 out of 10

Question 3

Question 3(a)

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.

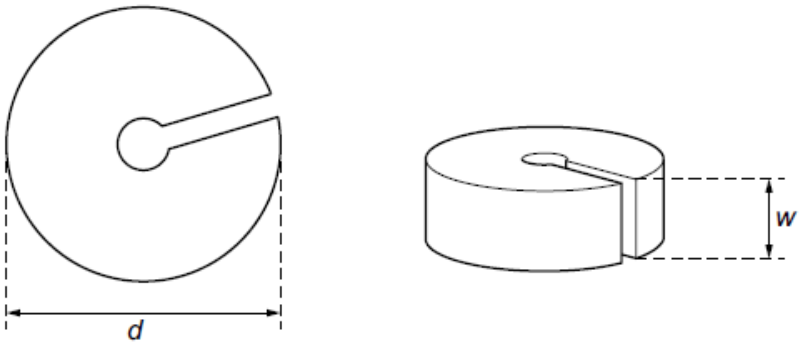


Fig. 3.1

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

d = ... 38 ✓ ..... unit = mm ✓

w = ... 11 ✓ ..... unit = mm ✓

[1]

Mark awarded = 1 out of 1

Examiner comment

Direct measurement. This response scores 1 mark.

Question 3(b)(i)

(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.

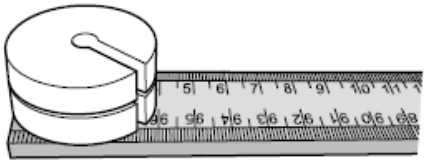


Fig. 3.2

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

1 m minus half the diameter of the masses. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

The centre of the masses on the ruler is found by subtracting half the diameter from the length of the ruler. This response scores 1 mark.

Question 3(b)(ii)

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

The masses are more likely to fall off the ruler. ✓ ..... [1]

Mark awarded = 2 out of 2

Examiner comment

The candidate is correct.

Question 3(b)(iii)

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

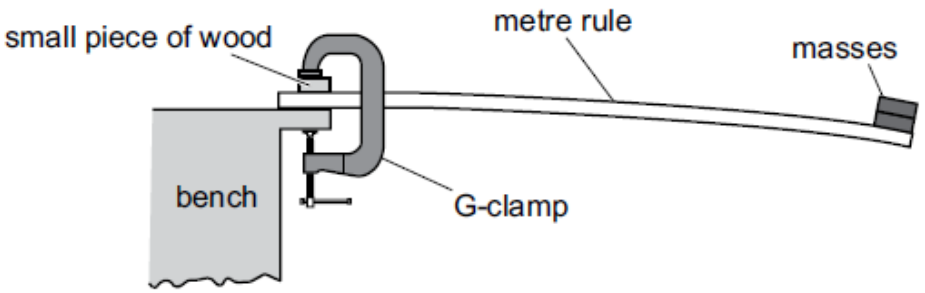


Fig. 3.3

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.

100-10.0=90.0 cm

Subtract half diameter of masses

$90.0 - \frac{3.8}{2} =$ ✓

L = 88.1 ✓ cm [2]

Mark awarded = 2 out of 2

Examiner comment

In this response the candidate has shown their working. The length of the ruler overhanging the desk was calculated. Half the diameter of the masses was subtracted. This response scores 2 marks.

Question 3(c)(i)

(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.

$\frac{10.56+10.51}{2} = 10.54$ s

$\frac{10.54}{20} =$ ✓

t = 0.53 ✓ s [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has calculated the average of the two times given. Then they have divided by 20 to find the time for 1 oscillation. This response scores 2 marks.

Question 3(c)(ii)

(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 / cm ✓	*t* / s ✓
88 ✓	0.53 ✓
80	0.46
70	0.42
50	0.27
40	0.22

[1]

Mark awarded = 1 out of 1

Examiner comment

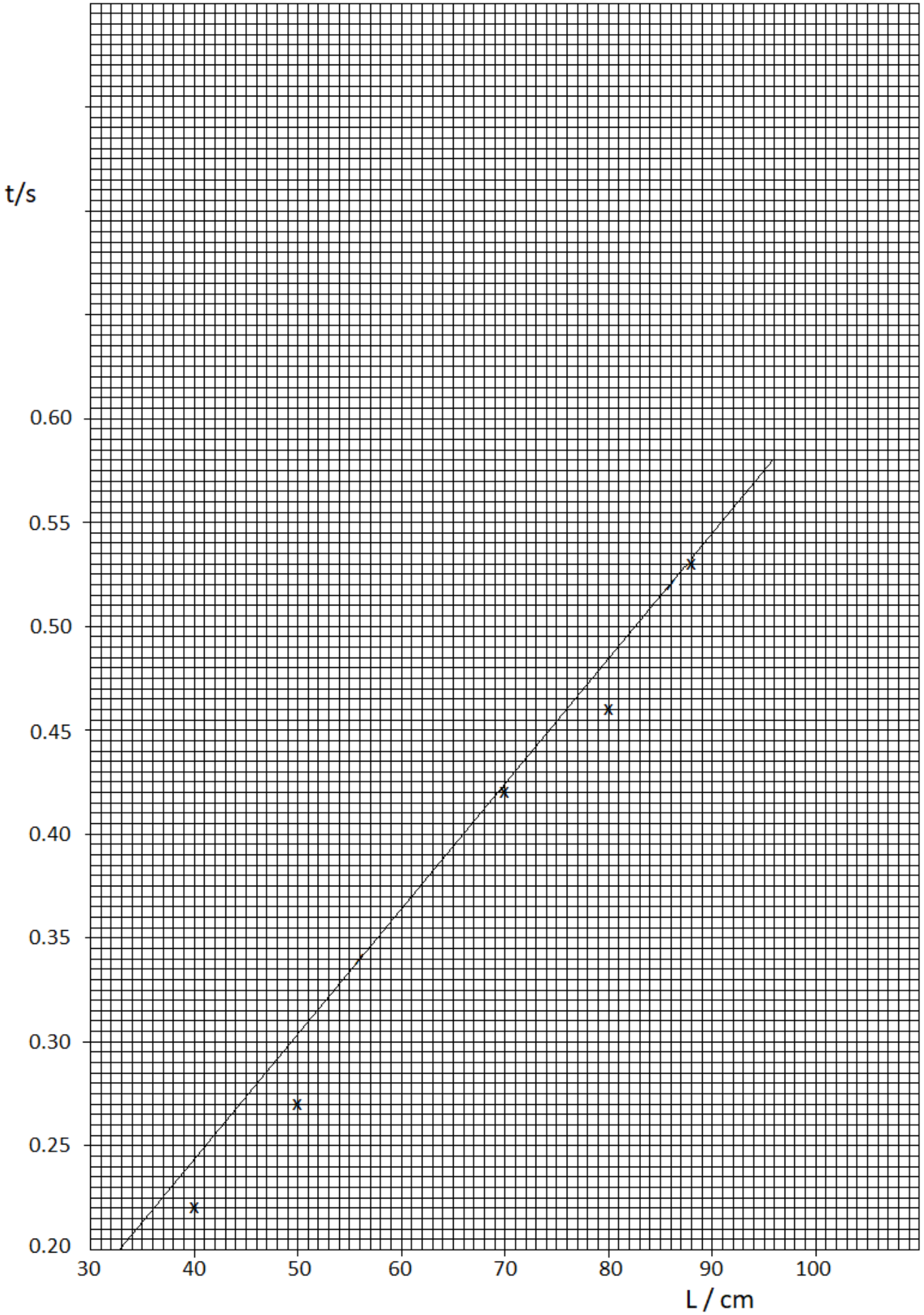
This response shows the values copied from earlier in the paper for the first row of data. Correct column headings and units have been added. This response scores 1 mark.

Question 3(c)(iii)

(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]

Mark awarded = 3 out of 4

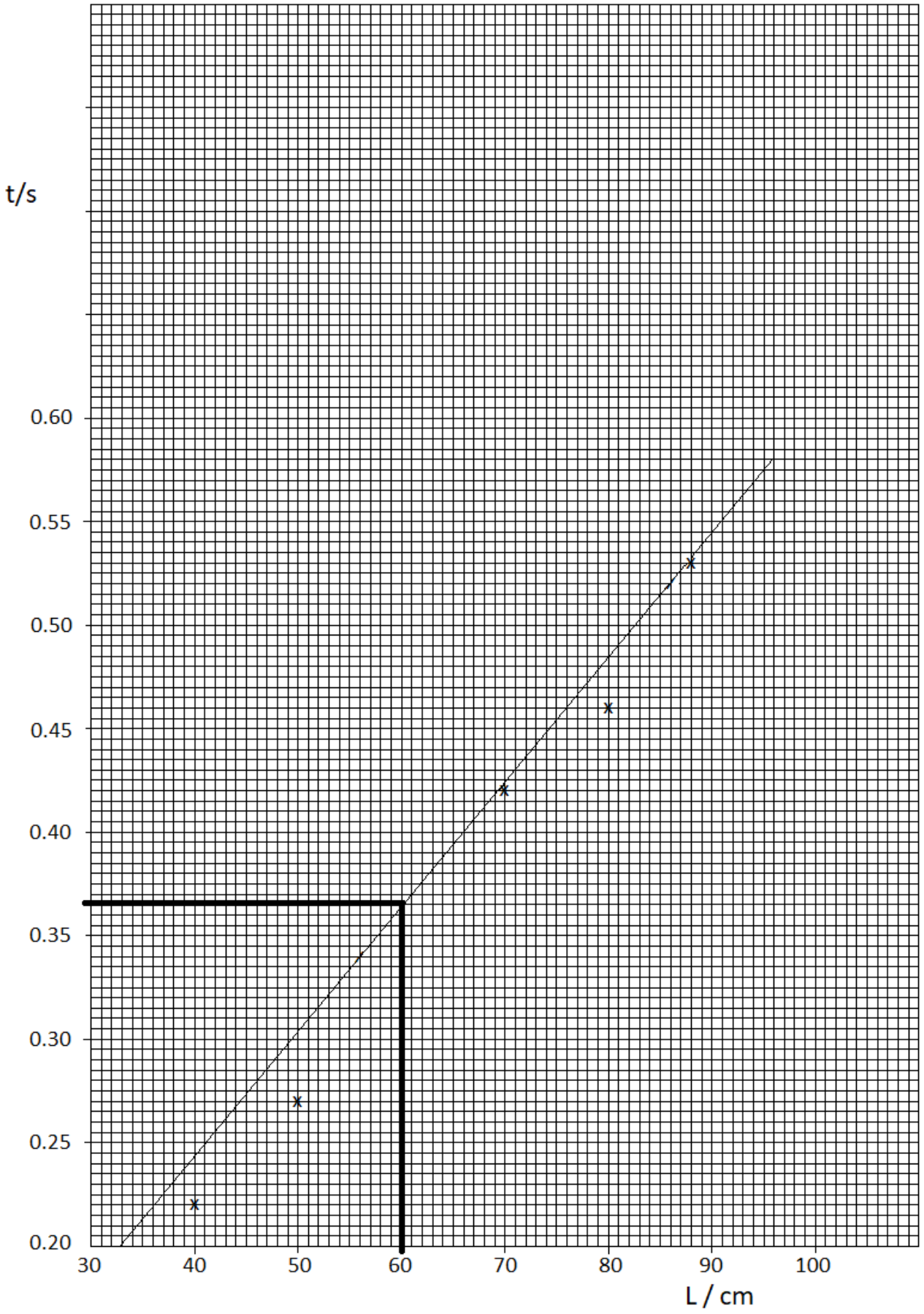
Examiner comment

The candidate has the axes the correct way around and has labelled the axes. Suitable, uniformly increasing scales are chosen. The graph covers 5 large squares horizontally and 7 vertically. All points are plotted correctly. However, the line of best fit is not correct as there are no points above the line and three below. This response scores 3 marks.

Common mistakes

Common mistakes include: the graph not occupying a large enough portion of the graph paper due to a poor choice of scale; non-linear scales; large blobs used to plot the points rather than fine crosses; a long line of best fit that is not straight because it was drawn with a 15 cm ruler laid down twice.

Question 3(c)(iv)



[4]

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

t = ... 0.37 ✓ ..... s [1]

Mark awarded = 3 out of 4

Examiner comment

A line is drawn clearly upwards from L = 60 cm to meet the line of best fit and across to the vertical axes at a time of 0.365 s which has been rounded to 0.37 s. This is just within the tolerance allowed on the mark scheme. This response scores 1 mark.

Question 3(d)

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

The oscillation is too quick so it's really hard to count the right number of oscillations. ✓

..... [1]

Mark awarded = 1 out of 1

Examiner comment

This response has referred to the oscillation being too quick rather than the period of oscillation being too short but the candidate has conveyed their understanding sufficiently with the second half of their sentence. This response scores 1 mark.

Total mark awarded = 13 out of 14

Question 4

Question 4

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.

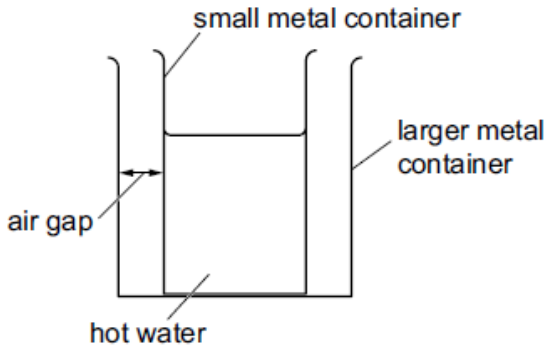


Fig. 4.1

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.

I will fill the copper container with hot water and measure its starting temperature with the thermometer. I will start the stopwatch. After 10 minutes I will stop the stopwatch and measure the end temperature of the water. I will need to keep the volume of the water and the starting temperature of the water constant. ✓

Metal Container	Start temperature /°C	End temperature /°C	Temperature decrease /°C

Using the two temperatures I measured I will calculate the temperature decrease after 10 minutes. The air gap with the largest temperature decrease has the largest rate of cooling of the hot water. ✓

.....

.....

.....

.....

.....

.....

.....

..... [6]

Mark awarded = 5 out of 6

Examiner comment

The method for one measurement is explained correctly. However, there is no mention of changing the independent variable by using different outer containers. Two variables to keep constant are given. The table is correct, and the conclusion is appropriate. This response scores 5 marks.

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