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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/10 Summer 2024 series

Version 1

ocr.org.uk/science

Contents

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 answers 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 OCR.

Paper 10 series overview

J250/10 is the second of two higher papers assessing chemistry in the Combined Science A suite. The other four papers in the suite assess biology and physics. This paper assesses content from topics C4–C6 and CS7, with assumed knowledge of C1–C3. To do well on this paper, candidates need to be comfortable applying their knowledge and understanding to unfamiliar contexts and be familiar with a range of practical techniques. There is also an emphasis on knowledge and understanding of the assessment objectives from the specification.

It is important that candidates understand the command words and what is expected when a particular command word is used. In some cases, descriptions were given when explanations were needed and so not all marks were accessed. In other cases, answers were given that, although included some good science, did not answer the question in terms of the context the question was set. This was especially the case in Question 16 where candidates gave responses in terms of collision theory rather than method.

Exam practice is essential so that candidates understand the requirements of a paper. In some cases, it was clear candidates were not reading the question carefully which sometimes caused them to lose marks as they did not use information given to them.

It is good to see that the candidates are reading the maths style questions correctly and recognising where specific number of decimal places or significant figures are needed. It is also good to see working shown.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• produced a clear, concise, and well-structured answer for the Level of Response question (, **Question 16)** • understood the purpose of Life Cycle Assessment and recycling (**Questions 11 (a) and 11 (b)**) • could balance equations (**Questions 11 (d) and 14 (d)**) • performed calculations relating to mass (**Question 11 (c)**), percentages (**Question 13 (b)**), and temperature change (**Question 14 (a)**) • could apply knowledge of separation techniques (**Question 12**) • knew and could use the general formula for hydrocarbons (**Questions 13 (e) (i) and 13 (e) (ii)**) • applied their knowledge of reactivity (**Questions 11 (e) (iii), 14 (b), 14 (c) (iii), 17 (a) and 17 (c)**) • could interpret and use data appropriately (**Questions 14 (b), 15 (b) (i) and 11**)	• tended to repeat the question stem as their answer to a question • gave answers to calculations with no working steps shown or with conflicting steps shown • found describing methods and scientific processes difficult (**Questions 12 and 16**) • could not balance equations (**Questions 11 (d) and 14 (d)**) • found explaining reactivity and trends in groups difficult (**Question 17 (a) and 17 (c)**) • showed imprecise use of scientific terminology.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• could suggest appropriate variables and relate change in variable to results (**Question 16**).	

Section A overview

It was good to see few candidates leaving none of the multiple-choice questions blank although guesswork was evident.

The majority correctly answered questions 1, 6, and 7.

Slightly fewer got questions 2, 3, 4, 6, and 8 correct.

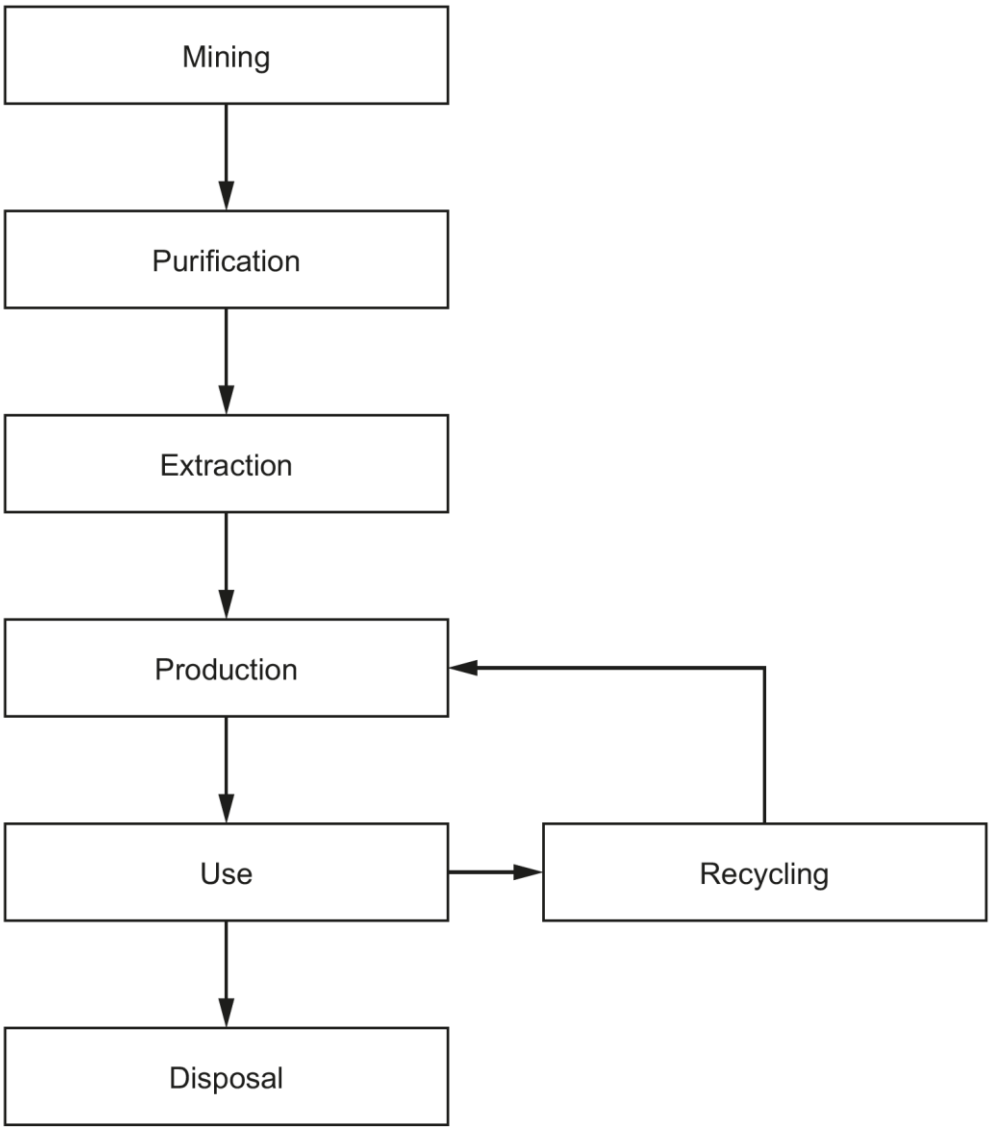
Candidates found questions 5, 9 and 10 quite challenging.

It is important that the question and all possible answers are read carefully. It is also important that their answer is clear to the examiner. If the candidate decides to change their mind they should clearly cross out the first answer and put the replacement answer next to the box.

Question 11 (a)

11 Aluminium is extracted from a rock called bauxite which contains aluminium oxide.

The diagram shows information from a life-cycle assessment for the manufacture and use of aluminium products.



(a) Give **one** reason why a life-cycle assessment is carried out.

.....

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

Many candidates responded in terms of what happens in a life cycle assessment rather than in terms of the purpose of the LCA. This meant they did not gain marks. Any ideas about use of materials or energy, environmental impact, lifespan, disposal or sustainability would have gained the mark here. The ideas of 'sustainability' and 'environmental impact' were the more common responses.

Question 11 (b)

(b) Give **two** reasons why the products should be recycled at the end of their useful life.

1 .....

.....

2 .....

.....

[2]

Less successful responses confused recycling with reusing materials and so did not gain marks. The more successful responses answered in terms of less waste and less new materials being needed. When talking about pollution it is important to be specific. In this case we were looking at the idea of less greenhouse gases, or visual/noise pollution due to less mining. Vague responses stating less pollution would not gain a mark.

Question 11 (c)

(c) 18% of the bauxite rock is turned into aluminium.

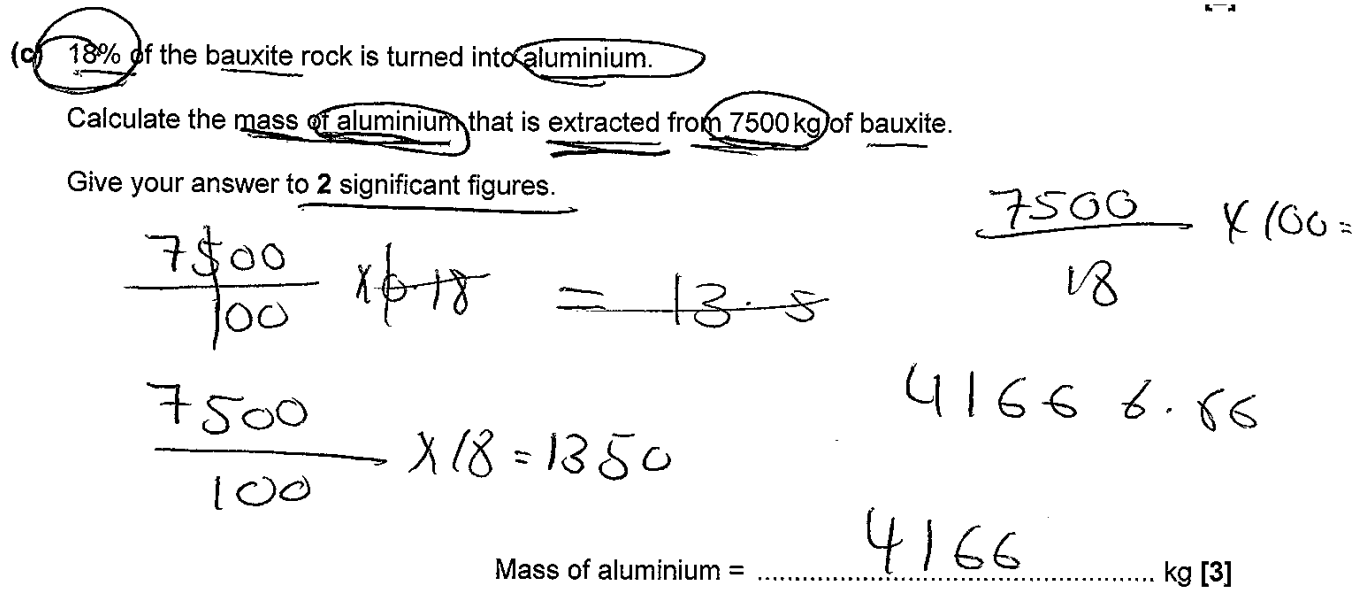
Calculate the mass of aluminium that is extracted from 7500 kg of bauxite.

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

Mass of aluminium = ... kg **[3]**

It was good to see most candidates attempt this question and many gained at least two marks. Some missed the instruction to give the answer to 2 significant figures. Good exam practice would be to tick off any instruction once the question has been answered to make sure nothing is missed. Some candidates rounded the number down but it is expected in this question for it to be rounded up.

Exemplar 1



This candidate has an incorrect answer on the answer line and so will not gain the final mark. However, if correct working is shown then marks can be given. This candidate has given two methods. One is correct and one is incorrect. This is a list. The answer on the answer line clearly comes from the incorrect method and so this is the part of the response that is marked. It is good practice to show the working but in this case because two different sets of working were given and one was incorrect no marks were given. It is important for any incorrect working to be crossed out. If the incorrect working had been crossed out then 2 marks would have been given for '1350'.

Question 11 (d)

(d) During the purification, aluminium oxide, Al_2O_3, is produced from aluminium hydroxide, $Al(OH)_3$.

Complete the **balanced symbol** equation for the reaction.

$$.....Al(OH)_3 \longrightarrow Al_2O_3 + ...H_2O$$

[2]

Assessment for learning

This question was generally well answered but it was clear some candidates struggled to balance the equation and did not know how to do so. This is a basic skill expected in the qualification and lots of practice will ensure candidates gain these marks in future.

Many candidates gained two marks. Those that scored one usually did so for 2 $AL(OH)_3$

Question 11 (e) (i)

(e) Aluminium is extracted from aluminium oxide, Al_2O_3, by electrolysis.

(i) This is the equation for the electrolysis of aluminium oxide.

$$2Al_2O_3 \longrightarrow 4Al + 6O_2$$

A student thinks that this reaction is an example of reduction.

Explain why the student is **correct**.

.....

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

In this equation, 6O2 should have been written as 3O2. After analysing candidate performance during marking, we decided the fairest approach was to award all candidates full marks for this question.

Question 11 (e) (ii)

(ii) Extracting aluminium by electrolysis is expensive.

Which statements about why the electrolysis is expensive are **true**, and which are **false**?

Tick **one** (✓) box in each row.

	True	False
Aluminium oxide is melted at a high temperature.		
The electrolysis produces impure aluminium.		
The electrolysis uses large amounts of electricity.		

[2]

Most candidates were able to gain at least one mark here. It was good to see almost all candidates attempt the question. They need to be clear which box they are ticking and follow the instructions to tick **one** box in each *row*. The most seen incorrect choice was for "electrolysis produces impure aluminium."

Question 11 (e) (iii)

(iii) It would be cheaper if aluminium could be extracted by heating the aluminium oxide with carbon.

Explain why aluminium oxide does **not** react with carbon.

.....

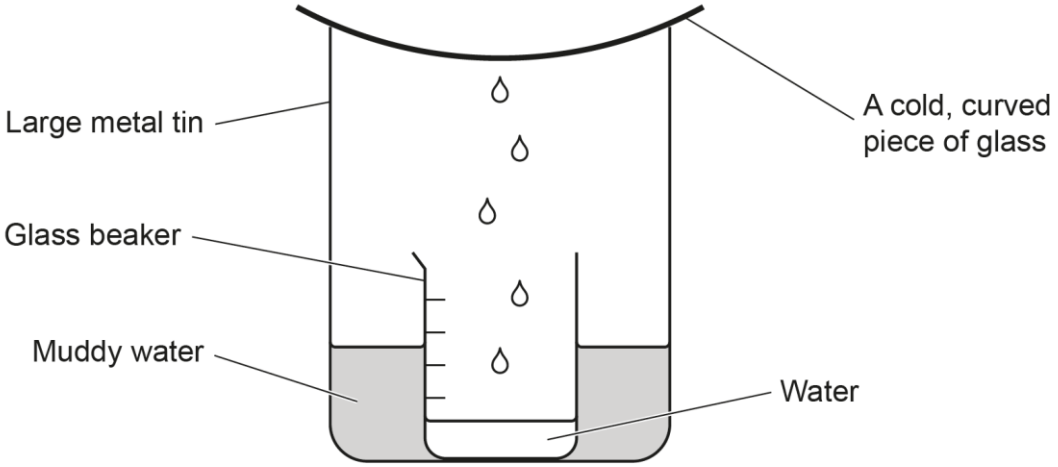
..... **[1]**

Many candidates stated "it" is more reactive than carbon. Unfortunately, the 'it' in this sentence is aluminium oxide and so this response made no sense and did not gain a mark. Some candidates answered in terms of reactivity series and this could gain the mark but several thought carbon was higher than aluminium on the series and so did not gain marks. Other candidates incorrectly thought they needed to talk about the atomic structure and suggested carbon had a full outer shell. It is important candidates understand the reactivity series and can apply this knowledge to specific examples.

Question 12

12 A student does an experiment to separate water from muddy water.

The diagram shows the equipment they use.



The student leaves the equipment in a sunny place.

Explain how the student's equipment separates water from muddy water.

.....

.....

.....

.....

.....

..... **[4]**

This was generally well answered with most candidates picking up at least one mark. Language was often an issue here. Candidates that did not do so well stated that the muddy water evaporated rather than the water. Or they did not explain that the vapour cooled to condense. Other common errors were that the curved glass was to increase the temperature from the sun or was to stop gases escaping.

Exemplar 2

AW Being left in a sunny place inside the large metal tin (increases the temperature inside the tin and) causes the muddy water to evaporate then condense. The curved piece of glass makes the condensed liquid drip into the glass beaker in the middle. Consequently turning muddy water into water. **[4]**

This candidate gains a mark for the sun increasing the temperature inside the tin. They then incorrectly state the muddy water evaporates rather than the water alone. Although they have stated it then condenses they do not say that it has cooled and so cannot gain this mark. It is also not clear if they mean water condenses or muddy water condenses. They do recognise it is the curve of the glass that makes the water drip into the beaker so gained a second mark, 2 marks overall.

Question 13 (a)

13 Crude oil is a mixture of useful hydrocarbons which are separated into fractions.

(a) Which statement describes why crude oil is called a **feedstock** for the petrochemical industry?

Tick **one** (✓) box.

- It's a naturally occurring finite resource. ☐
- It's a source of environmentally friendly fuels. ☐
- It's used to produce other chemicals. ☐

[1]

Misconception

Many candidates do not know what the term 'feedstock' means. This meant many candidates chose the response that they knew was correct for crude oil even though it did not answer the question.

A common wrong answer was 'It's a naturally occurring finite resource' although this is a correct statement about crude oil it does not answer the question asked.

Question 13 (b)

Table 13.1 shows some information about the fractions in crude oil.

Table 13.1

Fraction	Boiling point (°C)	Percentage in crude oil (%)
U	20–200	28
V	above 450	2
W	350–450	.....
X	below 20	4
Y	250–350	15
Z	200–250	21

(b) Calculate the percentage of fraction **W** found in crude oil.

Write your answer in **Table 13.1**.

[1]

Most candidates gained the mark here. Those that did not often divided again by 100 or by 10. Others produced answers such as '3', '1' or other lower figures to match a perceived trend. Candidates should check the answers to their calculations to make sure they are sensible in relation to the question.

Question 13 (c)

(c) The boiling point of a fraction depends on the number of carbon atoms in the molecules.

Complete **Table 13.2** by writing in the letters of **three** fractions shown in **Table 13.1**.

Table 13.2

Number of carbon atoms in the molecules	Fraction
1–4	.....
5–11	.....
12–14	.....

[2]

Many candidates misread or misunderstood this question and tried to give names of the fractions. We would not expect them to know the boiling points of the fractions or the names at each fraction. They just needed to use the data to give the letter relating to the fraction.

Question 13 (d)

(d) Write the letter of the fraction shown in **Table 13.1** which has the **strongest** intermolecular forces.

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

Most candidates gained this mark. There was no common incorrect response.

Question 13 (e) (i)

(e) Many of the hydrocarbons in crude oil are alkanes.

(i) Write the **general formula** for an alkane.

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

Many candidates struggled with this. Some tried to give a specific formula. Some did not include the C or the H. CH_4 was a common incorrect response.

Question 13 (e) (ii)

(ii) Write the formula for an alkane with **14** carbon atoms.

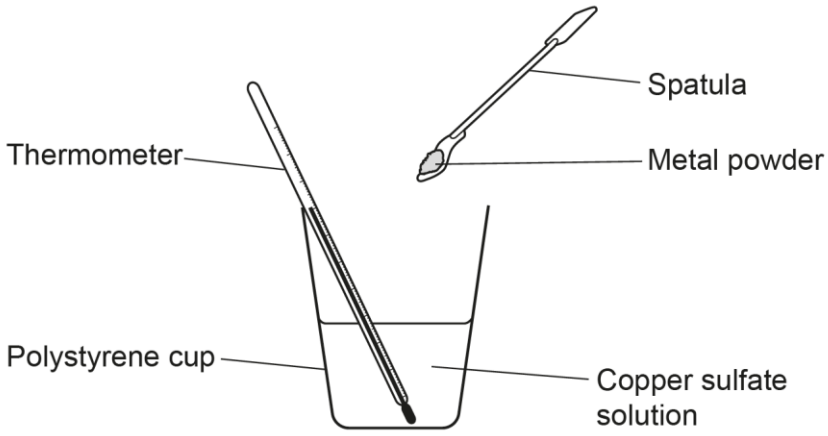
..... **[1]**

Candidates that struggled with 13 (e) (i) also struggled with this question. There was an error carried forward allowed from their answer to 13 (e) (i). However, the formula suggested had to have 14 carbon atoms. Many candidates did not recognise this and gave formulae with different number of carbons. Again, it shows the importance of carefully reading the question and following the instructions.

Question 14 (a)

14 A student investigates the reactivity of four metals.

The diagram shows the equipment they use.



This is their method:

- Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.
- Measure and record the initial temperature of the copper sulfate solution.
- Add two spatulas of a powdered metal and stir the mixture.
- Record the highest temperature reached.

The table shows some of the student's results.

Metal	Initial temperature (°C)	Highest Temperature (°C)	Temperature change (°C)
Tin		34.1	17.8
Zinc		43.6	27.5
Iron		29.7	13.6
Magnesium		47.2	31.0

(a) Calculate the **lowest** initial temperature of the copper sulfate solution.

Lowest initial temperature = ... °C **[1]**

This question was generally well answered. It was important to not just fill in the table but to choose the lowest initial temperature and make this clear. The best way was to write the answer on the answer line but if it was shown in other ways it would have gained credit. Some just added to two temperature columns together and produced such answers as 43.3, possibly having misread the question.

Question 14 (b)

(b) Use the student's results to list the metals in the order of reactivity **obtained by the student**.

Most reactive .....

.....

.....

Least reactive .....

[1]

Again, this was a well answered question. It is important that candidates can practice interpreting data so that they know what to do when dealing with this type of question.

Question 14 (c) (i)

(c) The student's results put the reactivity of iron and tin in the **incorrect** order.

(i) The student thinks that the error could be because they added incorrect masses of each metal.

What piece of equipment could the student use to get a more accurate measurement of the mass of each metal?

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

Incorrect use of correct terminology often prevented candidates from securing this mark. Balance or *scales* would have been acceptable. However, **scale** is not as this has a different meaning that does not answer the question. This is a Higher Tier paper and it is expected that candidates can name equipment correctly.

Question 14 (c) (ii)

(ii) Another student thinks that the error could be because the iron powder used is old and its surface has been oxidised.

Describe and explain how this oxidation could have affected the results for iron.

.....

.....

.....

..... **[2]**

This question was particularly challenging for the majority. Candidates struggled to explain why the iron being oxidised meant that it reacted less. They also did not relate their response to the results. Many candidates tried to explain in terms of ions or in terms of oxidation. Very few realised there was less iron to react with or less surface area available. Even fewer recognised that this would mean a lower temperature change. Careful reading of the question would have directed candidates to describe how the results were affected and then explain them.

Question 14 (d)

(d) The balanced symbol equation for the reaction between magnesium and copper sulfate solution is:

$Mg(s) + CuSO_4(aq) \longrightarrow MgSO_4(aq) + Cu(s)$

The reaction can be written as an ionic equation.

Complete the **balanced ionic** equation for the reaction.

$$Mg + Cu^{2+} \longrightarrow \text{.....} + \text{.....}$$

[2]

Assessment for learning

It would be good practice for candidates to practice writing and balancing ionic equations. The skill is transferable to a range of possible reactions that could be tested. There are a range of resources available from OCR on how to balance equations. These can be found under Activities on Teach Cambridge.

Very few candidates gained both marks here. The most common mark was for Cu. It is also important that the cases and superscript are the correct size.

Question 15 (a)

15 The amount of carbon dioxide in the Earth's atmosphere has changed over time.

(a) What is the percentage of carbon dioxide found in the Earth's atmosphere today?

Tick **one** (✓) box.

0.04% ☐

0.4% ☐

4% ☐

[1]

Misconception

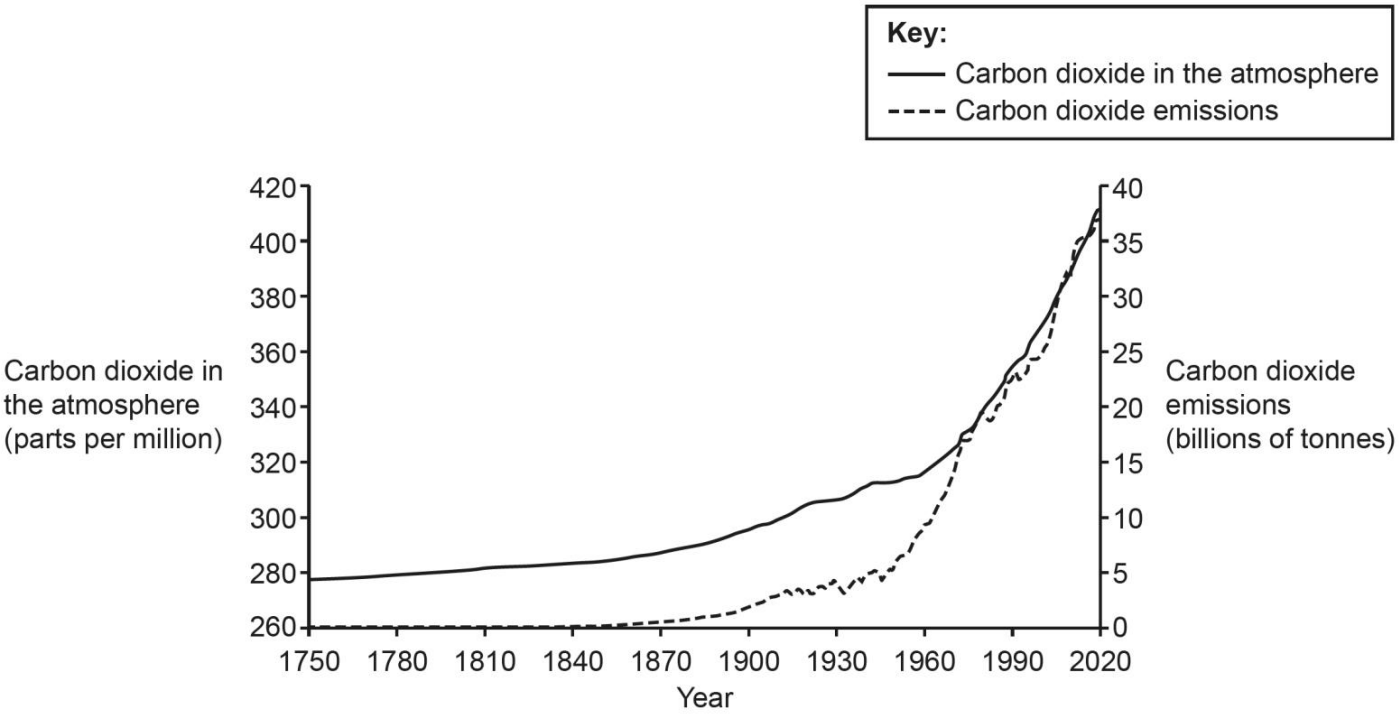
Candidates know that high levels of carbon dioxide cause climate issues, but they struggle to understand that this is a relative number. It is possible this is why very few gave the correct response here. Showing candidates graphs or tables of carbon dioxide levels over time may help them understand what is meant by a high level.

0.4% was a common incorrect answer here.

Question 15 (b) (i)

(b) Most scientists think that the amount of carbon dioxide in the Earth's atmosphere is being increased by human activity.

The graph shows the carbon dioxide in the atmosphere and carbon dioxide emissions from 1750–2020.



(i) Describe the correlation between carbon dioxide in the atmosphere and carbon dioxide emissions.

Most candidates gained a mark for recognising that carbon dioxide in the atmosphere increases when emissions do. Very few recognised that emissions increased more rapidly after around 1930. When interpreting a graph, it is important to use numbers to describe what is happening.

Question 15 (b) (ii)

(ii) Give **one** reason for the change in carbon dioxide emissions after 1960.

.....

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

Most candidates gained a mark here. However, language is very important. Transport did not gain a mark as many modes of transport do not produce carbon emissions. Burning of fossil fuels did not gain a mark as the question asked about the change after 1960. Examiners were looking for *increase* in burning of fossil fuels as fossil fuels have been used for a long time before then.

Question 15 (c) (i)

(c) It is thought that an increase in carbon dioxide in the atmosphere is causing global warming.

(i) Describe how an increase in carbon dioxide in the atmosphere is causing global warming.

.....

.....

.....

..... **[2]**

Many candidates gained the first mark for knowing that carbon dioxide in the atmosphere traps heat or infrared rays. Some were unable to gain that mark due suggesting it trapped UV rays. Less successful responses often referred to either "ozone layer" or "CO_2 being trapped in the atmosphere". Others did not mention that 'heat' from the sun was trapped and instead referred to sunlight. Most did not gain the second mark as they did not link an increase in trapped heat/rays to an increase in temperature.

Question 15 (c) (ii)

(ii) Describe **one** way that the emissions of carbon dioxide by human activity can be reduced.

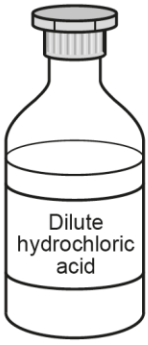
.....

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

Most candidates gained this mark. A common incorrect answer was to plant more trees. This does not answer the question as the question asks how *emissions* can be reduced. It is important to fully read and understand the question and then answer the question asked.

Question 16*

16* A student investigates the rate of reaction between magnesium and an excess of dilute hydrochloric acid.



Strip of magnesium Dilute hydrochloric acid

The student does three experiments. In the experiments they use the same length of magnesium but change one other variable.

The table shows the results of the three experiments.

Experiment	Time for the magnesium to react (s)
1	37
2	26
3	19

Describe the method the student used to get these results, including the variable they may have changed and the variables they controlled.

.....

.....

.....

.....

.....

..... **[6]**

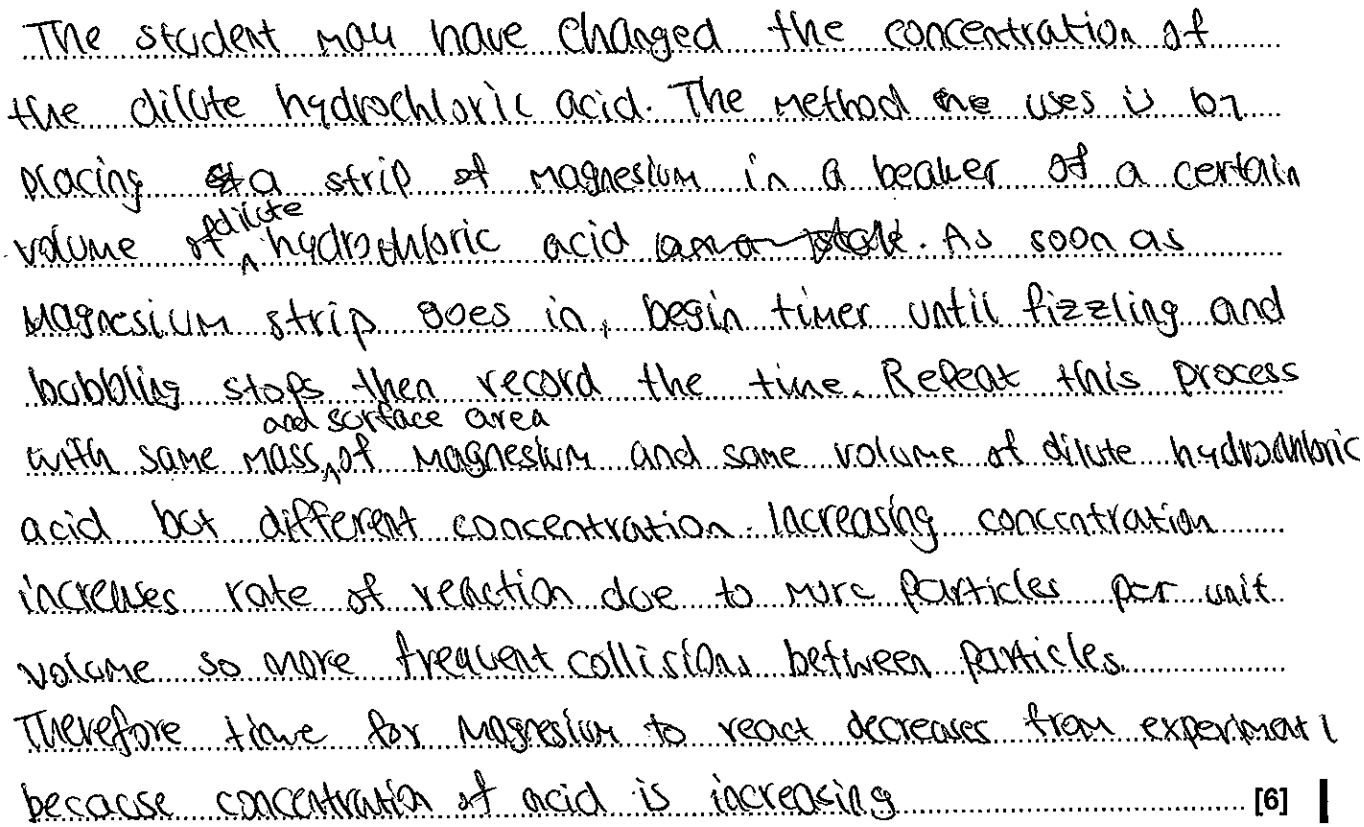
For Level 1 answers candidates gave basic method points but did not recognise any control variables except the one they were given (length of magnesium) and may not have suggested a correct independent variable. Candidates gaining Level 2 suggested appropriate control variables and an independent variable. Those at the top of this Level also gave specific measurements. Candidates who gained Level 3 did all of this but then also related the change in independent variable to the results table.

They also gave more than one control.

Many candidates tried to answer in terms of collision theory. However, this is not what the question asked for. So they were not penalised for this, whether their science was correct or not, but neither did they gain marks.

Some candidates suggested changing more than one variable at once and so were unable to gain higher marks.

Exemplar 3



The student may have changed the concentration of the dilute hydrochloric acid. The method she uses is by placing a strip of magnesium in a beaker of a certain volume of dilute hydrochloric acid and start. As soon as magnesium strip goes in, begin timer until fizzling and bubbling stops then record the time. Repeat this process with same mass and surface area of magnesium and same volume of dilute hydrochloric acid but different concentration. Increasing concentration increases rate of reaction due to more particles per unit volume so more frequent collisions between particles. Therefore time for magnesium to react decreases from experiment 1 because concentration of acid is increasing [6]

This candidate gave a Level 3 answer, 5 marks. They have method points – e.g. placing magnesium into acid. They change the concentration of the acid – independent variable - and controlled the amount of acid – control variable. They give specific measurements – timing the reaction. This would gain Level 2 marks. They also relate different concentrations to the table, which is a Level 3 response, but only give one control variable so were limited to the bottom of the level.

OCR support

OCR's Language of Measurement in Context: Chemistry can be shared with candidates to allow them to work through an example practical and understand where particular terminology can be seen in action.

Question 17 (a)

17 The elements in Group 1 of the Periodic Table show trends in their properties.

The table shows the diameter of atoms and arrangement of electrons for the first three elements in Group 1.

Element	Diameter of atoms (m)	Arrangement of electrons
Lithium	3.04×10^{-10}	2, 1
Sodium	3.72×10^{-10}	2, 8, 1
Potassium	4.54×10^{-10}	2, 8, 8, 1

(a) Describe and explain the trend in the diameter of atoms of the elements in Group 1.

.....

.....

..... **[2]**

Many candidates gained a mark for describing the trend. They did not gain the second mark as they did not explain the trend. Some candidates misread or misunderstood the question and answered in terms of reactivity. This was ignored but usually meant they did not answer the question asked.

Question 17 (b)

(b) Rubidium is the element below potassium in Group 1.

Predict the diameter of atoms of rubidium.

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

This question was generally answered very well. Some candidates did not give the full answer in standard form so suggested numbers such as 5.40 and did not gain the mark. Others tried to answer in words, e.g. diameter will be bigger which was not sufficient for the mark.

Question 17 (c)

(c) Describe and explain how the diameter of the atoms affects the reactivity of the elements in Group 1.

.....

.....

.....

.....

.....

..... **[4]**

Most candidates gained at least one mark here. Marks were often not given due to imprecise terminology. Candidates wrote about electrons without specifying outer electrons and so did not gain mark point 2. "Intermolecular forces" was often found in candidates' responses which showed a lack of understanding. Some candidates only answered in terms of the reactivity trend in the group and did not relate this to diameter. They had not read the question carefully. This meant that at least mark point one was not accessible to them and they possibly then struggled to gain further marks.

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