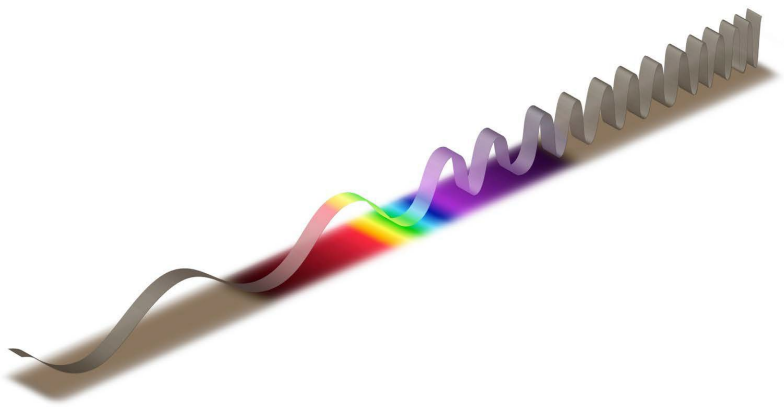
Cambridge Assessment International Education

Specimen Paper Answers
Paper 3: Practical Test

Cambridge O Level Physics

5054

For examination from 2023



Version 1

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Contents

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 3 Mark Scheme

2023 Specimen Paper 3 Confidential Instructions

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			1 hour 45 minutes	
40 Marks	30%		80 Marks	50%
40 four-option multiple-choice questions			Short-answer and structured questions	
Externally assessed			Externally assessed	

Practical assessment

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

Question 1

Question 1(a)(i)

1 In this experiment, you will investigate the effect of varying the amount of light reaching a light-dependent resistor (LDR).

You are provided with:

- a power supply
- a switch
- a light-dependent resistor (LDR)
- a resistor
- a voltmeter
- connecting leads
- a 250 cm^3 glass beaker containing 150 cm^3 of water
- a light source
- a container with a small amount of cloudy (non-transparent) liquid
- a 5 cm^3 plastic syringe
- a stirrer
- paper towels or cloths to clean up spillages.

The supervisor has set up the apparatus as shown in Fig. 1.1.

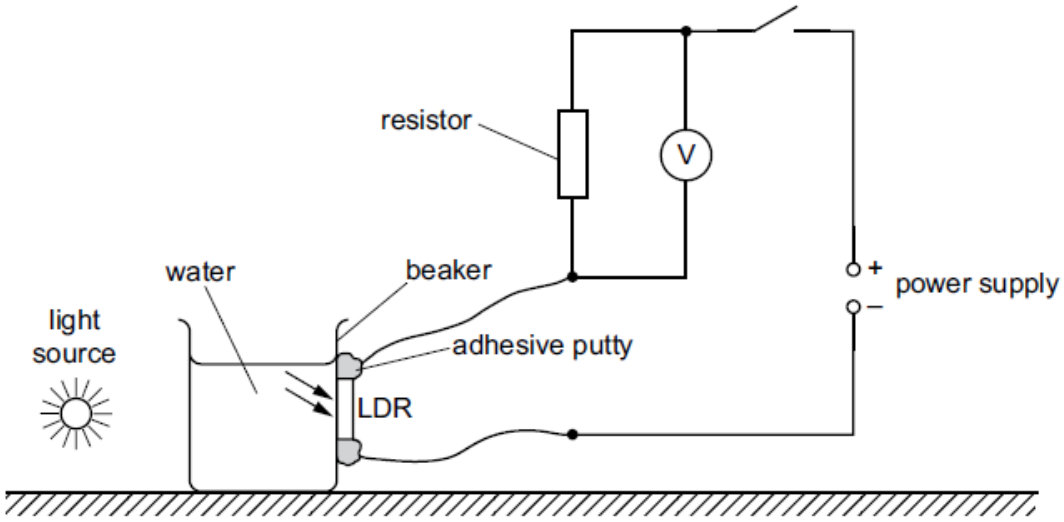


Fig. 1.1

(a) Switch on the light source and close the switch in the electrical circuit.

Measure and record the reading on the voltmeter.

voltmeter reading = ...3.7 ✓..... V [1]

Record your voltmeter reading in the first row of Table 1.1.

Mark awarded = 1 out of 1

Examiner comment

This response is within the acceptable range. This response scores 1 mark.

Question 1(b)

(b) Use the syringe to measure 2 cm^3 of cloudy liquid from the container.

Add this liquid to the water in the beaker and use the stirrer to mix the liquids together.

Record the new voltmeter reading in Table 1.1.

Continue by adding 2 cm^3 of the cloudy liquid to the water at a time, recording each new voltmeter reading in Table 1.1.

Table 1.1

volume of cloudy liquid / cm^3	voltmeter reading / V
0	3.7
2	3.2
4	2.9
6	2.6
8	2.4
10	2.3
12	2.2

[1]

Mark awarded = 1 out of 1

Examiner comment

There are six more readings, decreasing in magnitude and all recorded to the same number of decimal places. This response scores 1 mark.

Common mistakes

Candidates sometimes don't give whole number readings to a consistent number of decimal places e.g. the voltmeter reading for 8 cm^3 might incorrectly be given as 3.

Question 1(c)

(c) On Fig. 1.2, plot a graph of the voltmeter reading against the volume of cloudy liquid.

Draw the best-fit curve.

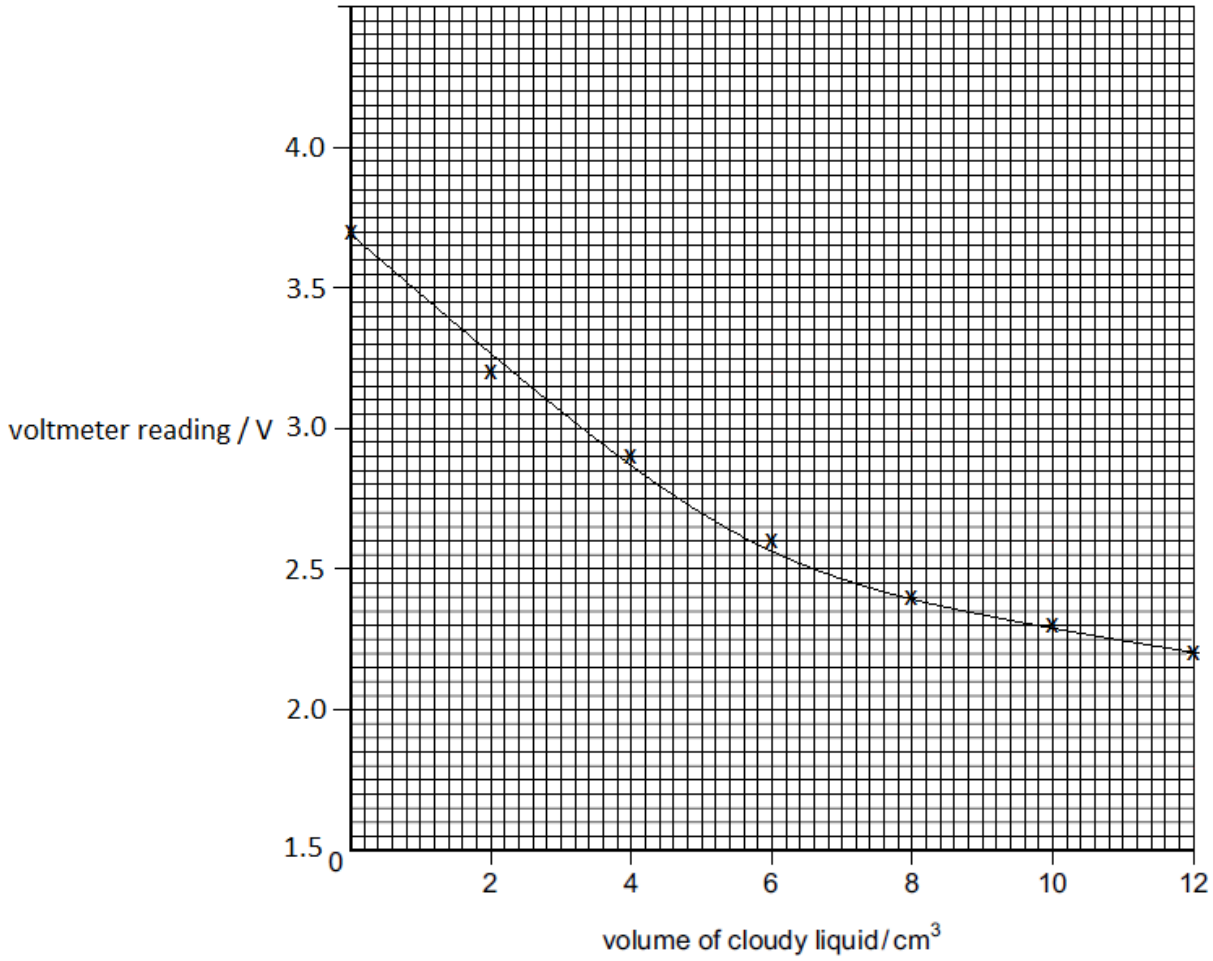


Fig. 1.2 [2]

Mark awarded = 2 out of 2

Examiner comment

All the values from the table are correctly plotted. The curve of best fit always has a negative gradient and 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(d)(i)

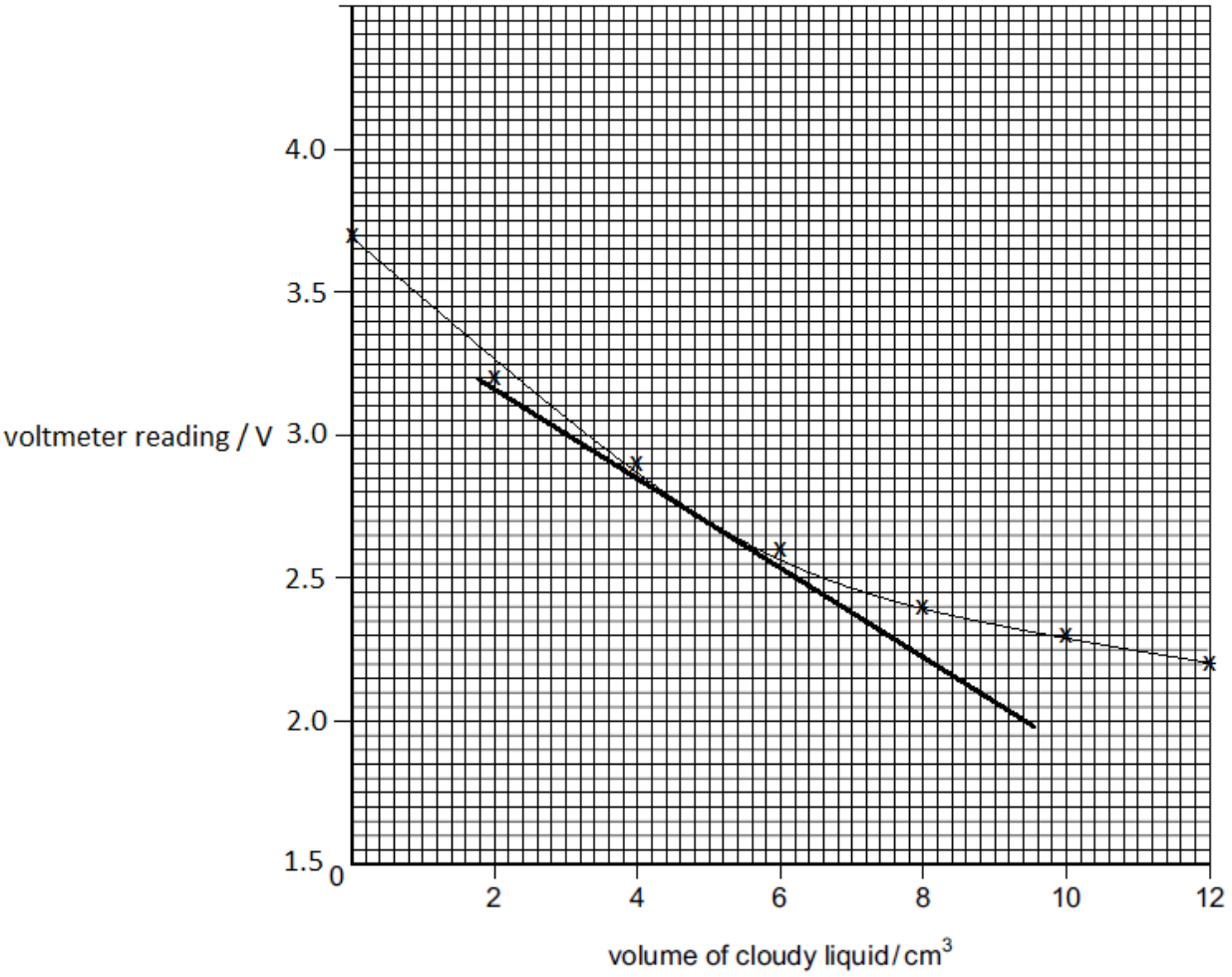


Fig. 1.2 [2]

(d) (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 cm^3. This response scores 1 mark.

Question 1(d)(ii)

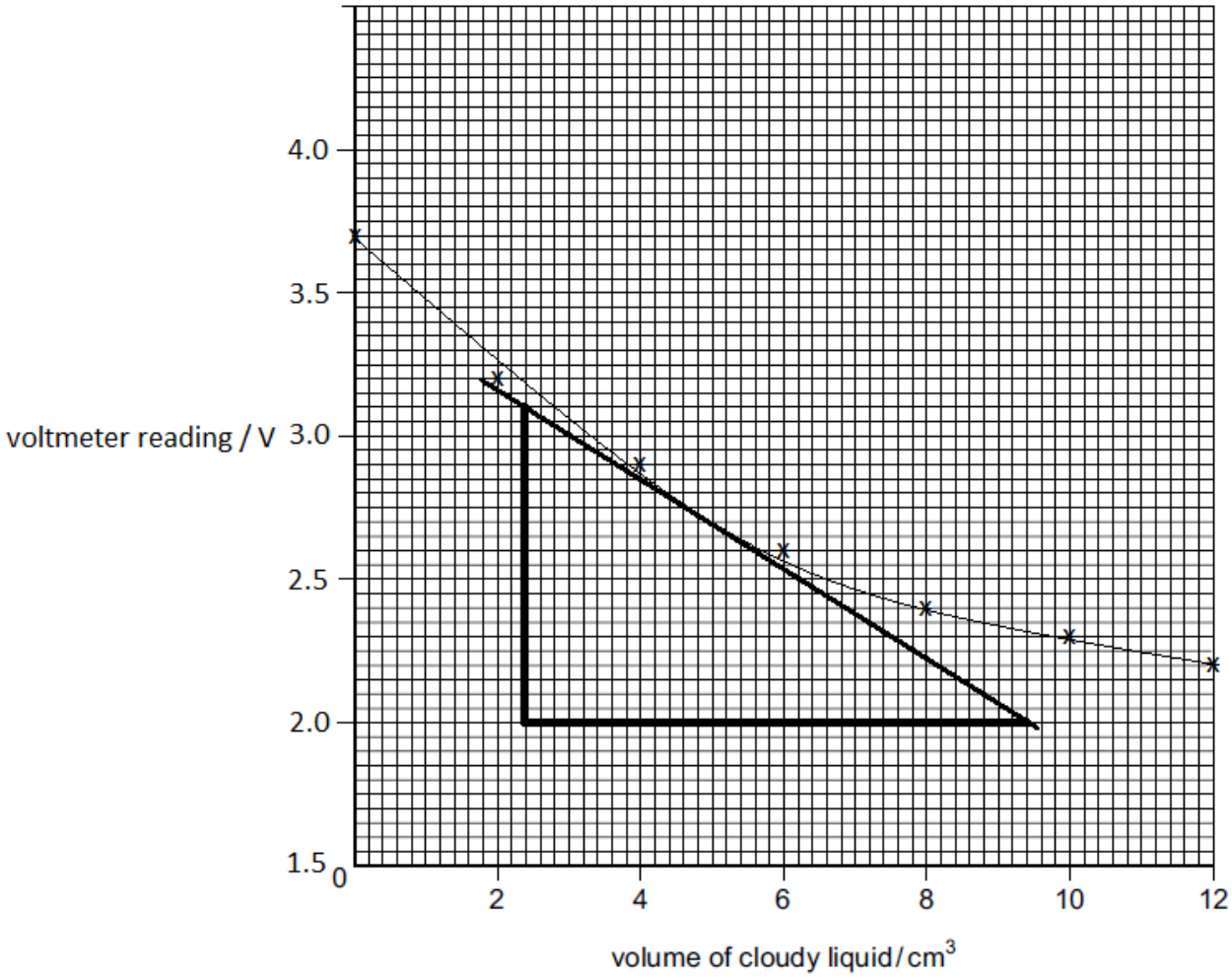


Fig. 1.2 [2]

(d) (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.

$$\frac{\Delta y}{\Delta x} = \frac{3.1-2.0}{2.4-9.4} = \checkmark$$

gradient = ... -0.16 ✓ ..... [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(e)

(e) Describe **one** precaution taken to ensure that the reading from your 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 possible correct answers on the mark scheme. This response scores 1 mark.

Question 1(f)

(f) Another student performs the same experiment. He calculates a gradient which is slightly different to the value you obtained in **(d)(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 In this experiment, you will investigate the effect of two lenses on the size of a shadow.

You are provided with:

- a lamp connected to a power supply
- a lens held in a clamp
- a second lens
- a sheet of graph paper
- a small circular piece of adhesive putty
- a metre rule
- a stand, weight, two clamps and two bosses.

The supervisor has set up the apparatus as shown in Fig. 2.1.

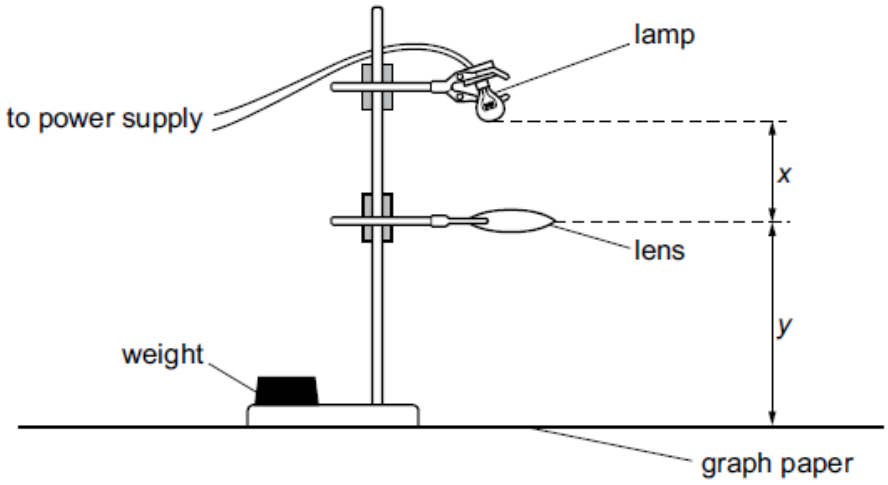


Fig. 2.1

(a) Describe **two** precautions taken 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.

Question 2(b)

(b) Adjust the position of the clamped lens so that distance x is approximately 20 cm.

Switch on the lamp. Place the small piece of adhesive putty on top of the clamped lens, in the centre of the lens.

Observe the circular shadow of the adhesive putty on the graph paper.

Hold the **second** lens under the lamp. The lamp and second lens should be touching.

Move the second lens down to the clamped lens and observe how the diameter D of the shadow of the adhesive putty changes.

On Fig. 2.2 sketch a graph to show how D changes as you move the second lens from the lamp at x = 0 cm to the clamped lens at x = 20 cm.

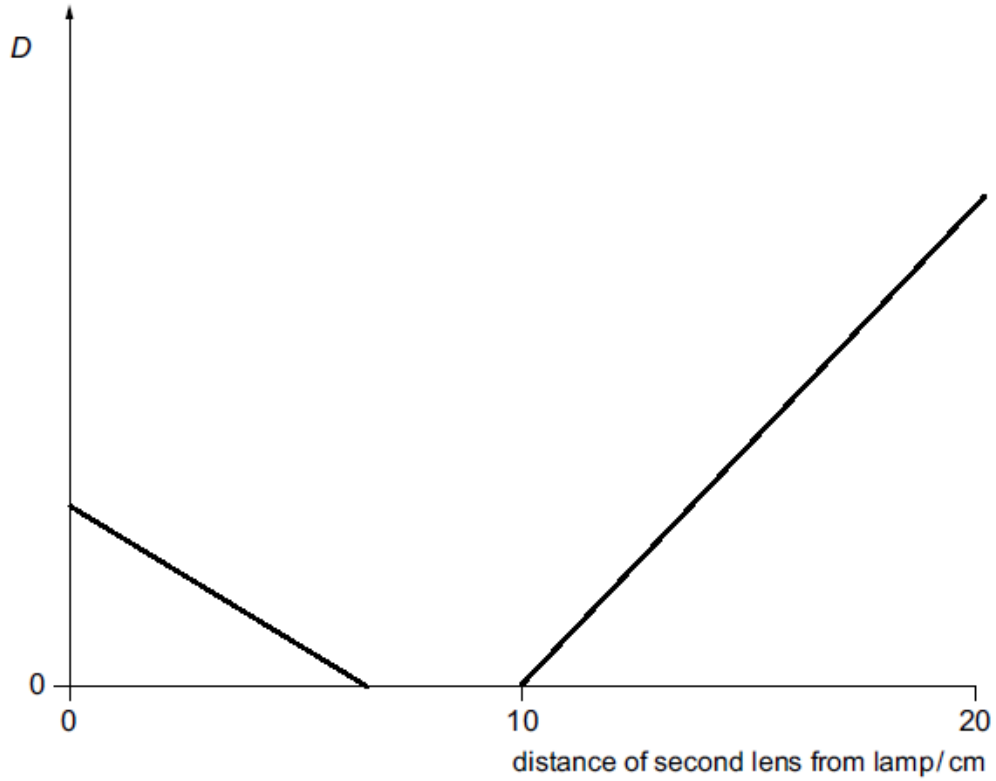


Fig. 2.2 [2]

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) Remove the small piece of adhesive putty from the clamped lens.

Adjust the position of the clamped lens so that the image of the light from the lamp is as small and bright as possible on the graph paper.

You may find that your smallest, brightest image is not in focus.

Measure and record:

the new value of x from the centre of the lens to the centre of the lamp

$x =$ ..... 25.0 ✓cm

the new value of y from the bench to the centre of the lens

$y =$ ..... 36.2 ✓cm
[2]

Mark awarded = 2 out of 2

Examiner comment

Two measurements are recorded with the same resolution as the ruler – i.e. to the nearest mm. This response scores 2 marks.

Question 2(c)(ii)

(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 and your values from **(c)(i)**.

Show your working.

$$f = \frac{25.0 \times 25.0}{25.0 + 25.0} = \checkmark$$

$f =$ ..... 12.5 ✓cm [2]

Mark awarded = 2 out of 2

Examiner comment

Substitution of distances measured in (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 of the clamped lens.

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)(i)

3 In this experiment, you will investigate the oscillation of masses attached to a metre rule.

You are provided with:

- a metre rule
- a G-clamp
- a stopwatch
- a small piece of wood to protect the scale on the rule
- two 100 g masses
- adhesive putty
- a 30 cm ruler.

(a) (i) The diameter *d* and width *w* of **one** of the masses are shown in Fig. 3.1.

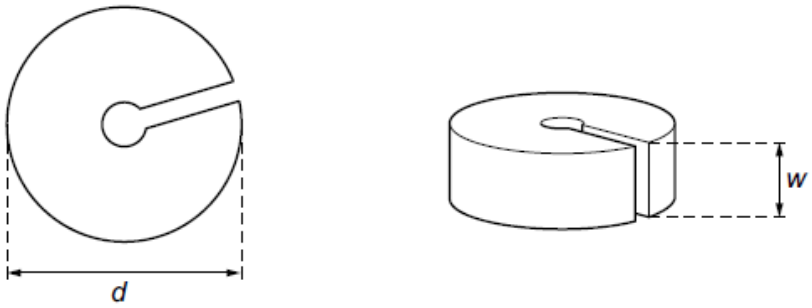


Fig. 3.1

Measure and record *d* and *w* for **one** of the masses provided.

d = ... 3.8 ✓ unit = cm ✓

w = ... 99 ✓ unit = g ✓

[1]

Mark awarded = 1 out of 1

Examiner comment

Direct measurement. This response scores 1 mark.

Question 3(a)(ii)

(ii) Use some of the adhesive putty to attach the two 100 g masses together.

Set up the apparatus as shown in Fig. 3.2 so that approximately 90 cm of the metre rule extends out from the bench. Ensure that the masses are secured to the end of the rule.

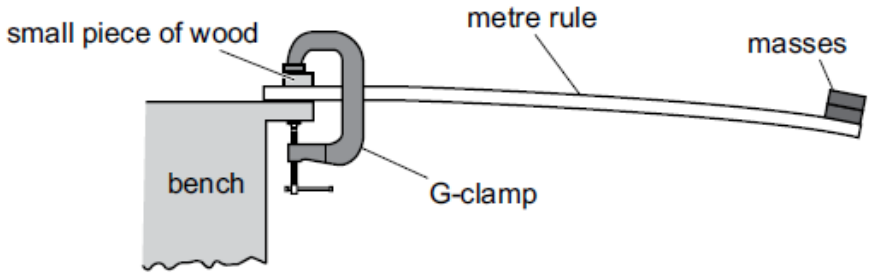


Fig. 3.2

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(a)(iii)

(iii) 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.

Show your working.

Bench stops at 87.9 cm

Masses start at 3.8 cm.

87.9-3.8=84.1 cm

Add half diameter of masses

$84.1+\frac{3.8}{2}=$ ✓

L = 86.0 ✓ cm [2]

Mark awarded = 2 out of 2

Examiner comment

In this response the candidate has clearly labelled what they have measured and shown their working. Two measurements have been taken from the ruler and used to find the distance from the edge of the bench to the left side of the masses. Half the diameter of the masses was added. This response scores 2 marks.

Question 3(b)(i)

(b) Lift the free end of the metre rule until the rule is approximately horizontal.

Release the rule and observe the rule and masses oscillating. One oscillation is when the masses move down and then back up to their starting position.

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

Show your working.

$\frac{10.44}{20} = \checkmark$

t = 0.52 ✓ s [2]

Mark awarded = 2 out of 2

Examiner comment

By showing the division by 20 this candidate has shown they have recorded a time for 20 oscillations. This response scores 2 marks.

Question 3(b)(ii)

(ii) Repeat **(b)(i)** for four more values of *L* by moving the masses along the top surface of the metre rule. Ensure that the masses stick to the rule using the adhesive putty provided.

Record all your readings in Table 3.1.

Add appropriate headings with units to each column.

Table 3.1

L/cm	T for 20/s	T for 1
86	10.44	0.52
76	8.82	0.44
66	7.45	0.37
56	6.81	0.34
46	5.37	0.27

[3]

Mark awarded = 2 out of 3

Examiner comment

This response shows 5 plausible sets of data with the correct trend. However, the candidate has not included the unit in each column heading. This response scores 2 marks.

Question 3(c)

(c) Explain why it is **not** practical 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

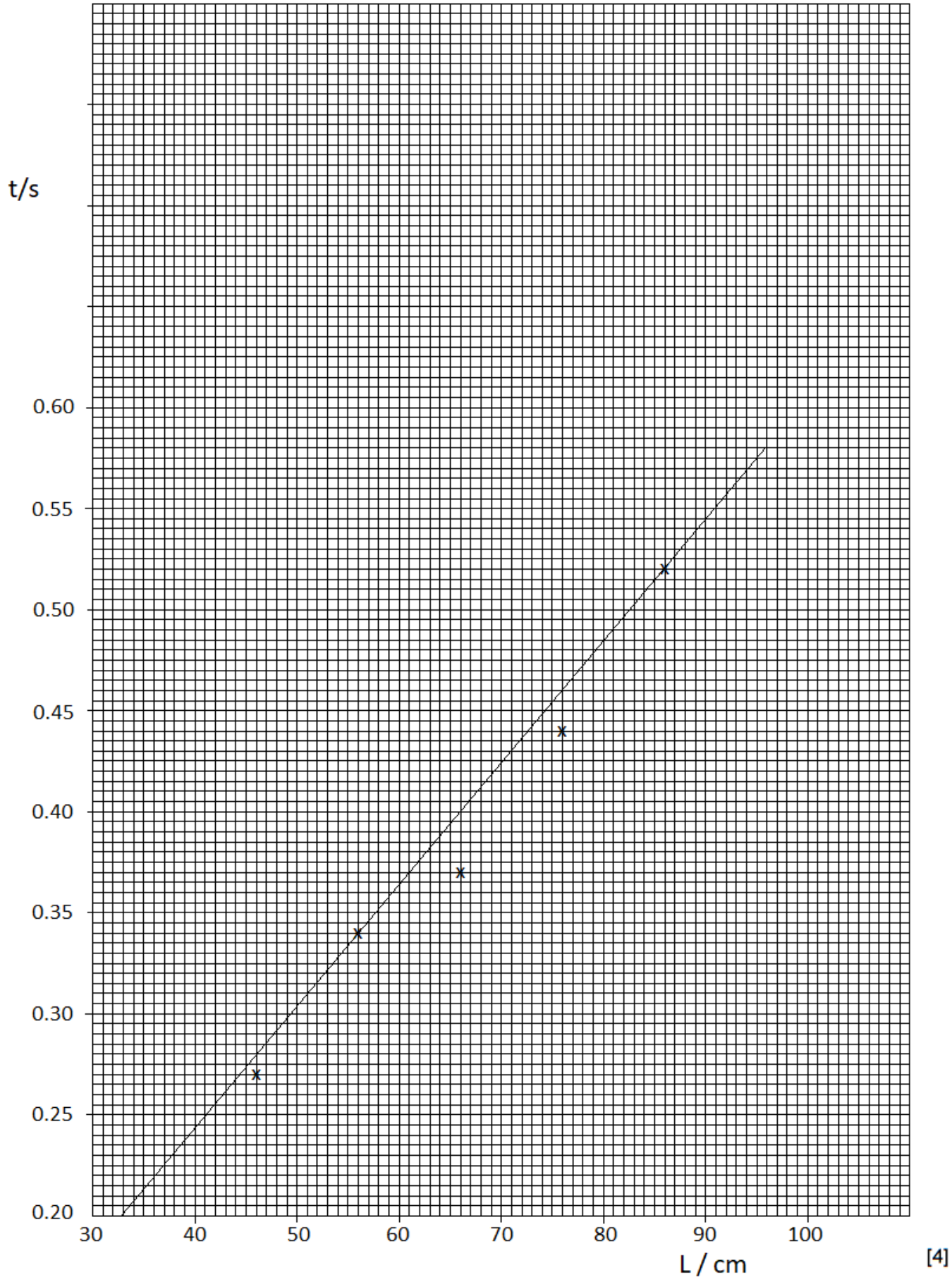
This response has referred to the oscillation being too quick rather than the period of oscillation being too short but the candidate has conveyed their understanding sufficiently with the second half of their sentence. This response scores 1 mark.

Question 3(d)

(d) 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 6 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.

Total mark awarded = 12 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.

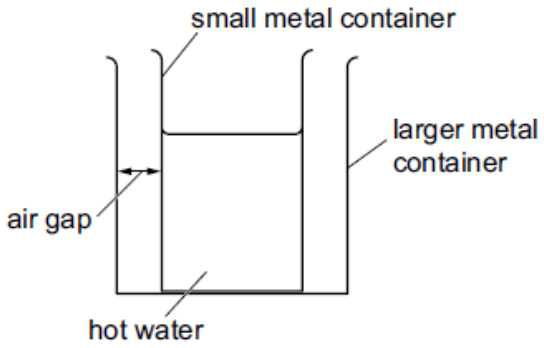


Fig. 4.1

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.

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.....

..... [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.

Common mistakes

A common mistake is not to discuss how the independent variable in the investigation will be changed. The candidate should have said that their method should be repeated with 5 larger outer containers.

Total mark awarded = 5 out of 6

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