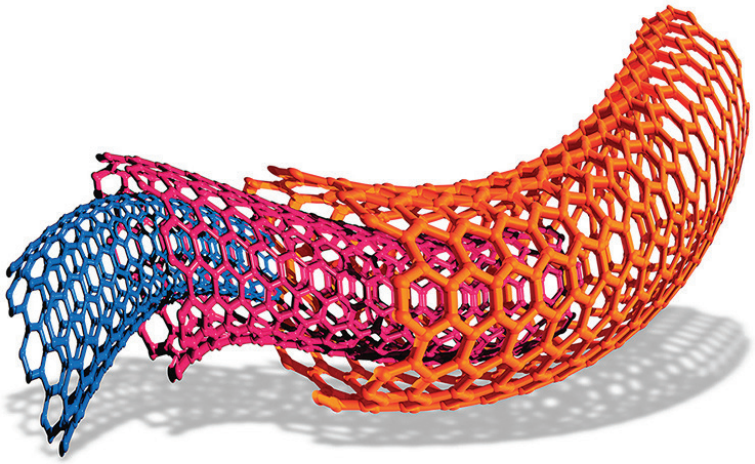
Cambridge Assessment International Education

Example Candidate Responses
Paper 6

Cambridge IGCSE®
Chemistry 0620

For examination from 2016



Version 2.0

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching IGCSE Chemistry (0620), 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 to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, response is annotated with clear explanation of where and why marks were awarded or omitted. This, in turn, 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 will have to do to improve their marks. At the end there is a list of common mistakes candidates made in their answers for each question.

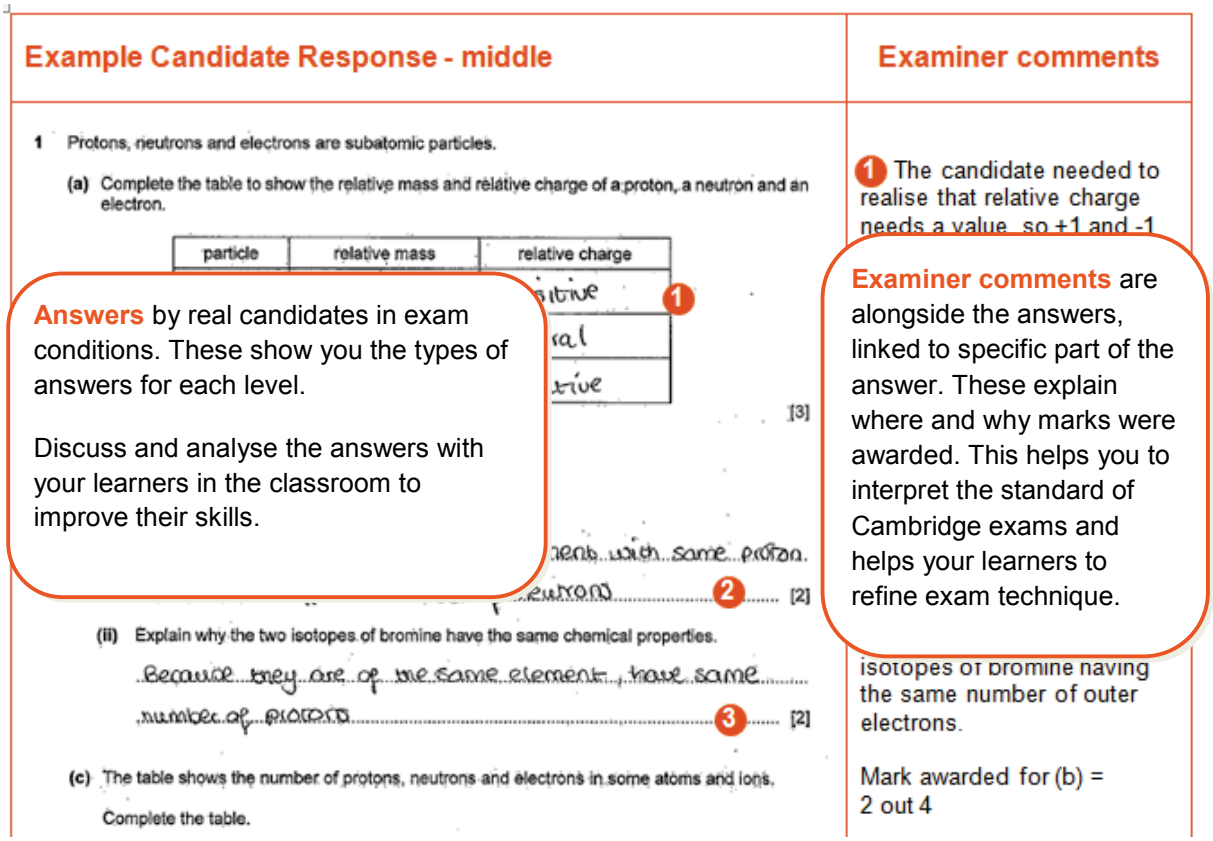
This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

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

Question Paper 31, June 2016	
Question paper	0620_s16_qp_31.pdf
Mark scheme	0620_s16_ms_31.pdf
Question Paper 41, June 2016	
Question paper	0620_s16_qp_41.pdf
Mark scheme	0620_s16_ms_41.pdf
Question Paper 61, June 2016	
Question paper	0620_s16_qp_61.pdf
Mark scheme	0620_s16_ms_61.pdf

Other past papers, Examiner Reports and other teacher support materials are available on the School Support Hub at www.cambridgeinternational.org/support

How to use this booklet



Example Candidate Response - middle

Examiner comments

1 Protons, neutrons and electrons are subatomic particles.

(a) Complete the table to show the relative mass and relative charge of a proton, a neutron and an electron.

particle	relative mass	relative charge
		itive
		ral
		tive

[3]

(ii) Explain why the two isotopes of bromine have the same chemical properties.

Because they are of the same element, have same number of protons [2]

(c) The table shows the number of protons, neutrons and electrons in some atoms and ions.

Complete the table.

1 The candidate needed to realise that relative charge needs a value, so +1 and -1

isotopes of bromine having the same number of outer electrons.

Mark awarded for (b) = 2 out 4

Answers 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, linked to specific part of the answer. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams and helps your learners to refine exam technique.

How the candidate could have improved the answer

(b) (ii) The candidate needed to realise than positive and negative for proton an

(c) The candidate failed to include the m

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

Common mistakes candidates made in this question

(a) Failing to give *relative* masses and *relative* cha

(b) (i) Failing to recall that isotopes are *atoms*.

(b) (ii) Failing to state that it is the number of outer

This describes the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes at the exam and give them the best chance of achieving a high mark.

Assessment at a glance

All candidates must enter for three papers.

Core candidates take:	Extended candidates take:
Paper 1 45 minutes A multiple-choice paper consisting of 40 items of the four-choice type. This paper will test assessment objectives AO1 and AO2. Questions will be based on the Core syllabus content. This paper will be weighted at 30% of the final total mark.	**Paper 2** 45 minutes A multiple-choice paper consisting of 40 items of the four-choice type. This paper will test assessment objectives AO1 and AO2. Questions will be based on the Extended syllabus content (Core and Supplement). This paper will be weighted at 30% of the final total mark.
and:	**and:**
Paper 3 1 hour 15 minutes A written paper consisting of short-answer and structured questions. This paper will test assessment objectives AO1 and AO2. Questions will be based on the Core syllabus content. 80 marks This paper will be weighted at 50% of the final total mark.	**Paper 4** 1 hour 15 minutes A written paper consisting of short-answer and structured questions. This paper will test assessment objectives AO1 and AO2. Questions will be based on the Extended syllabus content (Core and Supplement). 80 marks This paper will be weighted at 50% of the final total mark.

All candidates take	
either:	**or:**
Paper 5 1 hour 15 minutes Practical Test This paper will test assessment objective AO3. Questions will be based on the experimental skills in Section 7. The paper is structured to assess grade ranges A*–G. 40 marks This paper will be weighted at 20% of the final total mark.	**Paper 6** 1 hour Alternative to Practical This paper will test assessment objective AO3. Questions will be based on the experimental skills in Section 7. The paper is structured to assess grade ranges A*–G. 40 marks This paper will be weighted at 20% of the final total mark.

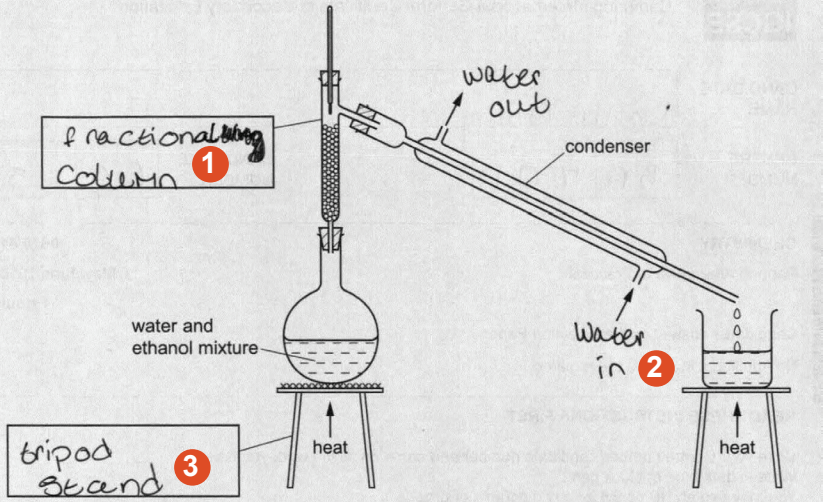
Teachers are reminded that the latest syllabus is available on our public website at www.cambridgeinternational.org and the School Support Hub at www.cambridgeinternational.org/support

Paper 6 – Alternative to Practical

Question 1

Example Candidate Response – Question 1, High	Examiner comments

1 The diagram shows the apparatus used to separate a mixture of water, boiling point 100 °C, and ethanol, boiling point 78 °C.



(a) Complete the boxes to name the apparatus. [2]

(b) Label the arrows on the condenser. [1]

(c) Identify **one** mistake in the apparatus.

applying heat to beaker 4 [1]

(d) Which liquid would collect first? Explain your answer.

ethanol water's
water; its boiling point is lower than ethanols,
boiling point
~~was 100°C for other boiling points were higher~~ 5 [2]

(e) Why would it be better to use an electrical heater instead of a Bunsen burner to heat the water and ethanol mixture?

ethanol is flammable 6 [1]

[Total: 7]

1 The mark scheme has 'fractionating column' but the answer given is close enough to score a mark

2 'Water' is all that was required for each of these labels, but the answers given are still better.

3 The word 'tripod' alone scores the mark but the word 'stand' alone would not.

Mark awarded for (a) =
2 out of 2

Mark awarded for (b) =
1 out of 1

4 The candidate does not use the wording in the mark scheme, but it is clear from their answer that they understand this.

Mark awarded for (c) =
1 out of 1

5 An incorrect answer has been crossed out and replaced with the correct one. It is important that incorrect answers are completely deleted by candidates. If two conflicting answers are given, no marks are scored.

Mark awarded for (d) =
2 out of 2

6 Almost the exact words on the mark scheme. It was not necessary for the candidate to state that an electrical heater would avoid the risk of fire.

Mark awarded for (e) =
1 out of 1

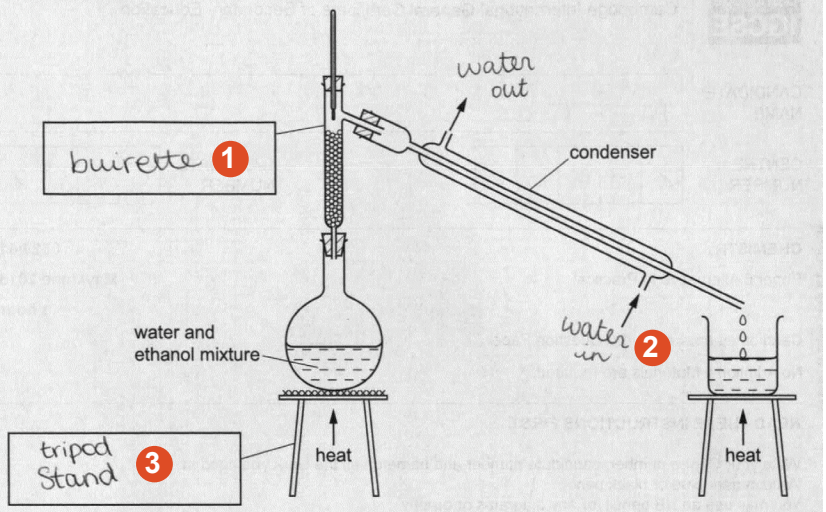
Total mark awarded =
7 out of 7

How the candidate could have improved the answer

(a) The correct name is ‘fractionating column’ but the answer given was close enough for a mark. The word ‘stand’ with ‘tripod’ was not really necessary.

Example Candidate Response – Question 1, Middle

1 The diagram shows the apparatus used to separate a mixture of water, boiling point 100 °C, and ethanol, boiling point 78 °C.



(a) Complete the boxes to name the apparatus. [2]

(b) Label the arrows on the condenser. [1]

(c) Identify **one** mistake in the apparatus.

heat applied to condensed liquid 4 [1]

(d) Which liquid would collect first? Explain your answer.

ethanol , it has a lower boiling point 5

[2]

(e) Why would it be better to use an electrical heater instead of a Bunsen burner to heat the water and ethanol mixture?

you can choose the exact temperature 6 [1]

[Total: 7]

Examiner comments

1 The candidate gives the name of a piece of apparatus with a similar shape but is clearly not familiar with the name specified in the mark scheme.

2 No problems here. The word 'water' would have sufficed but there is nothing wrong with the answer given. Simply labelling 'in' and 'out' would not have scored marks.

3 The word 'stand' is superfluous and would not have scored marks if used alone.

Mark awarded for (a) =
1 out of 2

Mark awarded for (b) =
1 out of 1

4 The mark scheme has 'heat applied under the beaker', but, since the beaker contains the condensed liquid, it is clear what the candidate means and the answer is still judged to be correct.

Mark awarded for (c) =
1 out of 1

5 A straightforward answer which almost exactly matches the mark scheme.

Mark awarded for (d) =
2 out of 2

6 It is true that an electrical heater allows the choice of a particular temperature. This is, however, not important in this experiment and it is not the reason given in the mark scheme.

Mark awarded for (e) =
0 out of 1

Total mark awarded =
5 out of 7

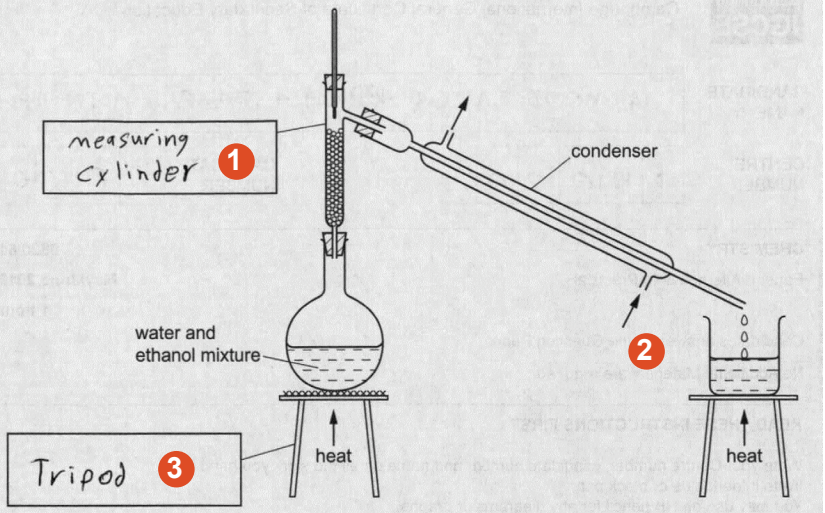
How the candidate could have improved the answer

(a) The piece of apparatus looks similar to a burette but isn't one. The candidate needed to give the correct name here.

(c) The candidate should have used the wording in the mark scheme which has 'heat applied under the beaker' or something similar, but, since the beaker contains the condensed liquid, this answer was allowed.

Example Candidate Response – Question 1, Low

1 The diagram shows the apparatus used to separate a mixture of water, boiling point 100 °C, and ethanol, boiling point 78 °C.



(a) Complete the boxes to name the apparatus. [2]

(b) Label the arrows on the condenser. [1]

(c) Identify **one** mistake in the apparatus. [1]

~~Water and ethanol mixture~~ Heat applied on collecting burrette. ~~Heat in the~~ 4

(d) Which liquid would collect first? Explain your answer. [2]

Water, because it will get seperated from ethanol. 5

(e) Why would it be better to use an electrical heater instead of a Bunsen burner to heat the water and ethanol mixture? [1]

For accurate heating. 6

[Total: 7]

Examiner comments

1 The candidate appears not to know the name of this piece of apparatus, perhaps because they haven't seen or done this experiment.

2 No answer given here. Candidates sometimes fail to answer questions which do not involve writing an answer on a line.

3 Correct and to the point.

Mark awarded for (a) =
1 out of 2

Mark awarded for (b) =
0 out of 1

4 Here the candidate has deleted a correct answer only to replace it with a wrong one. The use of the word 'burette' makes it wrong even though the word 'collecting' has been added. It is not wise for candidates to use words which they don't understand.

Mark awarded for (c) =
0 out of 1

5 The initial answer is wrong here, and so the reason, although there is some truth in it, cannot be correct either. Again, the candidate appears to be unfamiliar with this experiment.

Mark awarded for (d) =
0 out of 2

6 An electrical heater may result in 'accurate heating' but this is not the reason why it is used in this case.

Mark awarded for (e) =
0 out of 1

Total mark awarded =
1 out of 7

How the candidate could have improved the answer

The candidate was clearly unfamiliar with this experiment. It is in the syllabus and it is essential that candidates attempting this paper have had experience of practical work. This paper is NOT an alternative to practical work but an alternative way of assessing practical work.

Common mistakes candidates made in this question

(e) The commonest wrong answer to this question was stating that the electrical heater was used to provide accurate heating, rather than because ethanol is flammable.

Question 2

Example Candidate Response – Question 2, High	Examiner comments

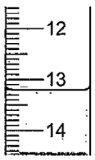
2 A student investigated the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, **A** and **B**.
The reaction is:

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Three experiments were carried out.

(a) *Experiment 1*

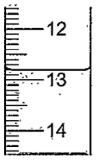
Using a measuring cylinder, 25 cm^3 of aqueous sodium carbonate were poured into a conical flask.
Thymolphthalein indicator was added to the conical flask.
A burette was filled up to the 0.0 cm^3 mark with solution **A** of dilute hydrochloric acid. **A** was added to the flask, until the solution just changed colour.
Use the burette diagram to record the reading in the table.



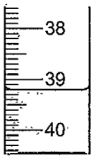
final reading

Experiment 2

Experiment 1 was repeated using methyl orange indicator instead of thymolphthalein.
Methyl orange is red-orange in acidic solutions and yellow in alkaline solutions.
Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

	experiment 1	experiment 2
final burette reading / cm^3	13.2	39.2
initial burette reading / cm^3	0.0	12.8
difference / cm^3	13.2	26.4

[4]

Mark awarded for (a) = 4 out of 4

Example Candidate Response – Question 2, High	Examiner comments

(b) What colour change was observed in the flask in experiment 2?

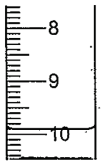
from ..yellow.. to ..orange.. [1]

Mark awarded for (b) = 1 out of 1

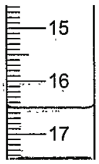
(c) *Experiment 3*

Experiment 1 was repeated using solution **B** of acid instead of solution **A**.

Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

	experiment 3
final burette reading / cm³	16.5
initial burette reading / cm³	9.9
difference / cm³	6.6

[2]

Mark awarded for (c) = 2 out of 2

(d) Suggest **one** observation, other than colour change, that is made when hydrochloric acid is added to sodium carbonate.

..Effervescence and bubbles of a colourless gas.. (carbon dioxide) [1]

Mark awarded for (d) = 1 out of 1

(e) Complete the sentence below.

Experiment ..2.. needed the largest volume of hydrochloric acid to change the colour of the indicator. [1]

Mark awarded for (e) = 1 out of 1

(f) What would be a more accurate method of measuring the volume of the aqueous sodium carbonate?

..using a burette.. [1]

Mark awarded for (f) = 1 out of 1

1 Parts (a) to (f) are all correct.

Example Candidate Response – Question 2, High

(g) What would be the effect on the results, if any, if the solutions of sodium carbonate were warmed before adding the hydrochloric acid? Give a reason for your answer.

effect on results ..... ~~decrease~~ NO change .....

reason ..... the heard to decompose sodium (reactive metal) ..... [2]

(h) (i) Determine the ratio of volumes of dilute hydrochloric acid used in experiments 1 and 3.

..... Experiment 3 used double volume of experiment 2 ~~1:1~~ 2:1 [1]

(ii) Use your answer to **(h)(i)** to deduce how the concentration of solution **A** differs from that of solution **B**.

..... solution A is more concentrated (double) than solution B [1]

(i) Suggest a **different** method, using standard laboratory chemicals, to determine which of the solutions of dilute hydrochloric acid, **A** or **B**, is more concentrated.

..... Using the same mass and particle size of a reactive metal (e.g. magnesium), add each to a separate conical flask. Add a known volume of solution A (25cm³) to the first conical flask and measure the rate of gas (hydrogen) production over a period of time, repeat with solution B (same volume of 25cm³) in the other flask, measure the rate of gas production over the same time, compare. One that produced more gas at time interval has more concentrated acid solution. [3]

[Total: 17]

Examiner comments

2 'No change' is correct but the reason given does not really apply. The candidate is perhaps implying that the concentration of the carbonate is not changed as a result, but this is not explicit.

Mark awarded for (g) =
1 out of 2

3 The candidate gives the ratio as 2:1 but an answer written as words would still have scored the mark.

4 The candidate has spotted that this means a twofold difference in concentrations but, unfortunately, has not thought this through and gives the wrong acid as the more concentrated.

Mark awarded for (h) =
1 out of 2

5 Correct reactants.

6 There is nothing about how the rate will be measured: timing, counting bubbles, etc.
One mark lost.

7 The candidate fails to explain a way to determine which solution is the more concentrated.

Mark awarded for (i) =
2 out of 3

Total mark awarded =
14 out of 17

How the candidate could have improved the answer

(g) The candidate could have improved their answer by giving the correct reason here. The answer included a correct chemical concept but it was not relevant to this problem.

(h) (ii) It is quite a common error to conclude that if more of a solution is used, it is more concentrated, whereas the opposite is the case.

(i) The candidate should have included more detail, in what was a correct answer, to gain full marks.

Example Candidate Response – Question 2, Middle

Examiner comments

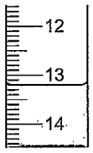
2 A student investigated the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, **A** and **B**.
The reaction is:

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Three experiments were carried out.

(a) *Experiment 1*

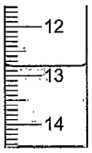
Using a measuring cylinder, 25 cm^3 of aqueous sodium carbonate were poured into a conical flask.
Thymolphthalein indicator was added to the conical flask.
A burette was filled up to the 0.0 cm^3 mark with solution **A** of dilute hydrochloric acid. **A** was added to the flask, until the solution just changed colour.
Use the burette diagram to record the reading in the table.



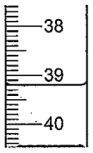
final reading

Experiment 2

Experiment 1 was repeated using methyl orange indicator instead of thymolphthalein.
Methyl orange is red-orange in acidic solutions and yellow in alkaline solutions.
Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

	experiment 1	experiment 2
final burette reading / cm^3	14.8 cm^3	40.8 cm^3
initial burette reading / cm^3	0.0 cm^3	13.2 cm^3
difference / cm^3	14.8 cm^3	27.6 cm^3

[4]

1 The candidate is reading the scales as if they were measuring cylinders and clearly hasn't looked at the next main division in either case. Only the differences are correct.

Mark awarded for (a) = 2 out of 4

Example Candidate Response – Question 2, Middle

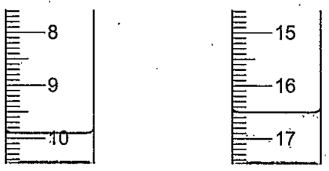
(b) What colour change was observed in the flask in experiment 2?

from ..yellow.. to ..red-orange.. [1]

(c) *Experiment 3*

Experiment 1 was repeated using solution **B** of acid instead of solution **A**.

Use the burette diagrams to record the readings in the table and complete the table.



initial reading final reading

	experiment 3
final burette reading/cm³	17.6cm³ ~~10.1~~
initial burette reading/cm³	10.1 cm³
difference/cm³	7.4cm³

[2]

(d) Suggest **one** observation, other than colour change, that is made when hydrochloric acid is added to sodium carbonate.

..a gas is formed.. [1]

(e) Complete the sentence below.

Experiment ..2.. needed the largest volume of hydrochloric acid to change the colour of the indicator. [1]

(f) What would be a more accurate method of measuring the volume of the aqueous sodium carbonate?

..using a volumetric pipette.. [1]

Examiner comments

2 Correct.

Mark awarded for (b) = 1 out of 1

3 Same error as in part (a).

Mark awarded for (c) = 1 out of 2

4 True, but no marks are scored here as this is not an observation. How would the gas be seen?

Mark awarded for (d) = 0 out of 1

Mark awarded for (e) = 1 out of 1

Mark awarded for (f) = 1 out of 1

Example Candidate Response – Question 2, Middle	Examiner comments
(g) What would be the effect on the results, if any, if the solutions of sodium carbonate were warmed before adding the hydrochloric acid? Give a reason for your answer. effect on results The reaction would be fast. reason There are particles with the activation energy 5 [2] **(h) (i)** Determine the ratio of volumes of dilute hydrochloric acid used in experiments 1 and 3. 2 : 1 [1] **(ii)** Use your answer to **(h)(i)** to deduce how the concentration of solution **A** differs from that of solution **B**. Solution A is twice the concentration of solution B 6 [1] **(i)** Suggest a **different** method, using standard laboratory chemicals, to determine which of the solutions of dilute hydrochloric acid, **A** or **B**, is more concentrated. You could react it with a base. You let take 20mg of Sodium Carbonate and then add 5a 40cm³ of Sample A of an HCl 7 and then note the time. You repeat this for the other sample of the acid 8 bu then Compare the time, so that the fastest is more Concentrated than the other One. 9 [3] [Total: 17]	5 A common wrong answer. The candidate knows the reaction would speed up and explains why, but does not state how the result (i.e. the volumes measured) would be affected. Mark awarded for (g) = 0 out of 2 6 The ratio in part (i) is correct but this result is misinterpreted. Only 1 mark. Mark awarded for (h) = 1 out of 2 7 These are correct reactants as a titration is not being used. 8 'Note the time' for what? No marks here. If 'bubbles collecting a gas' or 'waiting till effervescence stops' had been mentioned the answer would have scored full marks. 9 This is a correct way of deciding which is more concentrated. Mark awarded for (i) = 2 out of 3 **Total mark awarded = 9 out of 17**

How the candidate could have improved the answer

(a) and **(c)** The candidate read the scales as if they were using a measuring cylinder. A closer look at the values given on the scales would have made this careless error obvious.

(d) The candidate's answer was factually correct but did not constitute an observation, just a fact. The candidate needed to say how the gas would be seen.

(g) Again the candidate's answer was true, but this speeding-up would not affect the final results. The candidate needed to say how the result (i.e. the volumes measured) would be affected.

(h) (ii) The same error as the highest scoring candidate.

(i) A correct answer but not containing sufficient detail to score full marks. The candidate needed to mention 'bubbles collecting a gas' or 'waiting till effervescence stopped'.

Example Candidate Response – Question 2, Low

Examiner comments

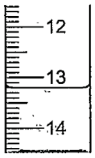
2 A student investigated the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, **A** and **B**.
The reaction is:

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Three experiments were carried out.

(a) *Experiment 1*

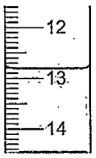
Using a measuring cylinder, 25 cm^3 of aqueous sodium carbonate were poured into a conical flask.
Thymolphthalein indicator was added to the conical flask.
A burette was filled up to the 0.0 cm^3 mark with solution **A** of dilute hydrochloric acid. **A** was added to the flask, until the solution just changed colour.
Use the burette diagram to record the reading in the table.



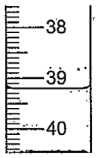
final reading

Experiment 2

Experiment 1 was repeated using methyl orange indicator instead of thymolphthalein.
Methyl orange is red-orange in acidic solutions and yellow in alkaline solutions.
Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

	experiment 1	experiment 2
final burette reading / cm^3	13.2	39.2
initial burette reading / cm^3	0	12.8
difference / cm^3	13.2	26.4

[4]

1 Correct readings are given here, but the lack of the .0 in the initial reading for experiment 1 loses a mark.

Mark awarded for (a) =
3 out of 4

Example Candidate Response – Question 2, Low

(b) What colour change was observed in the flask in experiment 2?

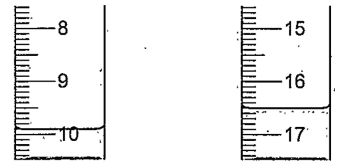
from ..Red - orange.. to ..Yellow.. [1]

2

(c) *Experiment 3*

Experiment 1 was repeated using solution **B** of acid instead of solution **A**.

Use the burette diagrams to record the readings in the table and complete the table.



initial reading final reading

	experiment 3
final burette reading / cm³	16.5
initial burette reading / cm³	9.9
difference / cm³	6.6

[2]

(d) Suggest **one** observation, other than colour change, that is made when hydrochloric acid is added to sodium carbonate.

..(Fizz) Bubbles are formed.. [1]

(e) Complete the sentence below.

Experiment ..3.. needed the largest volume of hydrochloric acid to change the colour of the indicator. [1]

3

(f) What would be a more accurate method of measuring the volume of the aqueous sodium carbonate?

..~~Measuring cylinder~~ Pipette.. [1]

4

Examiner comments

2 This is the correct colour change but in the wrong direction, so no mark.

Mark awarded for (b) = 0 out of 1

Mark awarded for (c) = 2 out of 2

Mark awarded for (d) = 1 out of 1

3 It is not clear why the candidate has chosen experiment 3 as the answer here.

Mark awarded for (e) = 0 out of 1

4 The candidate has realised that a measuring cylinder would have been less accurate here.

Mark awarded for (f) = 1 out of 1

Example Candidate Response – Question 2, Low

(g) What would be the effect on the results, if any, if the solutions of sodium carbonate were warmed before adding the hydrochloric acid? Give a reason for your answer.

effect on results ..... Different temperature

reason ..... the sodium carbonate ~~is should be eat~~ will react faster

5 [2]

(h) (i) Determine the ratio of volumes of dilute hydrochloric acid used in experiments 1 and 3.

19.8 6 [1]

(ii) Use your answer to **(h)(i)** to deduce how the concentration of solution **A** differs from that of solution **B**.

The ratio of ~~B~~ solution A is higher and more concentrated. 7 [1]

(i) Suggest a **different** method, using standard laboratory chemicals, to determine which of the solutions of dilute hydrochloric acid, **A** or **B**, is more concentrated.

Using ~~Conical flask~~ Burrette and thymolphthalein indicator and ~~add~~ adding dilute ~~hydroc~~ hydrochloric acid and the more acidic solution is the more concentrated and we can know that by the red ~~or~~ ~~color~~ ~~orang~~ or orange color. 8 [3]

[Total: 17]

Examiner comments

5 The candidate has misunderstood the question.

Mark awarded for (g) =
0 out of 2

6 The candidate doesn't understand the concept of ratio and has simply added the two values together.

7 Again, the candidate doesn't understand about concentrations.

Mark awarded for (h) =
0 out of 2

8 This seems to be a mixture of two methods, neither of which merits marks. Using thymolphthalein as an indicator is just another titration, but towards the end the candidate seems to suggest using universal indicator to measure pH and thus identify the more concentrated solution. This just wouldn't work even if it were properly explained.

Mark awarded for (i) =
0 out of 3

Total mark awarded =
7 out of 17

How the candidate could have improved the answer

(a) The candidate did not give 0.0 as the initial reading.

(b) The candidate gave the correct colour change but the wrong way round.

(e) Since the candidate correctly identified all the volumes, it is unclear why they picked the wrong answer here.

(g) The candidate could have improved their answer by reading the question more carefully. The answer given just did not answer the question.

(h) The candidate clearly did not understand the meaning of 'ratio'.

(i) The candidate explained a method (titration) which is essentially the same as that originally used. A different method was requested.

Common mistakes candidates made in this question

(i) Many candidates suggested using the same method again with different substances. Candidates should understand that the method is independent of the substances used. A titration is always a titration.

Question 3

Example Candidate Response – Question 3, High

3 Two substances, **C** and **D**, were analysed. Solid **C** was a salt and solution **D** was an aqueous solution of chromium(III) chloride.
The tests on solid **C**, and some of the observations, are in the following table.

tests	observations
tests on solid **C** Solid **C** was added to distilled water in a test-tube and shaken to dissolve. The solution was divided into two portions in test-tubes, and the following tests carried out. Appearance of the solution. The pH of the first portion of the solution was tested.	 colourless liquid pH = 7
Dilute nitric acid was added to the second portion of the solution followed by aqueous silver nitrate.	cream precipitate
A flame test was carried out on solid **C**.	yellow flame colour

(a) Identify solid **C**.

Sodium Bromide 1 ..... [2]

(b) Describe the appearance of solution **D**.

green colour solution 2 ..... [1]

(c) Tests were carried out on solution **D**.

Complete the observations for tests 1, 2 and 3.

(i) test 1

Drops of aqueous sodium hydroxide were added to solution **D**.

Excess aqueous sodium hydroxide was then added to the mixture.

observations green precipitate soluble in excess so aqueous sodium hydroxide 3 ..... [3]

Examiner comments

1 A perfect answer. A correct chemical formula would also have gained full marks.
The marks are separate so either 'sodium' or 'bromide' alone or coupled with another ion would gain a single mark.
Mark awarded for (a) =
2 out of 2

2 'Chromium' is not in the main body of the syllabus. This is a practical paper and any candidate who has done the ion tests would, like this candidate, know the correct answer.

Mark awarded for (b) =
1 out of 1

3 Again a perfect answer, repeating what is included in the 'Tests for ions' section of the syllabus.

Example Candidate Response – Question 3, High	Examiner comments

(ii) test 2

Excess aqueous ammonia was added to solution **D**.

observations grey-green precipitate insoluble in excess [2] 4

(iii) test 3

Dilute nitric acid was added to solution **D** followed by aqueous silver nitrate.

observations White precipitate 5 [1]

(d) Chromium(III) can be converted to chromium(VI). Chromium(VI) is hazardous.

Suggest **one** safety precaution when using chromium(VI).

Wear gloves 6 [1]

[Total: 10]

NaOH — green ppt — soluble

NH₄OH — grey-green — insoluble

C — Salt soluble no transition bromide ion. Na

D — solution chromium(III) chloride 7

4 Here 'grey-green' is important as this is the description of the colour given in the syllabus.

5 A perfect answer.

Mark awarded for (c) = 6 out of 6

6 This is the best answer to this question, as chromium (VI) is harmful to the skin. However, as the candidate is not expected to know this, other safety precautions would also have been accepted.

Mark awarded for (d) = 1 out of 1

7 These notes from the candidate show how they made sure of getting their answers correct.

Total mark awarded = 10 out of 10

How the candidate could have improved the answer

This candidate achieved full marks.

Example Candidate Response – Question 3, Middle

Examiner comments

3 Two substances, **C** and **D**, were analysed. Solid **C** was a salt and solution **D** was an aqueous solution of chromium(III) chloride.
The tests on solid **C**, and some of the observations, are in the following table.

tests	observations
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Dilute nitric acid was added to the second portion of the solution followed by aqueous silver nitrate.	cream precipitate
A flame test was carried out on solid **C**.	yellow flame colour

(a) Identify solid **C**.

bromide ion [2]

(b) Describe the appearance of solution **D**.

blue liquid [1]

(c) Tests were carried out on solution **D**.

Complete the observations for tests 1, 2 and 3.

(i) **test 1**

Drops of aqueous sodium hydroxide were added to solution **D**.

Excess aqueous sodium hydroxide was then added to the mixture.

observations green precipitate, which is soluble in excess [3]

1 The candidate gains a single mark for correctly identifying the bromide ion but has not taken account of the flame test which gives sodium as the other ion.

Mark awarded for (a) =
1 out of 2

2 If the candidate had carried out the ion tests described in the syllabus, they would know that the colour is green even though the metal chromium and its compounds are not mentioned elsewhere in the syllabus.

Mark awarded for (b) =
1 out of 1

3 The candidate has correctly learned this test and its result. Full marks.

Example Candidate Response – Question 3, Middle

(ii) **test 2**

Excess aqueous ammonia was added to solution **D**.

observations green precipitate which is insoluble [2]

4

(iii) **test 3**

Dilute nitric acid was added to solution **D** followed by aqueous silver nitrate.

observations White precipitate which is soluble [1]

5

(d) Chromium(III) can be converted to chromium(VI). Chromium(VI) is hazardous.

Suggest **one** safety precaution when using chromium(VI).

~~Using it in a fume cupboard and~~ wearing. [1]

gloves and goggles while using ~~it~~ it.

6

[Total: 10]

Examiner comments

4 The candidate knows this precipitate is insoluble and so gains one of the marks here. However, the 'Tests for ions' section of the syllabus describes the colour as grey-green and this was the description required to gain a mark.

5 The candidate knows that this test yields a white precipitate. However, they wrongly state that it is soluble and this cancels out the mark gained. Had the candidate simply stated 'white precipitate' they would have gained the mark. It is sometimes inadvisable to add unnecessary information.

Mark awarded for (c) =
4 out of 6

6 All of these answers are acceptable as a precaution (including the deleted one). 'Gloves' was the best answer because of the nature of the hazard.

Mark awarded for (d) =
1 out of 1

Total marks awarded =
7 out of 10

How the candidate could have improved the answer

(a) Solid C is a bromide but this is not a complete identification. The flame test should have told the candidate 'sodium' bromide.

(b) Solution D is indeed a liquid but a colour was also required here.

(c) (ii) The official description of this colour in the syllabus is 'grey-green'. This was the answer expected.

(c) (iii) The candidate correctly gave 'white precipitate' but this mark was cancelled out by the wrong statement that it was soluble. It was not necessary to state anything about solubility here, so if the candidate had not added these words, they would have gained the mark.

Example Candidate Response – Question 3, Low

Examiner comments

3 Two substances, **C** and **D**, were analysed. Solid **C** was a salt and solution **D** was an aqueous solution of chromium(III) chloride.
The tests on solid **C**, and some of the observations, are in the following table.

tests	observations
tests on solid **C** Solid **C** was added to distilled water in a test-tube and shaken to dissolve. The solution was divided into two portions in test-tubes, and the following tests carried out. Appearance of the solution. The pH of the first portion of the solution was tested.	 colourless liquid pH = 7
Dilute nitric acid was added to the second portion of the solution followed by aqueous silver nitrate.	cream precipitate
A flame test was carried out on solid **C**.	yellow flame colour

(a) Identify solid **C**.

~~Solid~~ Bromine 1 ..... [2]

(b) Describe the appearance of solution **D**.

Shiny 2 ..... [1]

(c) Tests were carried out on solution **D**.

Complete the observations for tests 1, 2 and 3.

(i) test 1

Drops of aqueous sodium hydroxide were added to solution **D**.

Excess aqueous sodium hydroxide was then added to the mixture.

observations becomes ~~green~~ ~~clear~~ more 3

Shiny ..... [3]

1 The candidate misses the importance of the flame test and loses the second mark by writing 'bromine', which is not the same as 'bromide', the bromine ion which the test shows.

Mark awarded for (a) =
0 out of 2

2 The candidate is clearly thinking of the metal chromium, not of the compound named.

Mark awarded for (b) =
0 out of 1

3 The mistake from part (b) is carried forward here. The candidate perhaps has no experience of testing for ions in a practical experiment.

Example Candidate Response – Question 3, Low	Examiner comments
(ii) test 2 Excess aqueous ammonia was added to solution **D**. observations Gets Soft 4 [2] **(iii) test 3** Dilute nitric acid was added to solution **D** followed by aqueous silver nitrate. observations 5 [1] **(d)** Chromium(III) can be converted to chromium(VI). Chromium(VI) is hazardous. Suggest **one** safety precaution when using chromium(VI). Safety goggles. 6 [1] [Total: 10]	4 The candidate has given a meaningless answer because they have no practical experience of this test. It is important that candidates attempting this paper have some experience of the practical part of the syllabus. 5 No answer offered. This is a very straightforward question for any candidate who has attempted this part of the practical syllabus. Mark awarded for (c) = 0 out of 6 6 This is a safety precaution and though it would not be of particular help in coping with this hazard it is worth a mark. Mark awarded for (d) = 1 out of 1 **Total mark awarded = 1 out of 10**

How the candidate could have improved the answer

(a) A careless mistake: the correct word to use is 'bromide'. 'Bromine' refers only to the element.

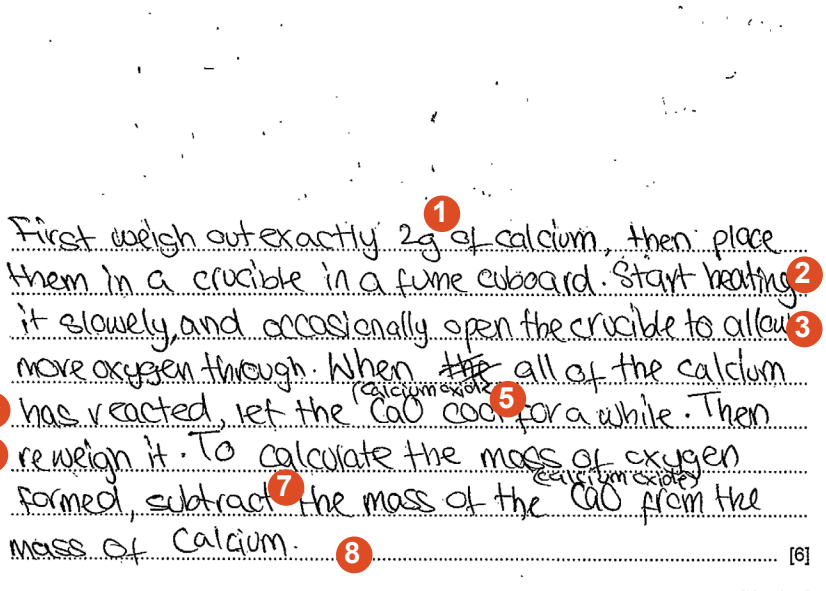
(b) and **(c)** The candidate was clearly thinking of the metal here, not about its compounds.

Knowledge of the tests for ions detailed in the syllabus would have enabled the candidate to score well in this answer.

Common mistakes candidates made in this question

A significant number of weaker candidates scored well on this question because they had learned the tests for different ions. It is essential that these are known and preferably experienced through practical experimentation by candidates.

Question 4

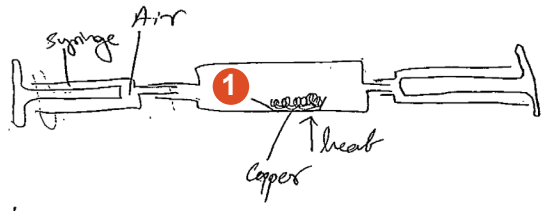
Example Candidate Response – Question 4, High	Examiner comments
4 Calcium burns in air to form calcium oxide. The reaction is vigorous and some of the calcium oxide can be lost as smoke. Plan an investigation to determine the maximum mass of oxygen that combines to form calcium oxide when 2g of calcium granules are burnt in air. You are provided with common laboratory apparatus and calcium granules.  First weigh out exactly 2g (1) of calcium, then place them in a crucible in a fume cupboard. Start heating (2) it slowly and occasionally open the crucible to allow (3) more oxygen through. When the (calcium oxide) all of the calcium has reacted (4), let the CaO cool (5) for a while. Then reweigh it (6). To calculate the mass of oxygen formed, subtract (7) the mass of the (calcium oxide) CaO from the mass of calcium. (8) [6] [Total: 6]	1 One mark awarded for weighing. 2 One mark awarded for heating the granules. 3 One mark awarded for allowing the entry of air here, but there is no mention of how the crucible is to be 'opened' (using a lid). 4 There is nothing about how the candidate will know when all the calcium oxide has reacted. 5 One mark awarded for allowing the calcium oxide to cool. 6 One mark awarded for reweighing the calcium oxide. 7 The candidate has made a mistake in calculating the mass of oxygen. 8 A good answer from a candidate who clearly knows the experiment and how to carry it out. However, some careless mistakes and omissions from the method mean that only 5 of the 6 marks are scored. **Total mark awarded = 5 out of 6**

How the candidate could have improved the answer

This was a good answer but the candidate lost a mark at the end as they subtracted the mass of the calcium oxide from the mass of calcium rather than the calcium from the calcium oxide. This careless mistake cost a mark.

Example Candidate Response – Question 4, Middle	Examiner comments

4 Calcium burns in air to form calcium oxide. The reaction is vigorous and some of the calcium oxide can be lost as smoke.
Plan an investigation to determine the maximum mass of oxygen that combines to form calcium oxide when 2 g of calcium granules are burnt in air.
You are provided with common laboratory apparatus and calcium granules.



2 take 2g of Calcium granules in dish Connect it to 2 air Syringes one of them must be filled with air then ~~be~~ put ethane 3 under the Copper and push the air from side to side by the syringes the Volume of air will start decreasing till specific Volume then you remove all the apparatus take the Calcium oxide after the reaction measure the mass then subtract it from 2g it will give you the mass of oxygen reacted with 2g of 4 5 Calcium use gloves and wear eye ~~goggles~~ goggles 6 [6]

[Total: 6]

1 The candidate is clearly thinking about the experiment to find the percentage of oxygen in air here and has even labelled the metal as copper.

2 One mark awarded for implying that 2g of calcium is weighed.

3 One mark is awarded for mentioning heating. (This mark is gained even though the candidate has again referred to the metal as copper.)

4 One mark awarded for reweighing the calcium oxide.

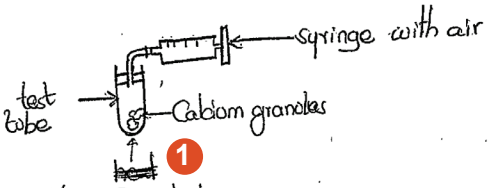
5 The candidate explains the final calculation incorrectly and so fails to earn this mark.

6 The candidate gives an incorrect method which would not work here. However, they score 3 marks overall and nearly gain 4.

Total mark awarded = 3 out of 6

How the candidate could have improved the answer

In this exercise the candidate needed to devise an experiment which they would not have carried out during their course, but which was based on one they were familiar with. If they had used a different experiment as the basis for their own method, they would have gained more marks.

Example Candidate Response – Question 4, Low	Examiner comments
4 Calcium burns in air to form calcium oxide. The reaction is vigorous and some of the calcium oxide can be lost as smoke. Plan an investigation to determine the maximum mass of oxygen that combines to form calcium oxide when 2 g of calcium granules are burnt in air. You are provided with common laboratory apparatus and calcium granules.  1 You can take a 50cm³ syringe and fill it in with air which contains oxygen. You take the Calcium granules and place them inside the test tube. You the starting releasing the air using a tube into the test to make sure there is no air already or no air comes in. You then wait for smoke to be produced and then you check the initial temperature of the air on the Cylinder and Compare it to the final [6] The volume you get you sublimate to a solid [Total: 6] and then you measure the mass of the solid. 2 3	1 Unfortunately, 'heat' has been crossed out here. This would have scored a mark. 2 A mark is awarded for measuring the mass of the solid produced. 3 The candidate only earns one mark for this answer and does not seem to know how such an experiment could be carried out. **Total mark awarded = 1 out of 6**

How the candidate could have improved the answer

The candidate had little idea of how to approach the task, and could have made better use of the information given in the question. For instance, it was clear that the calcium should be burnt in air. It was also clear that weighing before and after the experiment was necessary ('maximum mass of oxygen', '2 g of calcium granules').

Common mistakes candidates made in this question

Candidates are told in the question that some of the calcium oxide 'can be lost as smoke'. This was to prompt them to try to prevent this, e.g. by using a lid. The low-level response above focused on collecting and weighing the 'smoke', and this was quite a common error. However, the question makes it clear that this is only 'some' of the calcium oxide. Candidates should read questions carefully.

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