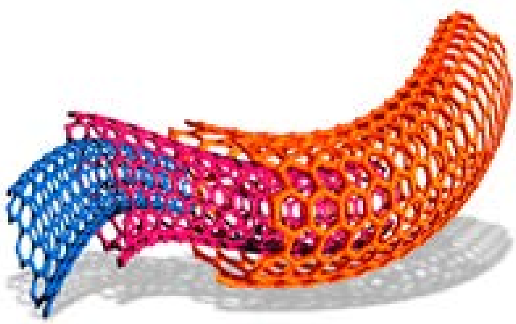
Cambridge Assessment
International Education

Example Candidate Responses
Paper 5

Cambridge IGCSE™
Combined Science 0653

Cambridge O Level
Combined Science 5129

For examination from 2019



Version 1

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE Combined Science 0653 and Cambridge O Level Combined Science 5129, and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen from June 2019 scripts to exemplify a range of answers.

For each question, the response is annotated with a clear explanation of where and why marks were awarded or omitted. This is followed by examiner comments on how the answer could have been improved. In this way, it is possible for you to understand what candidates have done to gain their marks and what they could do to improve their answers. There is also a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work with examiner commentary. These help teachers to assess the standard required to achieve marks beyond the guidance of the mark scheme. Therefore, in some circumstances, such as where exact answers are required, there will not be much comment.

The questions and mark schemes and pre-release material used here are available to download from the School Support Hub. These files are:

June 2019 Question Paper 51

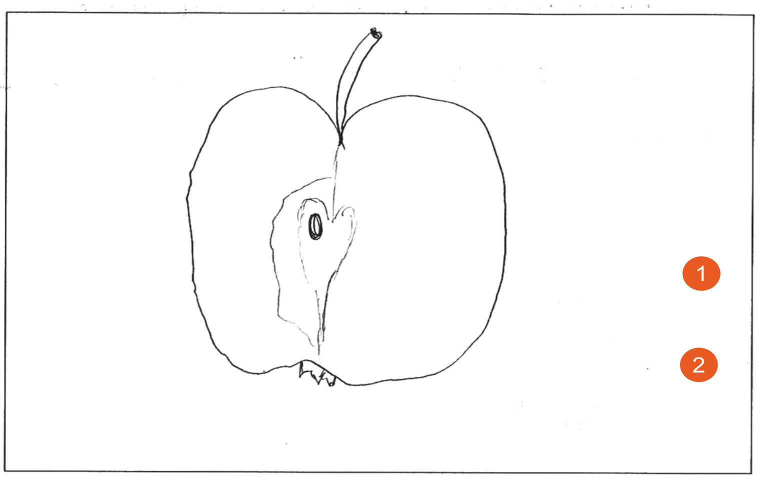
June 2019 Paper 51 Mark Scheme

Past exam resources and other teacher support materials are available on the School Support Hub:

www.cambridgeinternational.org/support

How to use this booklet

This booklet goes through the paper one question at a time, showing you the high-, middle- and low-level response for each question. The candidate answers are set in a table. In the left-hand column are the candidate answers, and in the right-hand column are the examiner comments.

Example Candidate Response – Question 1, high	Examiner comments
 (ii) Use a ruler to measure your drawing, in millimetres, at its widest point and record value. 59 (3)	(1) Outline of apple is a clear continuous pencil line AND the drawing is large (at least half of box filled). This is correct. Mark for (a)(i) = 2 out of 2 (2) Candidate adds detail of the core, including a pip (seed) and some of core outline. This is correct. Mark for (a)(ii) = 1 out of 1 (3) Candidate correctly measures the width of the apple in the drawing and records the

Answers are by real candidates in exam conditions. These show you the types of answers for each level. Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner comments are alongside the answers. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams so you can help your learners to refine their exam technique.

How the candidate could have improved their answer

- **(a)(i)** Candidates were asked to make a large, detailed, drawing. This outline needed to be bigger, using at least half of the box provided.

This section explains how the candidate could have improved each answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

Common mistakes candidates made in this question

- A number of candidates drew feathery and fuzzy outlines to their drawings in **(a)(i)**. In **(a)(ii)**, many candidates did not indicate clearly on their drawing where they were measuring the width. Some also recorded their answer in centimetres not millimetres.

Often candidates were not awarded marks because they misread or misinterpreted the questions.

Lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes and give them the best chance of achieving the available marks.

Question 1

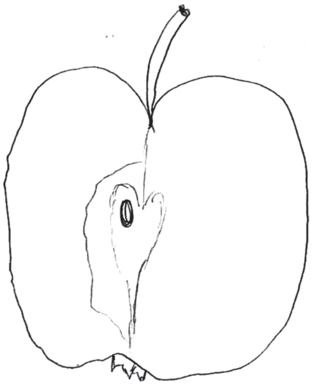
Example Candidate Response – high

1 You are going to investigate the nutrient content of an apple.

(a) You are provided with half of an apple, **A**.

(i) Remove the plastic film from the apple.

In the box, make a large detailed drawing of the **cut surface** of the apple.



1

2

[2]

(ii) Use a ruler to measure your drawing, in millimetres, at its widest point and record this value.

width of apple in drawing = 59 mm 3

Measure the same distance on the half apple, **A**, and record this value.

width of apple **A** = 80 mm

[1]

(iii) Calculate the magnification of your drawing.

Show your working. 4

80 ÷ 59 = 1.36

magnification of drawing = x 1.36 [1]

Examiner Comments

1 Outline of apple is a clear continuous pencil line AND the drawing is large (at least half of box filled). This is correct.

2 Candidate adds detail of the core, including a pip (seed) and some of core outline. This is correct.

Mark for (a)(i) = 2 out of 2

3 Candidate correctly measures the width of the apple in the drawing and records the measurement in millimetres.

Mark for (a)(ii) = 1 out of 1

4 Candidate calculates magnification incorrectly.

Mark for (a)(iii) = 0 out of 1

Example Candidate Response – high, continued	Examiner Comments
(b) • Place the half apple, **A**, on the white tile. Use the knife, with care, to cut two small cubes of apple. The cubes must be small enough to fit into the test-tubes provided. • Place one cube into a test-tube and add two drops of iodine solution. • Place the second cube into another test-tube and add about 1 cm^3 of Benedict's solution. Heat in a water bath for five minutes. (5) **(i)** Record your observations. colour observed after adding iodine solution ....orange........ colour observed after heating with Benedict's solution ..orange /red........ [2] **(ii)** State the conclusions about the nutrient content of an apple that can be made from your observations. ..It doesn't contain starch but does contain.. ..reducing sugars.......... (6) [1] [Total: 7]	(5) Candidate identifies the colours for a negative result with iodine and a positive result with Benedict's solution. Mark for (b)(i) = 2 out of 2 (6) Candidate correctly identifies the nutrients tested for with iodine (starch) and Benedict's (reducing sugar) and correctly interprets the results of the tests; negative test for starch and positive test for reducing sugar. It is important to state both negative and positive conclusions about nutrients. Mark for (b)(ii) = 1 out of 1 **Total mark awarded = 6 out of 7**

How the candidate could have improved their answer

- **(a)(ii)** Candidates were being tested on their ability to measure accurately. The candidate should have marked on their drawing with a line, the width they were measuring.
- **(a)(iii)** The correct formula was: magnification = $\frac{\text{width of drawing}}{\text{width of actual apple}}$.

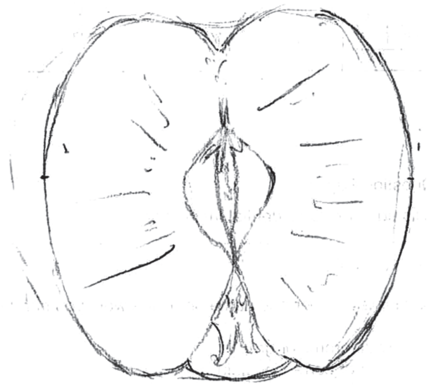
Example Candidate Response – middle

1 You are going to investigate the nutrient content of an apple.

(a) You provided with half of an apple, **A**.

(i) Remove the plastic film from the apple.

In the box, make a large detailed drawing of the **cut surface** of the apple.



1

2

[2]

(ii) Use a ruler to measure your drawing, in millimetres, at its widest point and record this value.

width of apple in drawing = 73 (3) mm

Measure the same distance on the half apple, **A**, and record this value.

width of apple **A** = 71 mm

[1]

(iii) Calculate the magnification of your drawing.

Show your working.

magnification of drawing = ... [1]

Examiner Comments

1 Outline of apple is large enough but is made of multiple pencil strokes, not a single continuous outline.

2 Candidate includes some detail of the core, even although no pips (seeds) are drawn.

Mark for (a)(i) = 1 out of 2

3 Candidate records a correct measurement of the width of the apple drawing in millimetres between the two points marked on their drawing.

Mark for (a)(ii) = 1 out of 1

Mark for (a)(iii) = 0 out of 1

Example Candidate Response – middle, continued	Examiner Comments
(b) • Place the half apple, **A**, on the white tile. Use the knife, with care, to cut two small cubes of apple. The cubes must be small enough to fit into the test-tubes provided. • Place one cube into a test-tube and add two drops of iodine solution. • Place the second cube into another test-tube and add about 1 cm^3 of Benedict's solution. Heat in a water bath for five minutes. **(i)** Record your observations. colour observed after adding iodine solution ...black... colour observed after heating with Benedict's solution ...red / brown... (4) [2] **(ii)** State the conclusions about the nutrient content of an apple that can be made from your observations. After doing the iodine solution, the colour is black which means it's positive, after the [1] Benedict's solution the color is red / brown, which [Total: 7] means it positive, this means that it contains starch and reducing sugars. (5)	(4) Candidate gives a correct colour for positive Benedict's result (red) but also an incorrect colour (brown). Mark for (b)(i) = 1 out of 2 (5) Candidate correctly links black colour of iodine to presence of starch and red colour of Benedict's to presence of reducing sugar. Mark for (b)(ii) = 1 out of 1 **Total mark awarded = 4 out of 7**

How the candidate could have improved their answer

- **(a)(i)** Drawings should always be made with a clear continuous pencil outline and not multiple pencil strokes.
- **(b)(i)** Candidates were expected to know the range of colours for both positive and negative nutrient tests in the syllabus. The inclusion of an incorrect colour for Benedict's solution contradicted the otherwise correct answer 'red'.

Example Candidate Response – low

1 You are going to investigate the nutrient content of an apple.

(a) You are provided with half of an apple, **A**.

(i) Remove the plastic film from the apple.

In the box, make a large detailed drawing of the **cut surface** of the apple.

1

2

[2]

(ii) Use a ruler to measure your drawing, in millimetres, at its widest point and record this value.

width of apple in drawing = ...7.......... mm 3

Measure the same distance on the half apple, **A**, and record this value.

width of apple **A** = ...6.......... mm

[1]

(iii) Calculate the magnification of your drawing.

Show your working. 4

$7 \times 10^6 =$

magnification of drawing = ...7000000.......... [1]

Examiner Comments

1 Candidate's outline is too small.

2 Candidate includes some detail of the apple core with two pips (seeds).

Mark for (a)(i) = 1 out of 2

3 Candidate records the width in centimetres, not millimetres.

Mark for (a)(ii) = 0 out of 1

4 Incorrect method used to calculate magnification.

Mark for (a)(iii) = 0 out of 1

Example Candidate Response – low, continued	Examiner Comments
(b) • Place the half apple, **A**, on the white tile. Use the knife, with care, to cut two small cubes of apple. The cubes must be small enough to fit into the test-tubes provided. • Place one cube into a test-tube and add two drops of iodine solution. • Place the second cube into another test-tube and add about 1 cm^3 of Benedict's solution. Heat in a water bath for five minutes. **(i)** Record your observations. colour observed after adding iodine solution ......Red, black...... 5 colour observed after heating with Benedict's solution ...Blue..... 6 [2] **(ii)** State the conclusions about the nutrient content of an apple that can be made from your observations. ...The nutrient content of an apple is very delicate and... ...changes very quickly.... 7 ..... [1] [Total: 7]	5 'Black' is given the mark for a positive result with iodine. There may have been only small areas of 'black' with other parts of the apple cubes showing the brown iodine colour and so the 'red' is ignored here. 6 A positive result with Benedict's is expected here and so 'blue', the colour for a negative result, is not accepted unless the supervisor's report indicates that the samples used by the centre gave a negative result. Mark for (b)(i) = 1 out of 2 7 This question is testing whether candidates know which nutrients are tested for with iodine and Benedict's solutions. The candidate doesn't indicate which nutrients are present or absent. Mark for (b)(ii) = 0 out of 1 **Total mark awarded = 2 out of 7**

How the candidate could have improved their answer

- **(a)(i)** Candidates were asked to make a large, detailed, drawing. This outline needed to be bigger, using at least half of the box provided.
- **(a)(ii)** Candidates needed to read the question carefully. They were asked to give their answer in millimetres but here, the width had been recorded in centimetres.
- **(b)(i)** To get a negative test result with Benedict's solution suggested that the candidate had not performed the test correctly.
- **(b)(ii)** This question was testing candidates' knowledge of which nutrient was tested for with iodine and Benedict's solutions.

Common mistakes candidates made in this question

- A number of candidates drew feathery and fuzzy outlines to their drawings in **(a)(i)**. In **(a)(ii)**, many candidates did not indicate clearly on their drawing where they were measuring the width. Some also recorded their answer in centimetres not millimetres.
- Incorrect recall of the equation for calculating magnification was the common mistake in **(a)(iii)**.
- **(b)(i)** The test for Benedict's solution had a clear expected range of colours for negative and positive tests, which candidates were expected to know. Where candidates wrote multiples colours, the inclusion of a colour that was not one of those expected for Benedict's solution contradicted a correct colour.
- When candidates were asked to identify nutrients present, they should comment on all the tests carried out, including any that gave negative results. It was important here to say that starch was not present if the iodine test gave a negative result, as well as stating that reducing sugar was present with the invariably positive Benedict's test.

Question 2

Example Candidate Response – high

2 Fig. 2.1 shows a cut stem of the water plant *Elodea* placed in a beaker of water. When light shines on the *Elodea* it photosynthesises, and bubbles of gas are produced.

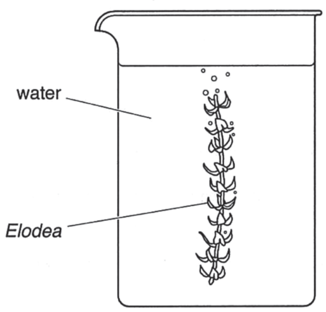


Fig. 2.1

Plan an investigation to find out how the rate of photosynthesis of *Elodea* is affected by the brightness of the light.

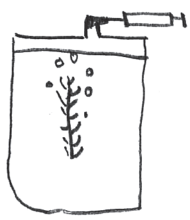
You are not required to carry out this investigation.

In your answer, include:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including how you will treat variables and any safety precautions
- the measurements you will make
- how you will process your results
- how you will use your results to draw a conclusion.

I would use a gas syringe (1) and cover the whole beaker exept the part where I would put the syringe so I would keep using different lamps with different brightnesses (2) but the same water, same plant, same amount of water (3) and same beaker, and same syringe. And everytime the bubbles (sign of photosynthesis) were produced they would go up into the syringe and I would measure how much has the syringe been filled (4) and if it was fuller it meant it had done more photosynthesis (5) I would draw all m

[7]



Examiner Comments

1. Candidate identifies two relevant pieces of apparatus needed in the investigation; a gas syringe and lamp.

2. Credit is awarded as a method mark for recognising the need to vary the brightness of the lamps.

3. Credit is awarded for a second mark in the method and variables section for stating that volume of water should stay the same.

4. Since the candidate has stated that the bubbles go into the syringe 'how much the syringe is filled' is sufficient for credit to be awarded for measuring the volume of gas.

5. The amount of gas produced hasn't been linked to the brightness of the lamp, which is the independent variable.

Total mark awarded = 5 out of 7

How the candidate could have improved their answer

- Marks were awarded in four categories, which linked to the bullet points in the question: apparatus, method and variables, measurements and processing results, and making conclusions. To be awarded full credit, candidates needed to include in their answer something creditworthy from each of these categories.
- The candidate linked the amount the syringe is filled with, to the amount of photosynthesis, but credit here depended on linking the amount of gas produced with the brightness of the lamps used.
- Additional credit for control variables was available for controlling the length of elodea but ‘same plant’ was too vague. Specific environmental controls, e.g. room temperature would also have been accepted. Finally, the candidate could have mentioned the use of a stop-clock or timer.

Example Candidate Response – low

2 Fig. 2.1 shows a cut stem of the water plant *Elodea* placed in a beaker of water. When light shines on the *Elodea* it photosynthesises, and bubbles of gas are produced.

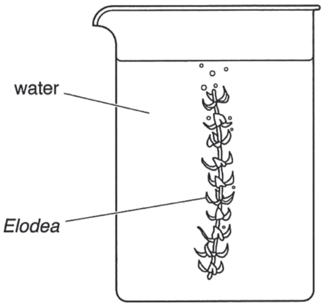


Fig. 2.1

Plan an investigation to find out how the rate of photosynthesis of *Elodea* is affected by the brightness of the light.

You are not required to carry out this investigation.

In your answer, include:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including how you will treat variables and any safety precautions
- the measurements you will make
- how you will process your results
- how you will use your results to draw a conclusion.

For this experiment you need a beeker with clean water inside and the Elodea. The most important variable that can't change is that sun (1) has to be 100% ~~[illegible]~~ shining on the Elodea inside the beaker. There can't ~~[illegible]~~ be anything blocking the top of the beaker (the surface). You also have to be carefull with the beaker, cause it could fall. Anotherthing you need to have in mind is the amount of water, the beaker can't be full of water. The measurements you have to take are how many bubles (2) come out?, how much time did it take for the bubles to come out? In the conclusion you have to include your photosynthesis knolege, what happened, how did it happen? [7]

Examiner Comments

1 A source of light is identified.

2 The candidate identifies the need to count the number of bubbles produced in an amount of time.

Total mark awarded = 2 out of 7

How the candidate could have improved their answer

- This candidate could have been awarded additional credit in the first section, apparatus, by stating that a stop-clock was needed to time the production of bubbles.
- None of the marks available in the second section were credited. The candidate needed to say how they would vary the brightness of the light. They could also have identified variables to be controlled, e.g. amount of water, room temperature.
- In the final section, processing results and making conclusions, the candidate needed to state that they would calculate the number of bubbles per unit time or clearly state that they would compare the rate of bubbles produced with the brightness of the light.

Common mistakes candidates made in this question

- Candidates often used vague statements when identifying variables to be controlled, e.g. ‘control the environment’. Candidates needed to state clearly which variable was to be controlled, e.g. volume of water or length of elodea.
- A number of candidates stated a prediction of what they thought would happen in the investigation, instead of saying how they would draw a conclusion. Other vague statements such as ‘draw a graph of the results and draw a conclusion’ did not give sufficient detail to be awarded credit. For example, candidates needed to state the variables that would be plotted on the graph, e.g. volume of bubbles against intensity of light.

Question 3

Example Candidate Response – high	Examiner Comments

3 You are going to investigate the temperature changes which occur when aqueous copper(II) sulfate reacts separately with excess magnesium and with excess zinc.

(a) Method

1. Use a measuring cylinder to place 25 cm^3 aqueous copper(II) sulfate into the small beaker.
2. Measure the temperature of the aqueous copper(II) sulfate. Record this temperature in Table 3.1 to the nearest 0.5 °C for time = 0.
3. Start the stop-clock and immediately add 2 g magnesium powder, an excess, to the beaker and stir.
4. Measure the temperature every 30 seconds for 5 minutes. Record these temperatures, to the nearest 0.5 °C, in Table 3.1.
5. Pour the mixture into the waste container.
6. Rinse the small beaker with distilled water.

[2]

Table 3.1 (1)

reaction with magnesium	
time / min	temperature / °C
0	20
0.5	40
1.0	60
1.5	66
2.0	66
2.5	64
3.0	61
3.5	60
4.0	58
4.5	57
5.0	56

Table 3.2

reaction with zinc	
time / min	temperature / °C
0	21
0.5	31
1.0	30
1.5	29
2.0	29
2.5	29
3.0	29
3.5	29
4.0	29
4.5	29
5.0	29

(2)

Examiner Comments

(1) All temperatures are recorded in Table 3.1.

The temperatures increase to a maximum value and then decrease.

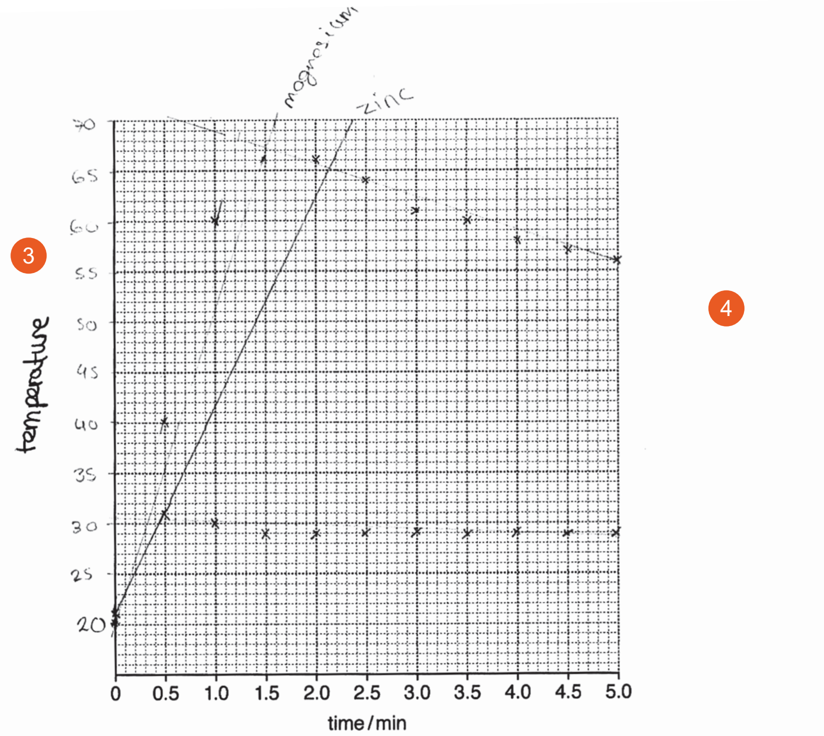
(2) All temperatures are recorded in Table 3.2.

The initial temperature is similar to that of Table 3.1 and the maximum temperature is lower than in Table 3.1.

Mark for (a) = 2 out of 2

Example Candidate Response – high, continued

(b) (i) On the grid provided plot a graph of temperature (vertical axis) against time. [2]



(ii) Draw a best-fit straight line for the **increasing** temperatures only. Extend the line further than the highest point. Label the line magnesium.

5

Draw a best-fit line through the **decreasing** temperatures only. Extend the line back past the highest point. [1]

(iii) The maximum temperature reached by the reaction is where the two lines cross.

State the maximum temperature reached by the reaction.

6

maximum temperature = ...67...... °C [1]

(c) Suggest a value for the maximum temperature reached if 5 g magnesium powder is reacted with 25 cm^3 of the same copper(II) sulfate solution.

(67 ÷ 2) × 5 =

7

maximum temperature = ...167.5...... °C [1]

(d) (i) Repeat steps 1 to 6 in **(a)** using 2 g zinc, an excess, instead of magnesium.

Record the temperatures in Table 3.2. [2]

(ii) Repeat **(b)** for the results for zinc. Draw the graph on the same grid as that used for magnesium. Label this graph zinc.

State the maximum temperature reached by this reaction.

8

maximum temperature = ...30...... °C [2]

Examiner Comments

3 The label for the axis needs to have both temperature and the unit °C.

4 Points are plotted accurately with neat pencil crosses.

Mark for (b)(i) = 1 out of 2

5 The best-fit line through the decreasing temperatures should have a roughly even spread of points either side of the line. This line has almost all points below or on the line and only one point just above the line.

Mark for (b)(ii) = 0 out of 1

6 The value of maximum temperature is recorded correctly as the intersection of the two lines on the candidate's graph.

Mark for (b)(iii) = 1 out of 1

7 Since the method states that 2g of magnesium is an excess, the answer here should be the same as the candidate's answer to (b)(iii).

Mark for (c) = 0 out of 1

8 The lines for Magnesium and Zinc have both been labelled.

The two best-fit lines for Zinc have been drawn and the intersection is recorded correctly (to within 1/2 a small square of candidate's graph).

Mark for (d)(i) = 2 out of 2
Mark for (d)(ii) = 2 out of 2

Example Candidate Response – high, continued	Examiner Comments
(e) Suggest why the maximum temperature for magnesium is different from the maximum temperature for zinc. Because magnesium is a more reactive metal than zinc (9) [1] **(f)** Suggest and explain **one** improvement to the **apparatus** which would increase the accuracy of the maximum temperature. improvement: use a ~~~~ volumetric pipette (10) explanation: it allows more precision whilst measuring volumes [1] [Total: 13]	(9) The candidate has clearly stated that magnesium is more reactive than zinc. Mark for (e) = 1 out of 1 (10) The candidate has identified a piece of apparatus that allows greater precision in measurement than the measuring cylinder used in the method. They also state that it is because of the greater precision that it will give a more accurate value for the maximum temperature. Mark for (f) = 1 out of 1 **Total mark awarded = 10 out of 13**

How the candidate could have improved their answer

- **(b)(i)** The labelling of the vertical axis needed the inclusion of the correct unit to be complete.
- **(b)(ii)** A best-fit line should aim to be near to all the points and with a roughly even spread of points above and below the line. This candidate's line should have been a little lower down, closer to the lowest points and with a few more slightly above the line.
- The correct answer in **(c)** required candidates to realise that using 5g of magnesium did not affect the maximum temperature since 2g magnesium was already an excess, as stated in the method.

Example Candidate Response – middle

3 You are going to investigate the temperature changes which occur when aqueous copper(II) sulfate reacts separately with excess magnesium and with excess zinc.

(a) Method

1. Use a measuring cylinder to place 25 cm^3 aqueous copper(II) sulfate into the small beaker.
2. Measure the temperature of the aqueous copper(II) sulfate. Record this temperature in Table 3.1 to the nearest 0.5 °C for time = 0.
3. Start the stop-clock and immediately add 2 g magnesium powder, an excess, to the beaker and stir.
4. Measure the temperature every 30 seconds for 5 minutes. Record these temperatures, to the nearest 0.5 °C, in Table 3.1.
5. Pour the mixture into the waste container.
6. Rinse the small beaker with distilled water.

1

[2]

Table 3.1

reaction with magnesium	
time / min	temperature / °C
0	~~[illegible]~~ 22°C
0.5	65°C
1.0	65°C
1.5	62°C
2.0	61°C
2.5	60°C
3.0	59°C
3.5	57°C
4.0	55°C
4.5	54°C
5.0	52°C

Table 3.2

reaction with zinc	
time / min	temperature / °C
0	30°C
0.5	33°C
1.0	35°C
1.5	35°C
2.0	34°C
2.5	34°C
3.0	34°C
3.5	34°C
4.0	34°C
4.5	~~34°C~~ 33°C
5.0	~~34°C~~ 32°C

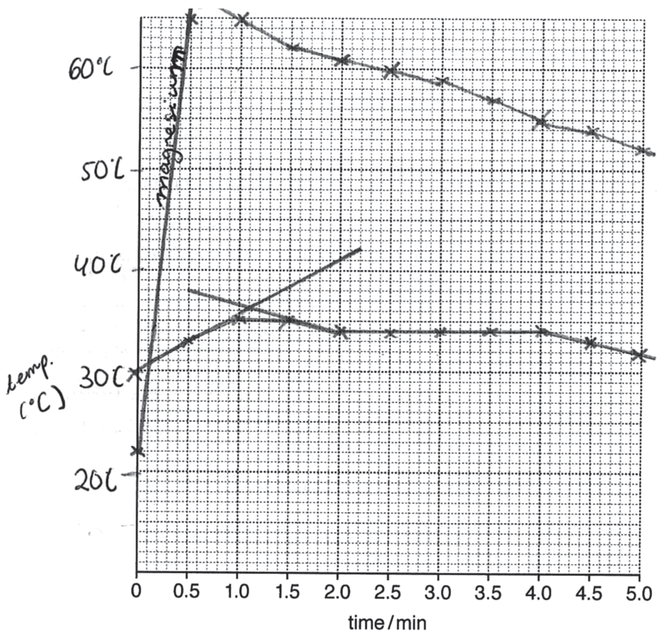
Examiner Comments

1 Table 3.1 includes a full set of results. The temperature increases to a maximum value and then decreases.

Mark for (a) = 2 out of 2

Example Candidate Response – middle, continued

(b) **(i)** On the grid provided plot a graph of temperature (vertical axis) against time. [2]



2

(ii) Draw a best-fit straight line for the **increasing** temperatures only. Extend the line further than the highest point. Label the line magnesium.

Draw a best-fit line through the **decreasing** temperatures only. Extend the line back past the highest point. [1]

3

(iii) The maximum temperature reached by the reaction is where the two lines cross.

State the maximum temperature reached by the reaction.

4

maximum temperature = ...68°C...... °C [1]

(c) Suggest a value for the maximum temperature reached if 5g magnesium powder is reacted with 25 cm³ of the same copper(II) sulfate solution.

5

68/2 + 2·68 =

34 + 136 = 170

maximum temperature = ...170...... °C [1]

(d) **(i)** Repeat steps 1 to 6 in **(a)** using 2g zinc, an excess, instead of magnesium.

6

Record the temperatures in Table 3.2. [2]

(ii) Repeat **(b)** for the results for zinc. Draw the graph on the same grid as that used for magnesium. Label this graph zinc.

7

State the maximum temperature reached by this reaction.

maximum temperature = ... 36°C...... °C [2]

Examiner Comments

2 Vertical axis is clearly labelled with the unit. The scale chosen allows all the points in Table 3.1 to be plotted.

Points are all plotted accurately.

Mark for (b)(i) = 2 out of 2

3 The points have been joined 'dot to dot' with short line segments and not a smooth best-fit line.

Mark for (b)(ii) = 0 out of 1

4 The intersection of the two lines lies above the graph so that candidate cannot record an accurate value for maximum temperature.

Mark for (b)(iii) = 0 out of 1

5 This value should be identical to the candidate's answer in (b)(iii).

Mark for (c) = 0 out of 1

6 Table 3.2 has a full set of results, however, the starting temperature is not similar to the starting temperature in Table 3.1. Since both record the room temperature, the answers should be close to each other.

Mark for (d)(i) = 1 out of 2

7 The candidate is not penalised again for the 'dot to dot' best-fit line and is awarded credit for plotting the points and identifying the intersection of their two lines to show the maximum temperature.

Mark for (d)(ii) = 1 out of 2

Example Candidate Response – middle, continued	Examiner Comments
(e) Suggest why the maximum temperature for magnesium is different from the maximum temperature for zinc. *magnesium is more reactive than zinc as it is higher in the periodic table.* (8) [1] **(f)** Suggest and explain **one** improvement to the **apparatus** which would increase the accuracy of the maximum temperature. improvement *Use a fully clean "new" beaker for each test.* (9) explanation *You make sure it is not contaminated by the first test ~~and so~~ making it the only reactant with the solution.* [1] [Total: 13]	(8) The student clearly states that magnesium is more reactive than zinc. Mark for (e) = 1 out of 1 (9) Students are provided with clean glassware for the experiment and so this is not an improvement. Mark for (f) = 0 out of 1 **Total mark awarded = 7 out of 13**

How the candidate could have improved their answer

- **(b)(ii)** A best-fit line should aim to be near to all the points and with a roughly even spread of points above and below the line. This candidate should have used a ruler to position a best-fit line close to the decreasing temperature values, aiming for all points to be fairly close to the line and an even spread of points above and below the line.
- Candidates should always read through the whole question before starting. In this case, doing so, highlighted that their best-fit lines were going to continue higher than the highest plotted point. Knowing this allowed the candidate to choose a more suitable scale for their graph and allowed them to get an accurate reading of the maximum temperature.
  The correct answer in **(c)** required candidates to realise that using 5g of magnesium did not affect the maximum temperature since 2g magnesium was already an excess, as stated in the method.
- **(d)(i)** Candidates were recording temperatures for a second experiment. If they had followed the instructions correctly, the first temperature value would be roughly the same as in Table 3.1. A tolerance was allowed, in case room temperature had altered slightly, but a difference of 8°C suggested that the instructions had not been followed accurately.
- **(f)** Candidates were being asked to critically evaluate the apparatus and identify a change that could be made to improve the accuracy of the value obtained for maximum temperature. Insulating the beaker to reduce thermal energy loss was one acceptable suggestion here. Other suggestions for using more precise measuring equipment were also acceptable.

Example Candidate Response – low

3 You are going to investigate the temperature changes which occur when aqueous copper(II) sulfate reacts separately with excess magnesium and with excess zinc.

(a) Method

1. Use a measuring cylinder to place 25 cm^3 aqueous copper(II) sulfate into the small beaker.
2. Measure the temperature of the aqueous copper(II) sulfate. Record this temperature in Table 3.1 to the nearest 0.5 °C for time = 0.
3. Start the stop-clock and immediately add 2 g magnesium powder, an excess, to the beaker and stir.
4. Measure the temperature every 30 seconds for 5 minutes. Record these temperatures, to the nearest 0.5 °C, in Table 3.1.
5. Pour the mixture into the waste container.
6. Rinse the small beaker with distilled water.

1 [2]

Table 3.1

reaction with magnesium	
time / min	temperature / °C
0	20,5
0.5	40, 5
1.0	60,5
1.5	60, 5
2.0	60,5
2.5	60, 5
3.0	60,5
3.5	60,
4.0	60
4.5	60
5.0	60

Table 3.2

reaction with zinc	
time / min	temperature / °C
0	20,5
0.5	30
1.0	30
1.5	30
2.0	30
2.5	30,5
3.0	30,5
3.5	30,5
4.0	30, 5
4.5	30,5
5.0	30, 5

2

Examiner Comments

1 Table 3.1 contains a full set of results. They increase to a maximum value and then decrease.

Credit is given to the readings here even although they may not be accurate.

Mark for (a) = 2 out of 2

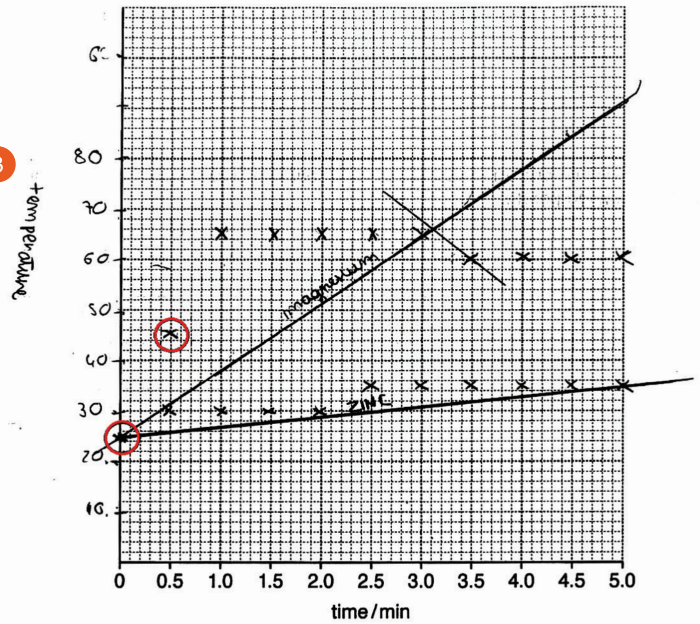
2 Table 3.2 has a full set of values.

The starting temperature is the same as in Table 3.1, however, the values have not started decreasing by the end of the experiment and so, no clear value for the maximum temperature can be identified.

This may be because of candidate error in reading the thermometer and/or recording temperatures, or it may be due to an error in following the instructions in the question.

Example Candidate Response – low, continued

(b) **(i)** On the grid provided plot a graph of temperature (vertical axis) against time. [2]



(ii) Draw a best-fit straight line for the **increasing** temperatures only. Extend the line further than the highest point. Label the line magnesium.

Draw a best-fit line through the **decreasing** temperatures only. Extend the line back past the highest point. [1]

(iii) The maximum temperature reached by the reaction is where the two lines cross.

State the maximum temperature reached by the reaction.

maximum temperature = ...60.5.................... °C [1]

(c) Suggest a value for the maximum temperature reached if 5 g magnesium powder is reacted with 25 cm^3 of the same copper(II) sulfate solution.

maximum temperature = ...151.25.................... °C [1]

(d) **(i)** Repeat steps 1 to 6 in **(a)** using 2 g zinc, an excess, instead of magnesium.

Record the temperatures in Table 3.2. [2]

(ii) Repeat **(b)** for the results for zinc. Draw the graph on the same grid as that used for magnesium. Label this graph zinc.

State the maximum temperature reached by this reaction.

maximum temperature = ...30.5.................... °C [2]

Examiner Comments

3 The label for the axis needs to have both temperature and the unit °C.

4 The plots circled in red have been mis-plotted.

Mark for (b)(i) = 0 out of 2
Mark for (b)(ii) = 0 out of 1

5 From the candidate's graph the intersection of the lines, giving the maximum temperature, is at 66 °C.

Mark for (b)(iii) = 0 out of 1

6 This value should be identical to the candidate's answer in (b)(iii).

Mark for (c) = 0 out of 1

7 The candidate is given credit for labelling the magnesium and zinc.

The candidate draws only one best-fit line for zinc and so there is no intersection of lines at a maximum temperature.

Mark for (d)(i) = 1 out of 2
Mark for (d)(ii) = 1 out of 2

Example Candidate Response – low, continued	Examiner Comments
(e) Suggest why the maximum temperature for magnesium is different from the maximum temperature for zinc. because magnesium ~~is more a higher reater~~ reacts faster, it's a higher reactant (8) [1] **(f)** Suggest and explain **one** improvement to the **apparatus** which would increase the accuracy of the maximum temperature. improvement putting the exact decimal (9) explanation if we put the exact decimal then we will now the exact temperatures and it will be more precise [1] [Total: 13]	(8) 'reacts faster' and 'higher reactant' are not equivalent to saying that magnesium is more reactive or higher up the reactivity series. Mark for (e) = 0 out of 1 (9) The candidate's suggestion is about improving the accuracy of recording results. The question specifically asks for an improvement to the apparatus. Mark for (f) = 0 out of 1 **Total mark awarded = 4 out of 13**

How the candidate could have improved their answer

- Candidates were performing practical experiments in this examination and were being tested on their practical skills, which included reading measuring instruments accurately. To improve, this candidate needed to read the thermometer correctly and also needed to follow the instructions carefully so that the experiment gave plausible results.
- **(b)(i)** The labelling of the vertical axis needed the inclusion of the correct unit to be complete.
- Part **(b)(ii)**, required accurate plotting of the points in the candidate's Table 3.1.
- **(b)(ii)** The candidate's points did not show a clearly decreasing trend, making it difficult for them to reach this conclusion.
- The correct answer in **(c)** required candidates to realise that using 5g of magnesium did not affect the maximum temperature since 2g magnesium was already an excess, as stated in the method.
- In both **(d)(i)** and **(d)(ii)**, the candidate needed to perform the experiment carefully and read the thermometer accurately, gaining a plausible set of results.
- **(e)** Candidates were expected to apply their knowledge of the reactivity series to the experiments they had just done.
- **(f)** Candidates were being asked to critically evaluate the apparatus and identify a change that could be made to improve the accuracy of the value obtained for maximum temperature. Insulating the beaker to reduce thermal energy loss was one acceptable suggestion here. Other suggestions for using more precise measuring equipment were also acceptable.

Common mistakes candidates made in this question

- Many candidates either did not label the vertical axis or included temperature without the unit °C.
- A number of candidates plotted in pen and then made corrections, which made the graph difficult for them to use. This should have been avoided as it also made it difficult for the examiner to read. Candidates should always use a sharpened pencil to plot neat dots or small crosses on their graph.
- Candidates found drawing two separate best-fit lines challenging in this question. Candidates were expected to know that a best-fit line, whether it is a straight line or curve should go smoothly close to all the points and have a roughly equal spread of points on either side of the line or curve. A common mistake in the best-fit line for decreasing temperatures was to join the points 'dot to dot' with short straight-line segments or draw a straight line with all or almost all the points either above or below the line.
- Very few candidates realised that the 2g of magnesium powder was an excess and so the maximum temperature with 5g would be exactly the same.
- In the second experiment, candidates needed to follow the instructions very carefully. In particular, they needed to stir their mixture to ensure that the temperature quickly rose to its maximum value. A number of candidates recorded temperatures that had not started to decrease by the end of the experiment and a few candidates recorded initial temperatures which were significantly different from the first experiment.
- In the final part of the question **(f)**, very few candidates gave an answer that was about improving the apparatus. Those that did, suggested using a more precise piece of measuring equipment needed to give a more detailed answer, e.g. 'use a thermometer that reads to 0.1 degrees as it is more precise'.

Question 4

Example Candidate Response – high

4 You are going to calculate the density of a liquid using two different methods.

You are provided with a balance, a measuring cylinder, a beaker containing liquid **L** and a test-tube.

Method 1

(a) (i) Measure and record the mass m_c of the measuring cylinder to the nearest 0.01 g. (1)

m_c = ...35.93.... g [1]

(ii) Add approximately 75 cm^3 of liquid **L** to the measuring cylinder.

Record the exact volume V_L of liquid **L** to the nearest 0.5 cm^3.
Keep the liquid in the measuring cylinder for **(b)**.

(2)

V_L = ...75.... cm^3 [1]

(iii) Measure and record the total mass of the measuring cylinder and liquid **L**.

(3)

total mass = ...119.53.... g [1]

(iv) Determine the mass m_L of liquid **L**. Use your answers to **(a)(i)** and **(a)(iii)** and the equation shown:

m_L = total mass – m_c

~~119.53 – 35.93~~ 83.6

119.53 – 35.93 = 83.6 (4)

m_L = ...83.6.... g [1]

(v) Calculate the density ρ_L of liquid **L**. Use your answers to **(a)(ii)** and **(a)(iv)** and the equation shown:

$$\rho_L = \frac{m_L}{V_L}$$

$\frac{83.6}{75}$ = 1.11~~48~~

ρ_L = ...1.11.... g/cm^3 [1]

(5)

Method 2

(b) (i) Measure and record the mass m_t of the test-tube to the nearest 0.01 g. (6)

m_t = ...20.06.... g [1]

(ii) Measure the length l_t of the test-tube and the internal diameter d_t of the test-tube each to the nearest 0.1 cm.

(7)

l_t = ...16.2.... cm

d_t = ...1.5.... cm [1]

(iii) Calculate the approximate volume V_t of the test-tube. Use your answers to **(b)(ii)** and the equation shown:

$$V_t = 0.79 \times d_t^2 \times l_t$$

0.79 × 1.5^2 × 16.2
= 28.80 (8)

V_t = ...28.80.... cm^3 [1]

Examiner Comments

(1) A sensible value recorded to the nearest 0.01g.

Mark for (a)(i) = 1 out of 1

(2) Question requires that the volume is recorded to the nearest 0.5 cm^3.

Mark for (a)(ii) = 0 out of 1

(3) Sensible value recorded.

Mark for (a)(iii) = 1 out of 1

(4) Correct calculation using candidate's values.

Mark for (a)(iv) = 1 out of 1

(5) The candidate has performed a correct calculation.

Mark for (a)(v) = 1 out of 1

(6) Sensible value recorded to the nearest 0.01g.

Mark for (b)(i) = 1 out of 1

(7) Both of these are sensible values, recorded to the nearest 0.1 cm.

Mark for (b)(ii) = 1 out of 1

(8) The candidate has performed a correct calculation.

Mark for (b)(iii) = 1 out of 1

Example Candidate Response – high, continued

(iv) Calculate the density ρ_t of the test-tube. Use your answers to **(b)(i)** and **(b)(iii)** and the equation shown:

$$\rho_t = \frac{m_t}{V_t} \qquad \frac{20.06}{28.80} = 0.69 \quad 0.70$$

9

ρ_t = ...0.70.......... g/cm³ [1]

(v) Carefully lower the test-tube into the measuring cylinder of liquid **L** from **(a)** until the test-tube is floating as shown in Fig. 4.1.

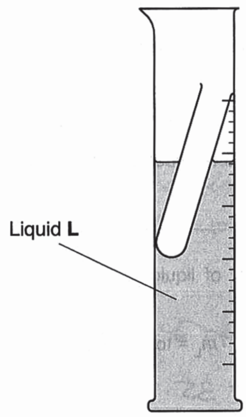


Fig. 4.1

Measure the length of the test-tube l_w that is below the surface of the liquid.
You will need to support the test-tube very gently in an upright position to take this measurement.

10

l_w = ...9.......... cm [1]

(vi) Calculate the density ρ_L of liquid **L**. Use your answers to **(b)(ii)**, **(b)(iv)** and **(b)(v)** and the equation shown:

$$\rho_L = \frac{\rho_t \times l_t}{l_w} \qquad \frac{0.70 \times 16.2}{9} = 1.26$$

ρ_L = ...1.26.......... g/cm³ [1]

11

Examiner Comments

9 The candidate has performed a correct calculation.

Mark for (b)(iv) = 1 out of 1

10 A sensible value is recorded.

Mark for (b)(v) = 1 out of 1

11 Credit is awarded for accuracy in conducting the experiment. The answer, correctly calculated, must be within a certain range of values, 1.05–1.75.

Mark for (b)(vi) = 1 out of 1

Example Candidate Response – high, continued	Examiner Comments
(c) Compare your values of ρ_L in **(a)(v)** and **(b)(vi)**. Suggest whether your two values of ρ_L agree within the limits of experimental error. Explain your answer. They do not agree in the density result, it should be the same density, the unaccuracy of the measuring of the test tube is the variant of the experiment [1] (12) **(d)** Suggest **one** practical difficulty in **method 2** that makes it difficult to get an accurate answer for the density of the liquid. It is difficult to measure precisely the test tube limits and when it's floating around in the measuring cylinder full of solution [1] 1. It can be moved very easily/manipulated. It is not a very reliable source of data. (13) [Total: 13]	(12) Candidates are being asked to compare two values and say whether they are close enough together to be considered equal within the limits of experimental error or not. Mark for (c) = 0 out of 1 (13) Candidate correctly identifies one practical difficulty with obtaining measurements in method 2. Mark for (d) = 1 out of 1 **Total mark awarded = 11 out of 13**

How the candidate could have improved their answer

- **(a)(ii)** Candidates needed to record their value to the nearest $0.5\,cm^3$, as was asked in the question stem.
- **(c)** The candidates were asked to compare two values and say whether they were close enough or too far apart to be considered the same within the limits of experimental error. This candidate's values are 1.11 and 1.26. They stated that these did not agree but also needed to justify this with a suitable reason e.g. 'because rounded to two significant figures they do not have the same value; 1.1 and 1.3'. They could also have suggested that the difference between the numbers was greater than 10% to justify why they did not agree. A minimally acceptable answer would have been that they did not agree because the numbers were too far apart.

Example Candidate Response – middle

4 You are going to calculate the density of a liquid using two different methods.

You are provided with a balance, a measuring cylinder, a beaker containing liquid **L** and a test-tube.

Method 1

(a) **(i)** Measure and record the mass m_c of the measuring cylinder to the nearest 0.01 g. 1

m_c = ...37,62........ g [1]

(ii) Add approximately 75 cm³ of liquid **L** to the measuring cylinder.

Record the exact volume V_L of liquid **L** to the nearest 0.5 cm³.
Keep the liquid in the measuring cylinder for **(b)**.

V_L = ...75........ cm³ [1] 2

(iii) Measure and record the total mass of the measuring cylinder and liquid **L**.

total mass = ...119,6........ g [1]

(iv) Determine the mass m_L of liquid **L**. Use your answers to **(a)(i)** and **(a)(iii)** and the equation shown:

$$m_L = \text{total mass} - m_c$$

119,6 − 75 = 3

m_L = ...44,6........ g [1]

(v) Calculate the density ρ_L of liquid **L**. Use your answers to **(a)(ii)** and **(a)(iv)** and the equation shown: 4

$$\rho_L = \frac{m_L}{V_L}$$

ρL = 44,6 / 75

ρ_L = ...0,6........ g/cm³ [1]

Method 2

(b) **(i)** Measure and record the mass m_t of the test-tube to the nearest 0.01 g.

m_t = ...20,08........ g [1]

(ii) Measure the length l_t of the test-tube and the internal diameter d_t of the test-tube each to the nearest 0.1 cm.

l_t = ...15,8........ cm

d_t = ...1,5........ cm [1]

(iii) Calculate the approximate volume V_t of the test-tube. Use your answers to **(b)(ii)** and the equation shown:

$$V_t = 0.79 \times d_t^2 \times l_t$$

Vt = 0,79 · 1,5² · 15,8

V_t = ...28,1........ cm³ [1]

[Turn over

Examiner Comments

1 Sensible value recorded to the nearest 0.01g.

Mark for (a)(i) = 1 out of 1

2 Volume needs to be recorded to the nearest 0.5 cm³.

Mark for (a)(ii) = 0 out of 1
Mark for (a)(iii) = 1 out of 1

3 Candidate has performed the wrong calculation.

Mark for (a)(iv) = 0 out of 1

4 The answer should be given to a minimum of two significant figures.

Mark for (a)(v) = 0 out of 1

Mark for (b)(i) = 1 out of 2

Mark for (b)(ii) = 1 out of 1

Mark for (b)(iii) = 1 out of 1

Example Candidate Response – middle, continued

(iv) Calculate the density ρ_t of the test-tube. Use your answers to **(b)(i)** and **(b)(iii)** and the equation shown:

$$\rho_t = \frac{m_t}{V_t}$$

$\rho t = \frac{20{,}08}{28{,}01} = 0{,}72$

~~$\rho t = \frac{119{,}67}{167{,}1} = 0{,}72$~~

5

ρ_t = ~~0,72~~ 0,72 g/cm³ [1]

(v) Carefully lower the test-tube into the measuring cylinder of liquid **L** from **(a)** until the test-tube is floating as shown in Fig. 4.1.

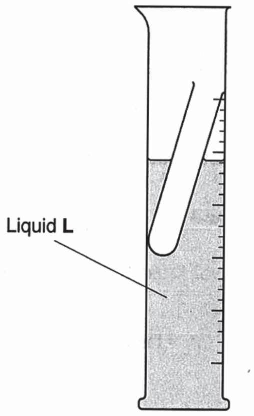


Fig. 4.1

Measure the length of the test-tube l_w that is below the surface of the liquid.
You will need to support the test-tube very gently in an upright position to take this measurement.

l_w = 8,7 cm [1]

(vi) Calculate the density ρ_L of liquid **L**. Use your answers to **(b)(ii)**, **(b)(iv)** and **(b)(v)** and the equation shown:

$$\rho_L = \frac{\rho_t \times l_t}{l_w}$$

$\rho L = \frac{0{,}72 \cdot 15{,}8}{8{,}7} = 1{,}3$

ρ_L = 1,3 g/cm³ [1]

Examiner Comments

5 The candidate has made a transcription error, recording 28.1 as 28.01 which leads to an incorrect calculation.

Mark for (b)(v) = 1 out of 1

Mark for (b)(vi) = 1 out of 1

Example Candidate Response – middle, continued	Examiner Comments
(c) Compare your values of ρ_L in **(a)(v)** and **(b)(vi)**. Suggest whether your two values of ρ_L agree within the limits of experimental error. Explain your answer. .... [1]	Mark for (c) = 0 out of 1
(d) Suggest **one** practical difficulty in **method 2** that makes it difficult to get an accurate answer for the density of the liquid. The fact that we have had to measure the test tube's length and diameter, ~~makes~~ causes that there could be [1] an unaccurate measure. Due to the fact that we use these results in order to find the test tube's volume and later it's density ~~make~~ ~~it's to~~ conse gently can make us arrive to wrong / inaccurate conclusions. 6 [Total: 13]	6 The question asks for a practical difficulty. Mark for (d) = 0 out of 1 **Total mark awarded = 7 out of 13**

How the candidate could have improved their answer

- **(a)(i)** and **(a)(ii)** The candidate needed to read the question carefully and record their measurements to the required degree of precision.
- **(a)(iv)** and **(b)(iv)** Errors have been made by not reading carefully either the question or a previous answer.
- **(a)(v)** Answers should generally have been quoted to at least two significant figures unless a question specifically stated otherwise or the data being used in a calculation was given to less than two significant figures.
- **(d)** The candidate needed to suggest a practical difficulty in making the measurements in method 2, e.g. 'it is difficult to measure the length of the test-tube because it has a rounded bottom'.

Example Candidate Response – low	Examiner Comments
4 You are going to calculate the density of a liquid using two different methods. You are provided with a balance, a measuring cylinder, a beaker containing liquid **L** and a test-tube. **Method 1** **(a)** **(i)** Measure and record the mass m_c of the measuring cylinder to the nearest 0.01 g. m_c = ...16,96.................. g [1]	Mark for (a)(i) = 1 out of 1
(ii) Add approximately 75 cm³ of liquid **L** to the measuring cylinder. Record the exact volume V_L of liquid **L** to the nearest 0.5 cm³. Keep the liquid in the measuring cylinder for **(b)**. V_L = ...75.......................... cm³ [1]	Mark for (a)(ii) = 0 out of 1
(iii) Measure and record the total mass of the measuring cylinder and liquid **L**. 120,59 + 16,96 = total mass = ...137,55.................. g [1] (1)	(1) This value is a measurement from the balance used in the experiment and not a calculation. Mark for (a)(iii) = 0 out of 1
(iv) Determine the mass m_L of liquid **L**. Use your answers to **(a)(i)** and **(a)(iii)** and the equation shown: 120,59 − 36,55 m_L = total mass − m_c m_L = ...84,04.............. g [1] (2) **(v)** Calculate the density ρ_L of liquid **L**. Use your answers to **(a)(ii)** and **(a)(iv)** and the equation shown: $\frac{84,04}{75}$ = $\rho_L = \frac{m_L}{V_L}$ ρ_L = ...1,12.................. g/cm³ [1]	(2) The answer here is calculated from candidate's answers in (a)(i) and (a)(iii). Mark for (a)(iv) = 0 out of 1 Mark for (a)(v) = 1 out of 1
Method 2 **(b)** **(i)** Measure and record the mass m_t of the test-tube to the nearest 0.01 g. m_t = ...16,96.................. g [1]	Mark for (b)(i) = 1 out of 1
(ii) Measure the length l_t of the test-tube and the internal diameter d_t of the test-tube each to the nearest 0.1 cm. l_t = ...16.......................... cm d_t = ...1,5.......................... cm [1]	Mark for (b)(ii) = 1 out of 1
(iii) Calculate the approximate volume V_t of the test-tube. Use your answers to **(b)(ii)** and the equation shown: $V_t = 0.79 \times d_t^2 \times l_t$ V_t = ...28,44.................. cm³ [1] **[Turn over**	Mark for (b)(iii) = 1 out of 1

Example Candidate Response – low, continued

(iv) Calculate the density ρ_t of the test-tube. Use your answers to **(b)(i)** and **(b)(iii)** and the equation shown:

$$\rho_t = \frac{m_t}{V_t}$$

3

ρ_t = ...0,59...................... g/cm^3 [1]

(v) Carefully lower the test-tube into the measuring cylinder of liquid **L** from **(a)** until the test-tube is floating as shown in Fig. 4.1.

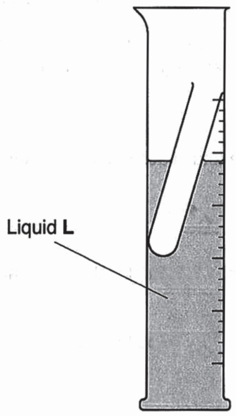


Fig. 4.1

Measure the length of the test-tube l_w that is below the surface of the liquid.
You will need to support the test-tube very gently in an upright position to take this measurement.

4

l_w = ...25.............................. cm [1]

(vi) Calculate the density ρ_L of liquid **L**. Use your answers to **(b)(ii)**, **(b)(iv)** and **(b)(v)** and the equation shown:

$$\rho_L = \frac{\rho_t \times l_t}{l_w}$$

5

ρ_L = ...0,37......................... g/cm^3 [1]

Examiner Comments

3 Candidate has incorrectly rounded their answer. Based on the candidate's values, the answer to two significant figures is 0.60.

Mark for (b)(iv) = 0 out of 1

4 An answer that is longer than the total length of the test-tube is not reasonable.

Mark for (b)(v) = 0 out of 1

5 Credit here is given for performing the experiment carefully and getting an answer within the range 1.05–1.75.

Mark for (b)(vi) = 0 out of 1

Example Candidate Response – low, continued	Examiner Comments
(c) Compare your values of ρ_L in **(a)(v)** and **(b)(vi)**. Suggest whether your two values of ρ_L agree within the limits of experimental error. Explain your answer. 6 Yes, Both results have sense, because .... [1]	6 The candidate's values, 1.12 and 0.37 are too far apart to be considered equal within the limits of experimental error. Mark for (c) = 0 out of 1
(d) Suggest **one** practical difficulty in **method 2** that makes it difficult to get an accurate answer for the density of the liquid. .... [1] [Total: 13]	Mark for (d) = 0 out of 1 **Total mark awarded = 5 out of 13**

How the candidate could have improved their answer

- **(a)(ii)** Candidates needed to record their value to the nearest $0.5cm^3$, as was asked in the question stem.
- **(b)(iv)** If the question did not specify the number of significant figures in the answer, then an answer of two or three significant figures was equally acceptable. However, if the candidate rounded their answer they had to do so correctly, in this case rounding 0.596 to 0.60.
- **(b)(v)** Candidates were asked to measure the length of the test-tube below the surface of the liquid. A reasonable answer could not be larger than the total length of the test-tube, which suggested that this candidate had mis-read their ruler or misunderstood the instruction in the question.

Common mistakes candidates made in this question

- Many candidates did not record answers in **(a)(i)** or **(a)(ii)** to the degree of accuracy specified in the question. It was vital that candidates read questions carefully and followed the instructions explicitly.
- A number of candidates made rounding errors when recording the results of calculations in several question parts.

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