

Examiners' report

GCSE

COMBINED SCIENCE A (GATEWAY SCIENCE)

**OCR Level 1/Level 2 GCSE (9-1) in
Combined Science A (Gateway Science)**

J250

For first teaching in 2016

J250/04 Summer 2025 series

Contents

Introduction	4
Paper 4 series overview	5
Section A overview	6
Question 1	6
Question 2	6
Question 3	7
Question 4	7
Question 5	8
Question 6	8
Question 7	9
Question 8	9
Question 9	10
Question 10	11
Section B overview	12
Question 11 (a)	12
Question 11 (b)	13
Question 11 (c)	13
Question 11 (d)	14
Question 11 (e)	15
Question 12 (a) (i)	15
Question 12 (a) (ii)	16
Question 12 (b)	16
Question 12 (c) (i)	17
Question 12 (c) (ii)	17
Question 12 (d)	18
Question 13 (a)	19
Question 13 (b)	20
Question 13 (c) (i)	21
Question 13 (c) (ii)	21
Question 14*	22
Question 15 (a)	25
Question 15 (b) (i)	26
Question 15 (b) (ii)	26
Question 15 (c) (i)	27

Question 15 (c) (ii)	28
Question 15 (d)	28
Question 16 (a)	28
Question 16 (b)	29
Question 16 (c) (i)	29
Question 16 (c) (ii)	30
Question 16 (c) (iii)	31
Question 16 (d) (i)	31
Question 16 (d) (ii)	32
Question 16 (e)	32

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from [Teach Cambridge](#).

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Paper 4 series overview

J250/04 is the fourth of six Foundation tier papers for Gateway Combined Science A. This component assesses Topics C4, C5 and C6, with assumed knowledge of Topics C1, C2, C3 and Topic CS7, and is worth 16.7% of the total GCSE.

The final question on the paper, Question 16, overlapped with the Higher Tier paper. This proved to be very challenging for candidates, with several parts of the question omitted.

To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas and application of this knowledge.

There were several numerical calculations on the paper and many candidates did not show their working.

There was no evidence to suggest that candidates did not have enough time to complete the paper.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
- highlighted or underlined the key points in questions - produced a well supported response to the Level of Response question, with reasoned comparisons of the two alternatives (Question 14) - recognised a greenhouse gas (Question 13 (c) (ii)) and the potential effects of global warming (Question 11 (e) and 13 (c) (i)) - interpreted graphical information (Question 11 (c)) - could add a reading to a thermometer (Question 15 (a)).	- did not show their working in calculations - confused significant figures and decimal places - did not recall elements or technical terms accurately - could not balance equations or use state symbols (Question 12 (b), 12 (c) (i) and 16 (a)) - did not describe the observations of experiments (Question 12 (a) (i), 12 (a) (ii)) - could not describe a trend or interpret experimental results (Question 15 (b) (i) and (ii) and 15 (c) (ii) and (iii)) - did not know the test for oxygen gas.

Question 3

3 When is electrolysis used to extract a metal from its ore?

- A The metal dissolves in water.
- B The metal has a high melting point.
- C The metal is in high demand.
- D The metal is very reactive.

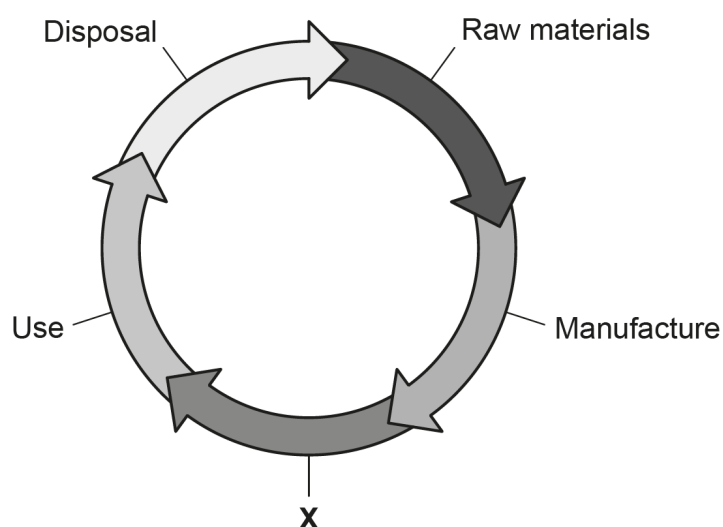
Your answer

[1]

The majority of candidates thought high melting point was the reason for extracting metals by electrolysis.

Question 4

4 The diagram shows the stages in a life-cycle assessment.



What is stage X?

- A Consumer research
- B Design of the product
- C Processing of the raw materials
- D Transportation of the product

Your answer

[1]

Life cycle assessments were quite well known with the majority of candidates choosing transportation (D). A and B were popular incorrect responses.

Question 5

5 Part of the reactivity series is shown below.

Aluminium	most reactive
Carbon	↑
Tin	↓
Lead	least reactive

Which metal(s) are produced when their metal oxides are heated with carbon?

- A Aluminium only
- B Aluminium and lead
- C Tin and lead
- D Tin only

Your answer

[1]

The majority of candidates thought that carbon would extract the metals which were more reactive than it, hence choosing A. Some chose the most and least reactive metals in the list, option B.

Question 6

6 When marble chips react with an acid, they produce a colourless solution and a gas.

Which method is used to determine the rate of reaction?

- A A disappearing cross experiment
- B Gas chromatography
- C Measuring the mass loss using a balance
- D Measuring the volume of solution produced

Your answer

[1]

This practical method of measuring rate was not well known and all responses were seen. B and D were slightly more popular.

Question 7

7 Which Group 7 element is a red-brown liquid at room temperature?

- A Fluorine
- B Chlorine
- C Bromine
- D Iodine

Your answer

[1]

Bromine and iodine were often confused, with D being a popular incorrect response.

Question 8

8 Desalination is the removal of salt from seawater to produce drinking water.

The seawater is heated and the water vapour condensed and collected.

Which **separation technique** is used to produce drinking water in desalination?

- A Chromatography
- B Crystallisation
- C Distillation
- D Filtration

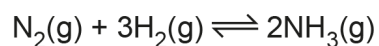
Your answer

[1]

Higher attaining candidates correctly recognised the process as distillation. The most popular response was filtration.

Question 9

- 9 The equation shows a reaction that has reached **dynamic equilibrium**.



Which statement explains why this reaction is a dynamic equilibrium?

- A N_2 and H_2 are gases.
- B The rates of the forward and reverse reactions are equal.
- C The reaction has stopped.
- D The reaction produces a 100% yield of NH_3 .

Your answer

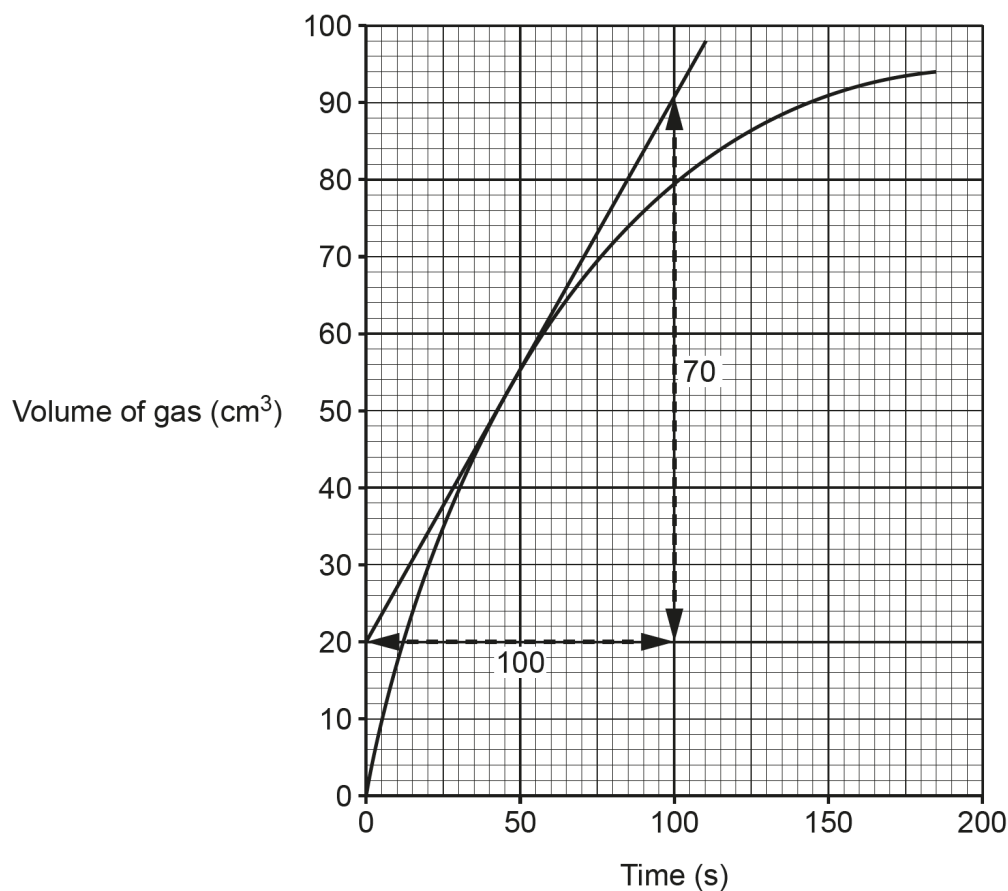
[1]

Dynamic equilibrium was understood by many candidates. A was the more popular incorrect response.

Question 10

10 The graph shows the volume of gas produced during a reaction.

A tangent has been drawn at 50 seconds. The gradient of the tangent gives the rate of reaction.



What is the rate of reaction, in cm^3/s , at 50 seconds?

- A** 0.56
- B** 0.70
- C** 1.1
- D** 1.4

Your answer

[1]

Candidates found this very challenging. Most read the value from the graph at 50 seconds as 56 and divided by 100 hence choosing A.

Section B overview

Many candidates attempted all of the questions except those that were most challenging. This was particularly notable in parts of the overlap question, Question 16.

Some candidates either highlighted or underlined the key points in questions and this clearly aided their answering of those questions.

There was no evidence to suggest that candidates did not have enough time to complete the paper.

Questions on environmental issues including greenhouse gases, global warming and calculation of percentages were particularly well answered.

Questions citing experimental details or observations, interpreting experimental results, recognising control variables, giving improvements to experiments and use of technical vocabulary proved to be very challenging for candidates.

The Level of Response question was answered particularly well by more candidates than in previous years.

Question 11 (a)

11 Crude oil is a source of hydrocarbons.

(a) Which chemical is a hydrocarbon?

Tick (✓) **one** box.

Calcium carbonate – CaCO_3

☐

Hydrogen chloride – HCl

☐

Methane – CH_4

☐

[1]

Higher achieving candidates knew the term hydrocarbon. Since the term begins hydro, the most popular response was hydrogen chloride.

Question 11 (b)

(b) Complete the sentences about crude oil.

Use words from the list.

cracking	filtration	fractional distillation	neutralisation	reduction
-----------------	-------------------	--------------------------------	-----------------------	------------------

The hydrocarbons in crude oil are separated by

Some of these hydrocarbons are made more useful by

[2]

Higher achieving candidates chose the correct processes. Fractional distillation was seen more frequently than cracking. A large number of candidates reversed the processes.

Question 11 (c)

(c) The table shows the description of three resources **A**, **B** and **C**.

Resource	Type	Composition
A	finite	an element
B	finite	a mixture of compounds
C	renewable	a mixture of compounds

Which resource is crude oil?

Explain your choice using information from the table.

Crude oil is resource

Reason

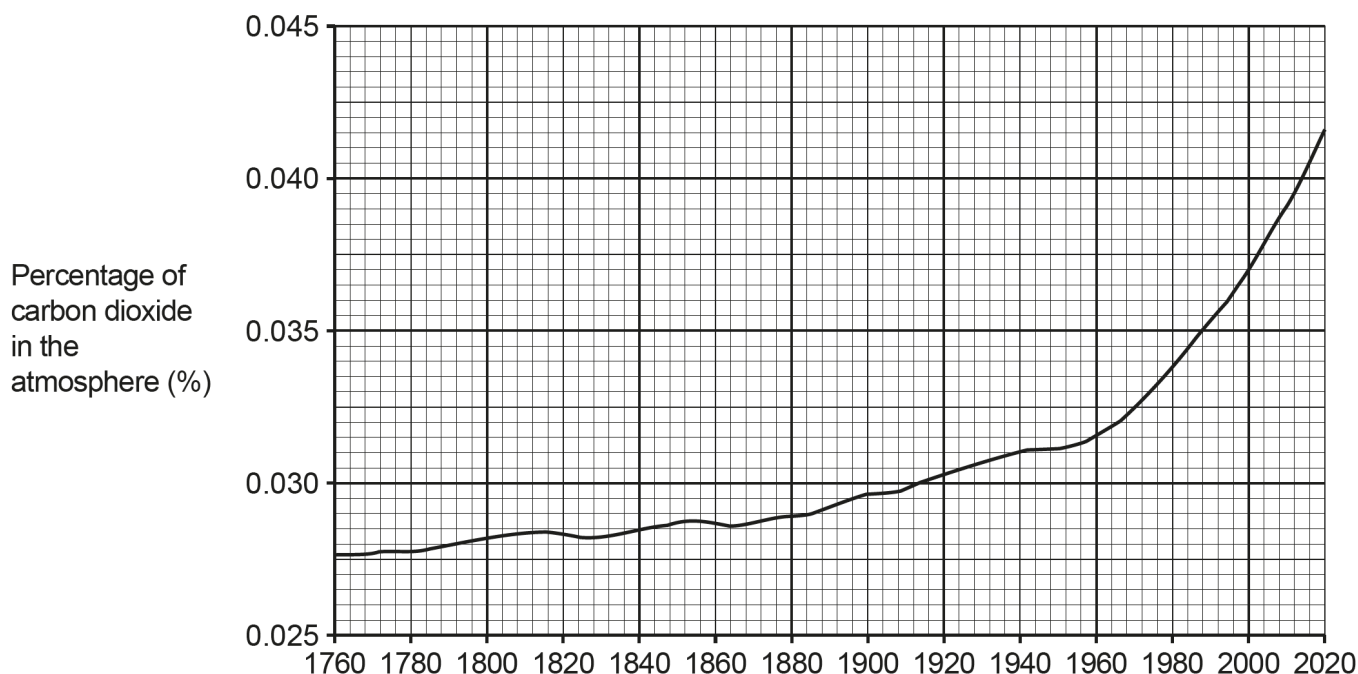
[2]

Many candidates chose B, citing finite or non-renewable as the reason. Mixture of compounds was seen much less often. C was a popular incorrect response with candidates reversing the meaning of finite and renewable. A significant number interpreted the words and thought renewable meant that the resource could be used more than once.

Question 11 (d)

(d) When hydrocarbons burn they produce carbon dioxide.

The graph shows how the percentage of carbon dioxide in the atmosphere has increased since 1760.



Complete the sentences about the graph.

Put a ring around each correct option.

The percentage of carbon dioxide has increased fastest

from **1760–1860** / **1860–1960** / **1960–2020**.

This percentage increase is mainly caused by the use of **fossil fuels** / **metals** / **plastics**.

[2]

Almost all candidates interpreted the graph correctly to give the correct years. Many knew the cause of the increase with plastics being the popular incorrect choice.

Question 11 (e)

- (e) Scientists think that increased levels of carbon dioxide are causing global warming.

Which statements about the potential effects of global warming are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
All animals will adapt to survive.		
Droughts and floods will become more likely.		
Extreme weather conditions will increase.		
It will impact crop growth.		

[2]

The effects of global warming were well known with most candidates gaining at least 1 of the 2 marks. Some thought that one or both of the final two statements were false.

Question 12 (a) (i)

- 12 This question is about elements in Group 1 and Group 7 of the Periodic Table.

- (a) Sodium is below lithium in Group 1.

Table 12.1 describes the observations when small pieces of lithium and sodium are placed in water.

Table 12.1

Element	Observation
Lithium	fizzes steadily and disappears slowly
Sodium	melts into a silver ball, fizzes rapidly and disappears quickly

- (i) Describe how these observations show how the reactivity of the elements **increases** going down Group 1.

.....
 [1]

Higher attaining candidates appreciated that the answer needed to show an increase in reactivity and so discussed the reactions being faster or a specific observation being faster, such as disappearing more quickly. Many candidates either repeated the question stem ('it is more reactive') or simply copied from the table, e.g. sodium disappears quickly. A significant number omitted the question.

Question 12 (a) (ii)

- (ii) Potassium is below sodium in Group 1.

Describe **one** observation when a small piece of potassium is placed in water.

Use information from **Table 12.1**.

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

More successful candidates on this paper appreciated the need to give an observation and that the observation should clearly show that potassium has a higher reactivity than sodium. Many candidates either repeated the observations for sodium, stated that potassium is more reactive or discussed the comparative distance of the outer electron. A significant number omitted the question.

Highlighting key points in questions



It is important to read questions carefully to ascertain exactly what is being asked.

More successful candidates either underlined or highlighted the key words in the question: observation and potassium is below sodium.

Question 12 (b)

- (b) When sodium reacts with water, it forms sodium hydroxide and hydrogen.

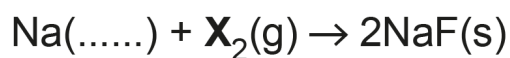
Complete the **word equation** for the reaction of **potassium** with water.

potassium + water → + [2]

Higher achieving candidates named both products, with hydrogen being seen more often than potassium hydroxide. Many candidates repeated the stem and gave sodium hydroxide, while a number of others gave the other product as water. A significant number omitted the question.

Question 12 (c) (i)

(c) The equation for sodium, Na, reacting with a Group 7 element, **X**, is:



(i) Sodium is a **solid** at room temperature.

Complete the equation by writing in the missing state symbol for sodium.

[1]

The state symbol for solid was not well known, with F commonly written in the space. Some also gave numbers including 2, 3 and 5. A significant number omitted the question.

Question 12 (c) (ii)

(ii) State the **name** of element **X**.

..... [1]

More successful candidates on the paper overall named X as fluorine, and the most common incorrect response was chlorine. A small number gave metals. A significant number omitted the question.

Question 12 (d)

- (d) A more reactive Group 7 element displaces a less reactive Group 7 element from a solution of one of its salts.

Chlorine **reacts** with potassium bromide as chlorine is **more reactive** than bromine.

Bromine **reacts** with potassium iodide as bromine is **more reactive** than iodine.

Iodine **does not react** with potassium chloride as iodine is **less reactive** than chlorine.

Table 12.2 shows the results of mixing three Group 7 elements and solutions of their salts.

Table 12.2

Key ✓ = reaction ✗ = no reaction

	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution
Chlorine		✓	
Bromine			✓
Iodine	✗		

Complete Table 12.2 by putting a tick (✓) or cross (✗) in the three answer spaces.

[2]

Many candidates gave answers to the shaded boxes as well as the three answer spaces. Lower achieving candidates gave the opposite for each reaction. The reaction of chlorine with potassium iodide solution was most commonly correct followed by the reaction of iodine with potassium chloride solution.

Question 13 (a)

13 The Earth's early atmosphere may have been mainly carbon dioxide, nitrogen and water vapour.

(a) The sentences describe how the Earth's atmosphere developed over time.

- A** The Earth cooled down.
- B** Plants absorbed carbon dioxide and produced oxygen.
- C** The water vapour condensed to form the oceans.
- D** The gases were released by volcanoes.
- E** Plants evolved.

Write the letters in the boxes to show the correct order of the sentences.

The first one has been done for you.

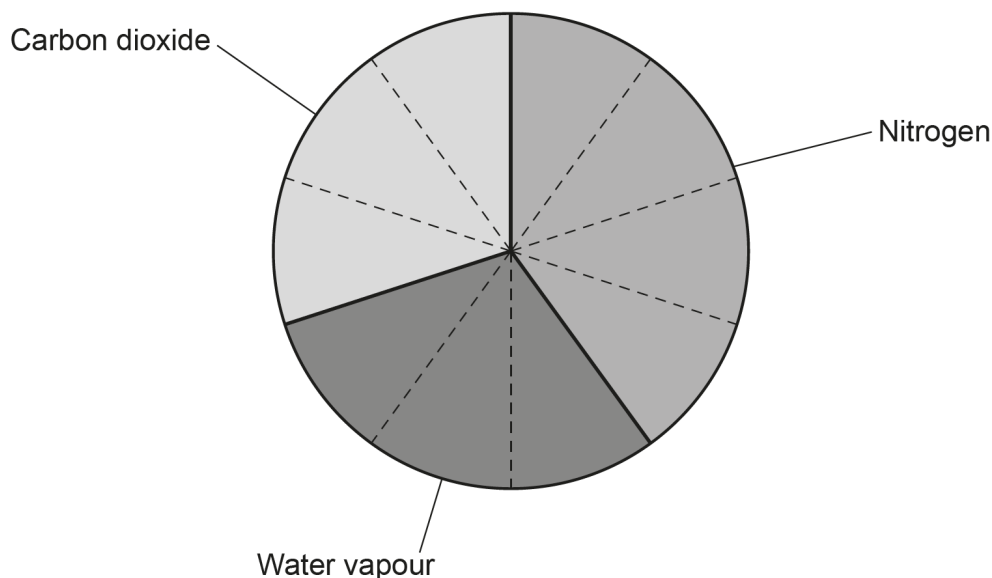
D				
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[2]

Candidates found this very challenging. Some gained partial credit for giving three in the correct order, usually ACE with B incorrectly placed or CEB with A incorrectly placed. Many gave water vapour condensing into oceans as the first in the sequence and reversing the sequence was also quite common.

Question 13 (b)

(b) The pie chart shows the relative amounts of each gas in the Earth's early atmosphere.



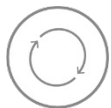
Calculate the percentage of nitrogen in the Earth's early atmosphere.

Percentage of nitrogen = % **[3]**

Many candidates gave the correct percentage. A significant number either gave 78% for the current percentage of nitrogen in the air or gave an incorrect percentage with no working out shown. Some gave complex equations using angles which usually resulted in an incorrect answer.

Calculations

It is really important that candidates show their working in calculations, otherwise it is impossible to award partial marks for responses where only one step is incorrect.

Highlighting key points in questions

The most successful candidates highlighted or underlined Earth's early atmosphere in the question stem. This prevented them giving the current percentage of nitrogen in the air.

Question 13 (c) (i)

(c) Some of the gases in the Earth's atmosphere today are called greenhouse gases.

(i) What effect do greenhouse gases have in the Earth's atmosphere?

Tick (✓) **one** box.

They dissolve in rain water making it acidic.

☐

They make a hole in the ozone layer.

☐

They trap heat from the Sun.

☐

[1]

Making a hole in the ozone layer was the most common incorrect response.

Question 13 (c) (ii)

(ii) Which of these gases is a greenhouse gas?

Tick (✓) **one** box.

Argon

☐

Methane

☐

Nitrogen

☐

[1]

Methane as a greenhouse gas was quite well known. Many gave nitrogen, possibly because that is the one gas in the list which is in the air naturally.

Question 14*

14* Containers for drinks are made from aluminium or glass.



Aluminium can



Glass bottle

The table shows some information about the containers.

	Aluminium can	Glass bottle
Energy used in production from raw materials (kJ/kg)	300 000	2 500
Contribution of production to global warming	medium	high
Amount of energy saved during recycling (%)	95	25
Amount of containers collected for recycling (%)	75	75
Time to decompose when put in landfill (years)	80	1 000 000

State which container you would choose to produce as a container for drinks.

Explain your choice using information from the table.

Include an advantage and a disadvantage of your chosen container in your answer.

.....

.....

.....

.....

.....

..... [6]

Most candidates were able to access this question and make use of the data to compare and contrast their choice. Aluminium was by far the most popular choice and most used at least some of the data to support this. Those that quoted the data from the table for both aluminium and glass were able to access Level 2 and those who compared the data were able to access Level 3. Very few candidates who attempted the question gained no credit and a significant, but small, number omitted the question.

Exemplar 1

I would choose the aluminium can, this is because it has a medium contribution to global warming, whereas a glass bottle is high. Aluminium cans also save 75% more energy when recycling than glass bottles. Aluminium cans take 80 years to decompose compared to 1,000,000 years for glass bottles, it also has the same amount of containers collected for recycling (75%). Although, ~~the~~ the disadvantage is that it takes 360,000 kJ/kg of energy in production from raw materials, which is much higher than glass bottles.

The candidate has chosen aluminium and so we are looking for statements supporting this choice.

They have two aspects copied from the table global warming contribution is medium and glass is high, and aluminium takes 80 years to decompose and glass takes 1 000 000 years. These are Level 2 statements as they have copied the information from the table and have included the data for both aluminium and glass.

They also have an interpreted, comparative advantage (save more energy recycling) and an interpreted comparative disadvantage (higher use of energy to produce). These are Level 3 statements since they are interpreted comparisons.

This is awarded Level 3, 5 marks. To gain 6 marks, a more comprehensive, comparative argument needed to be given.

Exemplar 2

I would use the aluminium can because it's better to travel without any chance of breaking. Using these is better for the environment less reactive to global warming than the glass bottle. It also is able to be recycled again to form more other things, if decomposed it only takes 80 years to instead of 1,000,000 with glass bottles. This product is safer to use than glass bottles with the damage it could cause breaking lots of them or harming by cutting yourself with the cap of the bottle, having to find openers to drink. [6]

The candidate has chosen aluminium and so we are looking for statements supporting this choice.

There is one comment about global warming for aluminium only with no reference to glass. This is a Level 1 statement.

There is also one advantage for aluminium citing the values from the table for both aluminium and glass, 80 years versus 1 000 000 years to decompose. This is a Level 2 statement.

The justification addresses one of the points for aluminium only and one (quoting data from the table) for aluminium and glass. This is Level 2, 3 marks.

To achieve 4 marks the candidate would need to address more points from the table using data for both aluminium and glass.

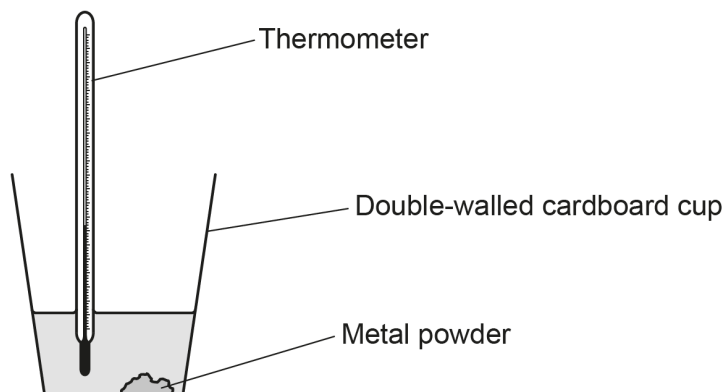
To achieve 6 marks there needs to be interpreted, comparative advantages and an interpreted, comparative disadvantage.

Question 15 (a)

15 A student investigates the reactivity of four different metals.

Fig. 15.1 shows their experiment.

Fig. 15.1



This is their method:

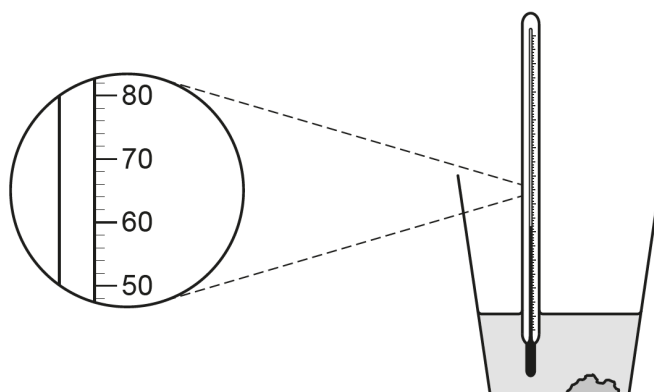
- Put 25 cm³ of dilute hydrochloric acid into the double-walled cardboard cup.
- Add one spatula of metal powder.
- Measure the highest temperature.

The table shows the student's results.

Metal	Highest temperature (°C)
Copper	20
Iron	23
Magnesium	65
Zinc	32

(a) **Fig. 15.2** shows the thermometer when the metal powder is magnesium.

Fig. 15.2



Draw a line on the thermometer in the circle to show the highest temperature for magnesium. **[1]**

The reading on the thermometer was generally well done. Some chose 75 or 65 or gave thick lines which covered more than two degrees. Many candidates omitted this question.

Question 15 (b) (i)

(b) Part of the reactivity series is shown below.

Sodium	most reactive
Magnesium	
Aluminium	
Zinc	
Iron	
Lead	
Copper	least reactive

(i) Describe how the highest temperature changes as the reactivity of the metals increases.

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

Higher achieving candidates were able to identify that it was the change in the highest temperature which was required by the question. Many gave just a snapshot such as the most reactive had the highest temperature increase rather than giving the trend or simply said that the temperature changes. Many misunderstood the experiment and discussed a high melting point or boiling point for the most reactive metal. A significant number omitted the question.

Question 15 (b) (ii)

(ii) The student repeats the experiment with another metal from the reactivity series shown above.

The highest temperature measured is 49 °C.

Suggest the name of this metal.

..... [1]

The more successful candidates on this paper were able to match the temperature to its relative place in the table of results and so choose the correct element from the reactivity series. Several metals were seen but the most common response was iron. A significant number omitted the question.

Question 15 (c) (i)

(c) The student repeats the experiment with magnesium.

This table shows all their results.

Experiment	Highest temperature (°C)
1	65
2	63
3	66

(i) Calculate the mean highest temperature.

Give your answer to **2** significant figures.

Mean highest temperature = °C [3]

Many candidates did not give their answer to 2 significant figures and some confused this with 2 decimal places. Rounding was a significant issue with many truncating their answer rather than rounding it. Less successful candidates on this paper overall found this challenging, with many not showing any working out and giving a close but incorrect answer only.

Calculations

It is really important that candidates show their working in calculations, otherwise it is impossible to award partial marks for responses where only one step is incorrect.

Significant figures.



Candidates must remember to read questions carefully and to take note of the number of significant figures required by a calculation. Correct rounding is also needed where the number of significant figures has been specified.

Misconception



Many confused number of significant figures with the number of decimal places.

Question 15 (c) (ii)

(ii) Describe **one** variable the student must control when they repeat this experiment.

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

Lower achieving candidates found this challenging. Temperature was a popular response, as well as thermometer and stop watch. A significant number omitted the question.

Question 15 (d)

(d) The student thinks that the highest temperatures are lower than they should be.

Suggest one **improvement** the student could make so the highest temperatures are more accurate.

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

All candidates found this question difficult. The most common incorrect response was repeat, while others included 'keep the temperature the same', 'add more magnesium' and 'add more hydrochloric acid'. A significant number omitted the question.

Question 16 (a)

16 Hydrogen peroxide solution, $\text{H}_2\text{O}_2(\text{aq})$, decomposes to make water and oxygen gas.

(a) Complete the **balanced symbol** equation for the reaction.



[2]

More successful candidates on this paper added the 2 in front of the water. Many gave the oxygen as O or 2O rather than O_2 . A significant number omitted the question.

Question 16 (b)

(b) Describe a test and its result which shows that the gas produced in the reaction is oxygen.

Test

.....

Result

.....

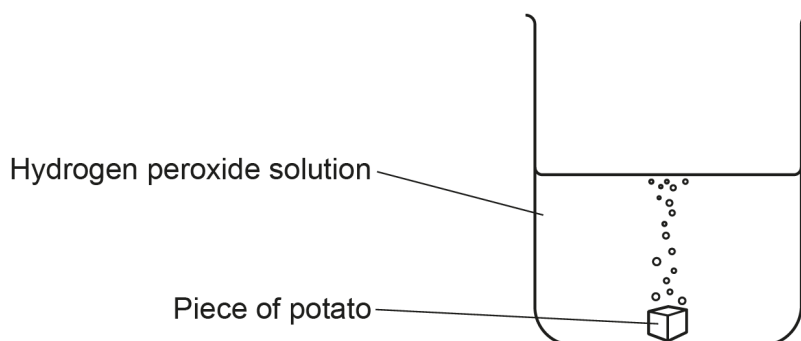
[2]

The test for oxygen was not well known. Some had lit splints relighting or blown out splints relighting. Many gave the test for hydrogen and some the test for carbon dioxide. A large number omitted the question.

Question 16 (c) (i)

(c) A hydrogen peroxide solution produces oxygen gas slowly.

A student adds a piece of potato to the hydrogen peroxide solution.
The potato contains a biological catalyst.



(i) What name is given to biological catalysts?

..... [1]

The most successful candidates could provide enzyme as the response. A whole range of other answers were seen including potato, starch, cations, cathodes and catalyst. Many omitted the question.

Question 16 (c) (ii)

(ii) Describe and explain the effect of adding the piece of potato to the hydrogen peroxide solution.

Include ideas about rate of reaction and activation energy.

.....

.....

.....

..... [2]

Higher achieving candidates appreciated the increase in rate, while most thought the activation energy would increase. Many omitted the question.

Question 16 (c) (iii)

- (iii) The student measures the total volume of oxygen produced in the reaction with and without the piece of potato.

With the potato, the total volume is: increased, decreased, stays the same.

Tick (✓) **one** box.

It is decreased.

☐

It is increased.

☐

It stays the same.

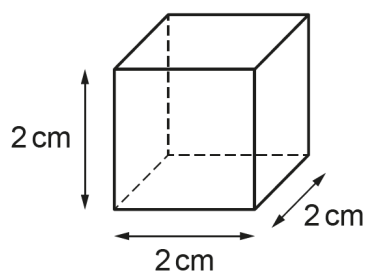
☐

[1]

Most candidates thought the volume increased.

Question 16 (d) (i)

- (d) The piece of potato added to the hydrogen peroxide solution is a six-sided cube.



- (i) Calculate the surface area of the piece of potato in cm^2 .

Surface area of the piece of potato = cm^2 [2]

Candidates found this challenging with the more successful candidates gaining credit. Most gave the volume of the cube. Those that calculated the surface area as 4 usually did not appreciate that there are 6 surfaces to the cube. Many candidates gave an answer with no working shown.

Calculations

It is really important that candidates show their working in calculations, otherwise it is impossible to award partial marks for responses where only one step is incorrect.

Misconception of volume and surface area

Many candidates confused surface area and volume.

Question 16 (d) (ii)

- (ii) A student thinks that cutting the potato into smaller pieces will make the catalyst more effective.

Explain why the student is **correct**.

Tick (✓) **one** box.

The smaller pieces have a larger mass.

☐

The smaller pieces have a larger surface area.

☐

The smaller pieces have a larger volume.

☐

[1]

Many candidates thought that the smaller pieces would have a larger volume.

Question 16 (e)

- (e) The student measures the rate of reaction when the piece of potato is added to the hydrogen peroxide.

The rate of reaction is $1.5 \text{ cm}^3/\text{s}$.

They then measure the rate of reaction again with an increased concentration of hydrogen peroxide.

What would the rate of reaction be now?

Tick (✓) **one** box.

Rate of reaction = $1.5 \text{ cm}^3/\text{s}$

☐

Rate of reaction $> 1.5 \text{ cm}^3/\text{s}$

☐

Rate of reaction $< 1.5 \text{ cm}^3/\text{s}$

☐

[1]

The most common response was $> 1.5 \text{ cm}^3/\text{s}$. This may be because candidates did not know the effect of increased concentration or because they did not understand the $>$ and $<$ symbols.

Supporting you

Teach Cambridge

Make sure you visit our secure website [Teach Cambridge](#) to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can [forward them this link](#) to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the [OCR website](#).

Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our [website](#).

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If you do not have an Interchange account, please contact your centre administrator (usually the Exams Officer) to request a username.

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