Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE CHEMISTRY B

J258

For first teaching in 2016

J258/01 Summer 2022 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 are 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.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 1 series overview

There was definite evidence of clear understanding, but examiners got a strong sense that many candidates lacked confidence, and so far more questions than normal were omitted by candidates. There was also the suspicion that some of those 'no response' questions were because the context looked unfamiliar, rather than the concepts being unfamiliar. Candidates were clearly comfortable with the time allocation and were able to work their way through to the end of the paper.

As usual, when marking mathematical questions examiners award full marks for the correct answer. We only look at the working if the answer is incorrect, and even then, we are not looking to penalise, we are looking for any signs of an appropriate procedure having been followed. Examiners actively try to award credit; it is important candidates show their working as if they have a correct calculation step, they can still be given marks.

Finally, and as always, any written examination is an exercise in communication. Examiners are completely dependent on the written answer to work out what the candidate meant, so the more clearly the candidates can express themselves, the more likely they are to be able to demonstrate their understanding.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• attempted questions even when they looked unfamiliar. • showed their working for mathematical questions. • read the question carefully.	• omitted questions. • gave an answer to mathematical questions but no indication of working.

Question 1 (a)

1 Earth's early atmosphere contained mostly carbon dioxide and water vapour.

(a) As the Earth cooled, water vapour turned to liquid water and the oceans formed.

Complete the sentence to explain why the oceans formed.

Put a (ring) around the correct answer.

The oceans formed because the water vapour **boiled / condensed / evaporated / froze**. **[1]**

Most candidates correctly identified 'condensed' as the correct term. Those who chose incorrectly still showed their familiarity with the topic by going for 'evaporated'.

Question 1 (b)

(b) Gradually, plants began to grow on the Earth.

Complete the sentences to describe how an oxygen-rich atmosphere has developed over time.

Use words from the list.

carbon dioxide	**combustion**	**methane**	**nitrogen**	**photosynthesis**

Plants make oxygen in a process called ....

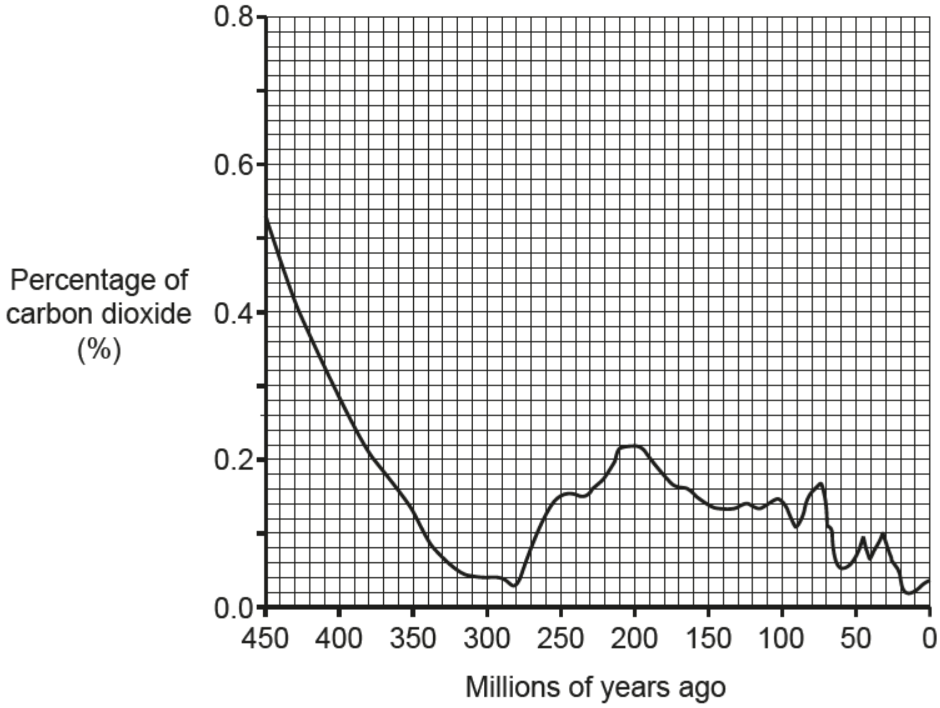
This process uses a gas called ....

[2]

Almost all candidates chose at least one of the terms correctly.

Question 1 (c) (i)

(c) The graph shows how the percentage of carbon dioxide in the atmosphere has changed over time.



(i) Describe how the percentage of carbon dioxide in the atmosphere has changed over the last 300 million years.

Use data from the graph in your answer.

....

....

....

.... **[2]**

The most able candidates identified the correct portion of the graph and not only described the trend shown but backed their description with relevant numerical information. Those candidates who described the whole graph were still able to gain some credit.

Question 1 (c) (ii)

(ii) State the percentage of carbon dioxide in the atmosphere 200 million years ago.

Percentage = ... % **[1]**

Graph reading skills were generally excellent.

Question 1 (c) (iii)

(iii) 400 million years ago there was 0.28% carbon dioxide in the atmosphere.

Today there is 0.04%.

Calculate how many times more carbon dioxide there was 400 million years ago compared with today.

There was .... times more carbon dioxide 400 million years ago. **[1]**

Most candidates correctly stated that there was 7 times more carbon dioxide. A minority subtracted the two numbers and suggested 0.24.

Assessment for learning

Examiners noticed the tendency to approach all mathematical calculations by subtracting any small number from a large number. Candidates could usefully be trained to recognise that questions involving ratios are unlikely to involve subtraction as a major stage!

OCR support

The Mathematical Skills Handbook provides both teachers and students support on the use of mathematical skills in GCSE sciences.

Question 2 (a)

2 **(a)** Complete the sentence to describe how Mendeleev placed elements in the Periodic Table.

Use words from the list.

atomic	**colour**	**molecular**	**properties**	**size**

Mendeleev organised the elements based on their .... and their relative

.... masses.

[2]

Relative atomic masses were well recognised as a basis for Mendeleev's table, and many also knew that properties was the other missing word.

Question 2 (b) (i)

(b) **Table 2.1** shows the properties of some elements.

Name	**Atomic number**	**Melting point (°C)**	**Appearance**	**Electrical conductivity**
Lithium	3	181	shiny when cut	good
Boron	5	2076	black	poor
Magnesium	12	650	shiny	good
Phosphorus	15	44	white/yellow	poor

Table 2.1

(i) Which **two** elements in **Table 2.1** are metals?

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

This question was well answered.

Question 2 (b) (ii)

(ii) Which **column** in **Table 2.1** did you use to work out your answer to **(b)(i)**?

.... **[1]**

Electrical conductivity was the major answer, but all the columns were chosen by some. Candidates who answered 'column 5' scored the mark.

Question 2 (b) (iii)

(iii) The elements in **Table 2.1** are all solids at room temperature (25 °C).

How does the data in the table show that this is true?

....

.... **[1]**

It was important to link melting point to room temperature/25°C in this question, and many candidates did so clearly.

Question 2 (b) (iv)

(iv) What does atomic number tell you about the nucleus of an atom?

....

.... **[1]**

Candidates demonstrated a clear familiarity with the basics of atomic structure, even if they were uncertain of the precise details. Furthermore, almost all the answers discussed protons. Many added that the number of protons would be the same as the number of electrons, even though that was not the point of this question

Question 2 (c) (i)

(c) Iodine and chlorine are halogens in Group 17 (Group 7).

(i) Draw lines to connect each **halogen** with its correct **appearance** at room temperature (25 °C).

Halogen	Appearance
	Grey solid
Chlorine	Purple gas
Iodine	Green gas
	Brown liquid

[2]

Surprisingly, one of the most common responses at all levels was to link chlorine to the grey solid and iodine to the brown liquid.

Question 2 (c) (ii)

(ii) Sodium iodide solution reacts with chlorine.

Complete the word equation for this reaction.

sodium iodide + chlorine ⟶ iodine + ...

[1]

Candidates who were familiar with word equations answered this well. Even those who were clearly unfamiliar engaged positively with the question and tried to give plausible answers.

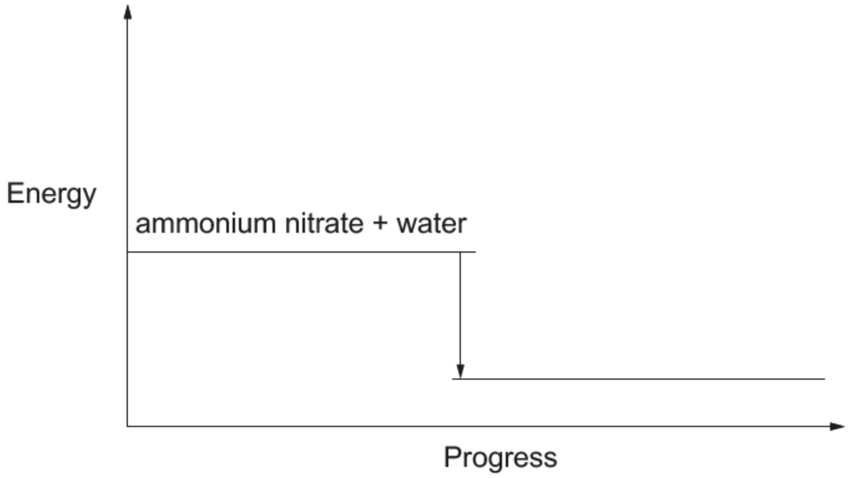
Question 3 (a) (i)

3 'Cool packs' containing ammonium nitrate are used to treat sports injuries.

(a) Ammonium nitrate absorbs energy when it dissolves in water.
The temperature of the water falls.

(i) Which energy level diagram shows the energy change when ammonium nitrate dissolves in water?

Tick (✓) **one** box.



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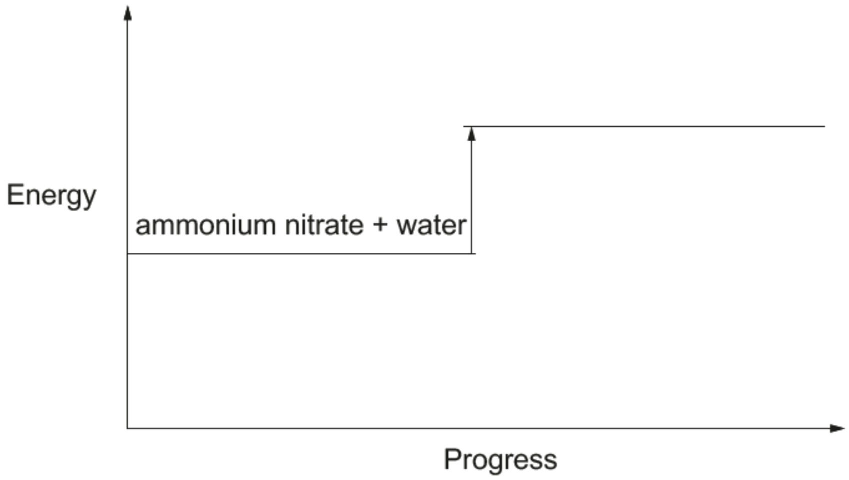

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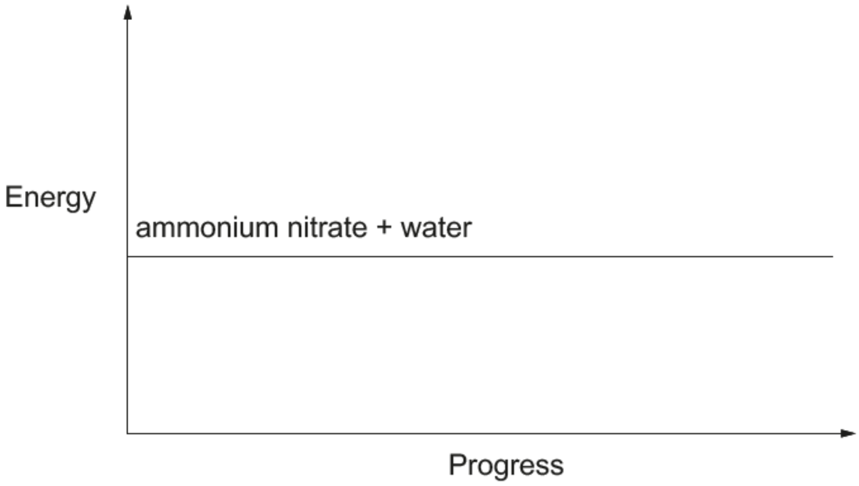


☐

[1]

Candidates were clearly a lot more familiar with exothermic reactions, and many went for the first option.

Assessment for learning

Candidates should be given the opportunity to experience endothermic reactions for themselves, and to marvel at them.

Question 3 (a) (ii)

(ii) Which label should be used for the product of the dissolving process?

Tick (✓) **one** box.

Ammonium nitrate liquid ☐

Ammonium nitrate solution ☐

Ammonium nitrate solvent ☐

[1]

Almost all candidates realised that solution and solvent were the terms that related best to 'dissolving', and there was a fairly equal split between these two responses.

Question 3 (a) (iii)

(iii) Which word describes this dissolving process?

Tick (✓) **one** box.

Decomposition ☐

Endothermic ☐

Exothermic ☐

Precipitation ☐

[1]

The focus here shifts from an emphasis on dissolving to the nature of this particular solution process and required candidates to step back and look at the reaction from a different direction. Many responses suggested that candidates had not been able to take that step.

Question 3 (b)

(b) Eve has some solid ammonium nitrate.

Describe the experiment Eve can do to find out how far the temperature of the water falls when solid ammonium nitrate dissolves in water.

....

....

....

....

.... **[3]**

Candidates who outlined some simple procedure gained full credit, and broad statements such as 'take the temperature at the beginning and the end' without any further detail gained partial credit.

Even candidates unable to gain credit for this question showed a willingness to attempt it, with responses such as 'do a temperature experiment'.

Many found it difficult to relate to the idea of an endothermic reaction and suggested heating the water to start with.

Exemplar 1

Eve can record the temperature of the water using a thermometer. Then disolve ammonium nitrate in the water and record the new temperature of the water. **[3]**

The candidate has understood what the question is asking for, and has provided a clear, structured response that gives the three stages in sequence. This response was given all 3 marks.

OCR support

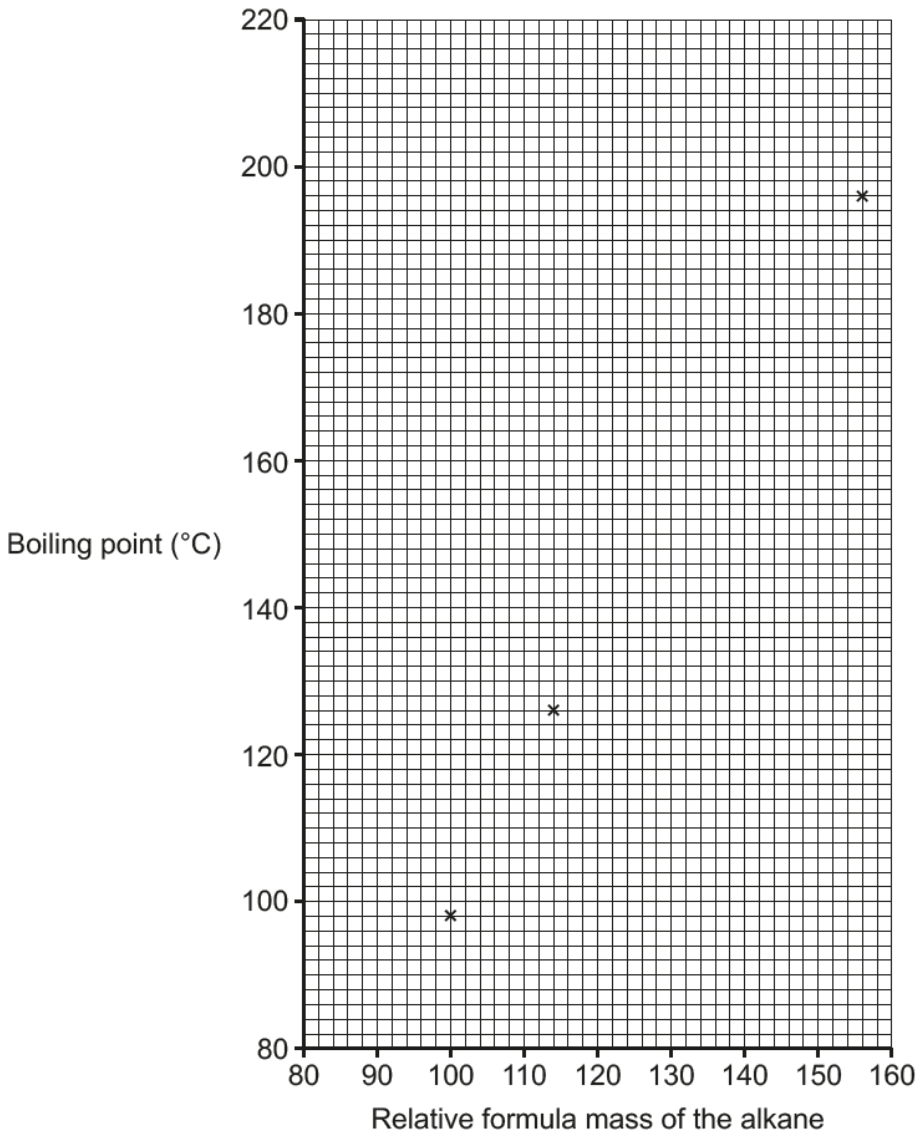
PAG C5 indicates that candidates should be able to make and record appropriate observations during chemical reactions including changes in temperature. The Practical support guide has a variety of videos, activities and simulations that can be shared with candidates.

Question 4 (a) (i), (ii) and (iii)

4 Crude oil contains many alkanes. The table shows some of these alkanes:

Alkane	Formula	Relative formula mass	Boiling point (°C)
Heptane	C_7H_{16}	100	98
Octane	C_8H_{18}	114	126
Decane	$C_{10}H_{22}$	142	174
Undecane	$C_{11}H_{24}$	156	196

(a) The graph shows how boiling point changes with relative formula mass for three of the alkanes.



(i) Plot the point for decane on the graph. **[1]**

(ii) Draw a line of best fit. **[1]**

(iii) The relative formula mass of C_9H_{20} is 128.

Use the graph to estimate the boiling point of C_9H_{20}.

Boiling point of C_9H_{20} = ... °C **[1]**

While most candidates plotted the point correctly, drawing a clean line caused considerable problems for some, and reading the point off their own graph proved to be even more difficult.

Candidates frequently drew their line well away from some points in order to make that line go through the origin.

Assessment for learning

Graphs do not always go through the origin.

OCR support

Our GCSE (9-1) Science Exam hints for students is a useful resource to provide students with when revising to help them avoid this common issue. They can also be downloaded as an A3 version to display in classrooms.

Question 4 (b) (i)

(b) **(i)** The general formula of alkanes is C_nH_{2n+2}. Pentane has five carbon atoms.

State the formula of pentane.

.... **[1]**

Many candidates were able to translate the general formula into the specific formula for pentane.

Question 4 (b) (ii)

(ii) Complete the word equation for the reaction when pentane burns completely in oxygen.

pentane + oxygen ⟶ carbon dioxide + ...

[1]

Some candidates forgot that the name 'pentane' referred to a hydrocarbon and instead thought of it as some unknown substance and suggested answers such as 'pentoxide'.

Question 4 (c) (i)

(c) **(i)** What is the **simplest** ratio of carbon atoms to hydrogen atoms in ethane (C_2H_6)?

Simplest ratio of carbon atoms : hydrogen atoms = ... : .... **[1]**

Many candidates were able to give the simple ratio.

Question 4 (c) (ii)

(ii) State the empirical formula of ethane (C_2H_6).

Empirical formula .... **[1]**

'Empirical formula', being a technical term, was not recognised, even by able candidates.

Question 4 (d)

(d) Complete the sentences to describe C–C bonds.

Use words from the list.

covalent	**given**	**ionic**	**shared**

C–C bonds are ....

The electrons between the carbon atoms are ....

[2]

The question was well answered, with C-C bonds being covalent better understood than the fact the electrons are shared.

Question 4 (e)

(e) Ethanol, C_2H_5OH can be made from crude oil.

Why is the OH group in ethanol called the **functional group**?

Tick (✓) **one** box.

It contains an oxygen atom. ☐

It is at one end of the molecule. ☐

It contains a covalent bond. ☐

It gives ethanol its chemical properties. ☐

[1]

Again, the fact that 'functional group' is a technical term meant that it was frequently not recognised, with the first or third box being the more popular choices.

OCR support

Teachers might find this delivery guide helpful for reinforcing the concepts and terminology in chapter C3.4 Why is crude oil important as a source of new materials. This contains video links, worksheets and weblinks to support teachers and students.

Question 5 (a) (i)

5 This question is about the reactivity of metals.

(a) Magnesium reacts with iron sulfide.

magnesium + iron sulfide → iron + magnesium sulfide

(i) The formula for iron sulfide is FeS.
The formula for magnesium sulfide is MgS.

Write a **balanced symbol** equation for this reaction.

.... **[1]**

To answer this question, candidates were required to amalgamate information from the previous rows of the question stem. Most candidates approached this very well, with the main problem being a desire to put '2's into the equation. Some gave responses such as "$FeSMgS_2$".

Question 5 (a) (ii)

(ii) How does this reaction show that magnesium is above iron in the reactivity series?

....

.... **[1]**

Many candidates described displacement using their own terminology and were often able to gain credit. The more able candidates were able to use the term itself.

Question 5 (b)

(b) Complete the sentences about the reactivity of metals with acids.

Use words from the list.

electrons	**protons**	**quickly**	**slowly**

Metals higher in the reactivity series react with acids more ....

This is because they form positive ions more easily by losing ....

[2]

This was well answered, with metals reacting quicker being better understood than the fact that they formed ions by losing electrons.

Question 6 (a)

6 **(a)** Iron ore contains iron oxide. Iron ore reacts with carbon to make iron.
This is a word equation for the reaction:

iron oxide + carbon ⟶ iron + carbon monoxide

Which statement describes this reaction?

Tick (✓) **one** box.

Iron is oxidised. ☐

Carbon is reduced. ☐

Iron oxide is reduced. ☐

Carbon monoxide is oxidised. ☐

[1]

That the iron oxide is reduced was not well understood.

Question 6 (b)

(b) 160 g of iron oxide makes 112 g of iron.

Calculate the mass of iron in 100 g of iron oxide.

Mass of iron = ... g **[2]**

Candidates of all abilities had great difficulty with this question although, unsurprisingly, the more successful candidates fared better.

Question 6 (c)

(c) Iron is used to make steel.

Complete the sentences about steel.

Use words from the list.

alloys	**aluminium**	**carbon**	**ceramics**	**polymers**

Steel contains atoms of iron and ………………………… .

Steel is an example of materials known as ………………………….. .

[2]

While many of the more successful candidates knew that steel contains carbon, most others suggested aluminium. Alloys as a term was better recognised, with polymers being the most frequent other option.

Question 6 (d)

(d) The main disadvantage of using steel is that it rusts.

Complete the sentences about rusting.

Use words from the list.

barrier	**carbon dioxide**	**nitrogen**	**reduction**	**solution**	**water**

Steel rusts when it reacts with oxygen and ....

Rusting can be prevented by covering the steel with grease,

which forms a ....

[2]

Candidates were very comfortable with this aspect of rusting.

Question 6 (e)

(e) Used steel is collected and recycled.

Which statements about recycling are advantages and which are disadvantages?

Tick (✓) **one** box in each row.

	Advantage	**Disadvantage**
Recycling steel uses much less energy than making iron and steel from iron ore.		
Materials must be collected and sorted in recycling.		
Raw materials (metal ores) are not used in recycling.		

[2]

Whereas recycling was far less well understood. Many suggested that the need to collect and sort would be an advantage, and even more did not realise that avoiding smelting iron ore would bring huge energy savings.

Question 7 (a)

7 Jack adds the **same** volume of dilute sulfuric acid to three different samples of solid zinc carbonate.

(a) Complete the sentence.

The gas made when the reaction fizzes is called carbon .... **[1]**

Most recognised that the gas would be carbon dioxide, although a sizeable minority went for carbon monoxide.

Question 7 (b) (i)

(b) Here are Jack's results:

Experiment	Mass of zinc carbonate (g)	Type of zinc carbonate	Time to stop fizzing (minutes)
1	2.0	lumps	10
2	2.0	powder	6
3	4.0	lumps	

(i) Jack looks at his results from **Experiment 1** and **Experiment 2**.

How do the results of these two experiments show that the powder reacts faster than the lumps?

....

.... **[1]**

Most candidates appeared to appreciate how the results showed that powder reacts faster, but often did not communicate their understanding clearly enough. Answers such as 'because the fizzing stopped after 6 minutes', with no extra detail, while common were not enough to gain credit.

Assessment for learning

Words in the question stem such as 'faster' require candidates to compare TWO situations, and the answers need to mention or imply that comparison clearly.

Question 7 (b) (ii)

(ii) Explain why the powder reacts **faster** than the lumps.

Use ideas about particles in your answer.

....

....

....

.... **[2]**

There was clear intuitive understanding of why powder reacts faster. However, only a few candidates were able to relate this to surface area and collisions. Of these, there was the usual cohort who assumed that increased collision frequency could only be caused by particles moving faster.

Exemplar 2

The powder allows for more succesful collisions between the particles as the powder has more of it's surface exposed to the sulfuric acid.

In this case examiners were prepared to accept 'more collisions', but the candidate has provided a much better response.

While not using the conventional phraseology 'greater surface area' the candidate has still demonstrated their understanding of the effect on surface area, so gains that mark as well.

Question 7 (c)

(c) What is the most likely time taken for **Experiment 3**?

Tick (✓) **one** box.

Less than 6 minutes.	☐
6 minutes.	☐
Between 6 and 10 minutes.	☐
10 minutes.	☐
Longer than 10 minutes.	☐

[1]

Most candidates correctly chose the last response.

Question 7 (d)

(d) At the end of **Experiment 2**, the mixture formed contains a solution of zinc sulfate with some unreacted solid zinc carbonate.

Jack filters the mixture to remove the unreacted solid zinc carbonate.

Describe how Jack can obtain a sample of zinc sulfate crystals from the solution.

....

....

....

.... **[2]**

Many candidates demonstrated some familiarity with the crystallisation process but had enormous difficulty in putting their understanding into words. There were many references to boiling the liquid, and few appeared familiar with act of crystallisation itself.

Question 7 (e)

(e) Jack makes 6.6 g of zinc sulfate. He calculates that he should have made 9.8 g.

Calculate the percentage yield.

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

Use the equation: $\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

Percentage yield = ... % **[3]**

The calculation was generally well answered, with many candidates scoring the third mark by giving their answer to two significant figures.

Question 8 (a)

8 Sara compares two drain cleaners called 'Drainclear' and 'Noblock'.
Both drain cleaners contain a solution of sodium hydroxide.

Sara titrates the **same** volume of each drain cleaner with the **same** concentration of dilute hydrochloric acid.

(a) Which word describes the reaction between sodium hydroxide and hydrochloric acid?

Tick (✓) **one** box.

Oxidation ☐

Reduction ☐

Neutralisation ☐

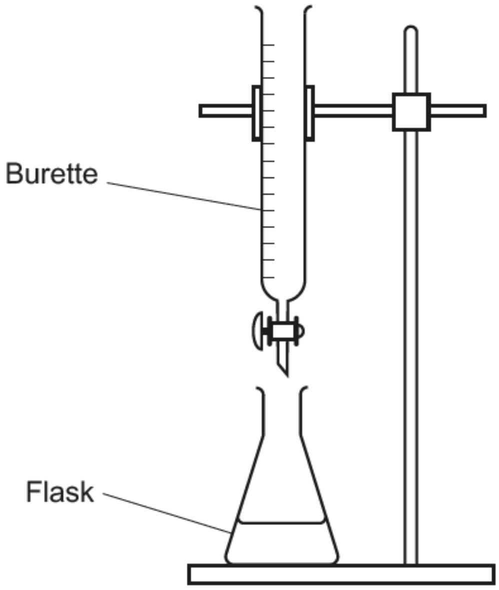
Condensation ☐

[1]

Successful candidates realised this was a neutralisation reaction.

Question 8 (b)

(b) This is a diagram of Sara's apparatus:



This is Sara's method:

- Put 25.0 cm^3 of drain cleaner into the flask.
- Add an indicator to the drain cleaner.

Write down the next **two** steps of Sara's method to get to the end-point of the titration.

1 ....

....

2 ....

....

[2]

Titrations as a procedure was not well recognised. However, most were able to suggest or imply opening the tap, and a few discussed the possibility of a colour change. There was much confusion about whether the drain cleaner was in the flask or in the burette.

Question 8 (c) (i)

(c) Here are Sara's results:

Drain cleaner	Accurate titration results (cm^3)			Mean volume of hydrochloric acid (cm^3)
Drainclear	6.85	6.80	6.75	6.80
Noblock	20.45		20.35	20.40

(i) Calculate the missing titration result for Noblock.

Answer = ... cm^3 **[1]**

This question was very well answered.

Question 8 (c) (ii)

(ii) Look at the mean volume of hydrochloric acid used for each drain cleaner.

What can you conclude about the amount of sodium hydroxide in Drainclear and Noblock?

Give **one** reason for your answer.

Conclusion ....

....

Reason ....

.... **[2]**

This part of the question further highlighted the lack of familiarity with titrations as a procedure, with many candidates thinking that the higher titration result showed that there was more hydrochloric acid in Noblock.

OCR support

There are two suggested activities for PAG 6 available within our list of practical activities, and it includes guidance for teachers and technicians, as well as activities to reinforce key concepts and expected answers.

Question 9 (a)

9 (a) When molten compounds are electrolysed:

- the metal is made at the negative electrode
- the non-metal is made at the positive electrode.

State what is made at each electrode when **molten** aluminium oxide is electrolysed.

Negative electrode ....

Positive electrode ....

[2]

Again, this question required candidates to amalgamate the information from the first three lines of question, and for many this was a difficult task.

Able candidates identified aluminium and oxygen with ease, but others appeared to treat the command line of the question as a stand-alone instruction and gave a fairly random set of answers such as 'dissolve' and 'solid'.

Some of those who did think about the first three lines sometimes did not notice the reference to aluminium oxide in the command line, and so wrote down 'metal' and 'non-metal' as their answer.

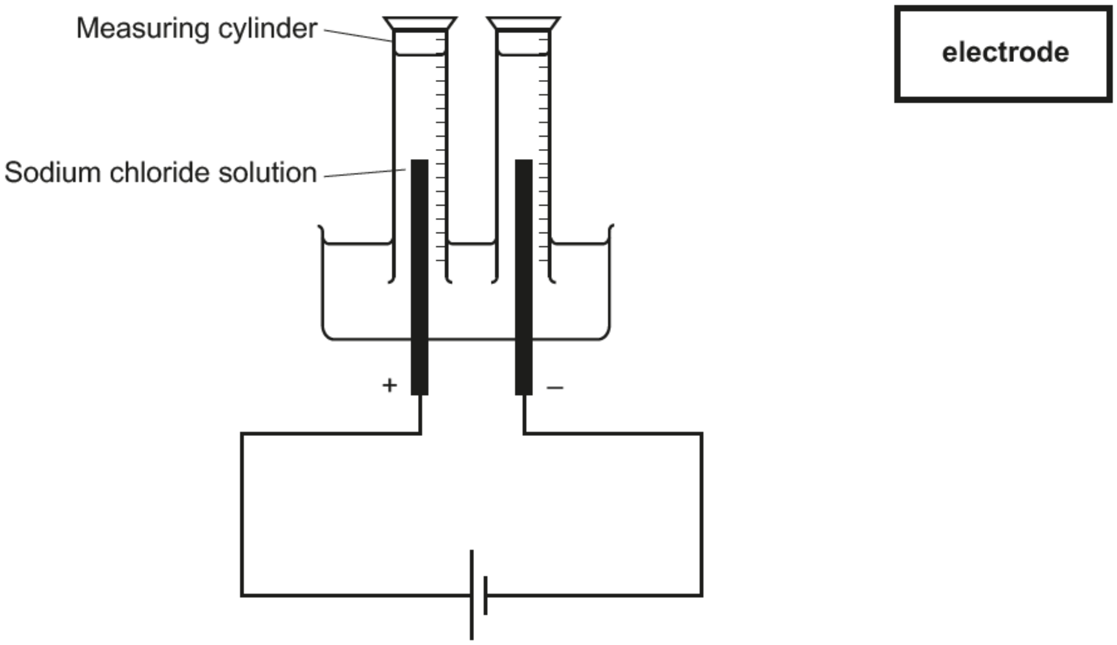
Assessment for learning

As ever, read the question carefully! Candidates are working under great pressure in an examination and this sort of error is all too easy to make. They should be encouraged to step back and check that the question they see in their heads is the one that is written on the page. It helps to mark up the stem of the question to show any key points, and any instructions.

Examiners are very sympathetic but have to mark to the response as written.

Question 9 (b) (i)

(b) Nina electrolyses sodium chloride **solution**, using inert (unreactive) electrodes.



(i) Draw a line to connect the box labelled **electrode** with the correct part of the diagram. **[1]**

There were many correct lines here, and these correct answers linked strongly to a candidate's overall performance.

Question 9 (b) (ii)

(ii) Explain why Nina places a measuring cylinder containing sodium chloride solution over each electrode.

....

....

....

.... **[2]**

A very few candidates recognised why the tubes were used, although this seemed to depend on specific experience rather than overall ability.

Question 9 (b) (iii)

(iii) Sodium is **not** made at the negative electrode when sodium chloride solution is electrolysed.

Name the gas made at the negative electrode.

.... **[1]**

This was another question that demanded candidates think carefully about the specific context. Chlorine as an answer was understandably, far and away the most common response, but showed the failure to relate to the details of this electrolysis.

OCR support

The Electrolysis Topic exploration pack could be used to develop understanding for this topic by providing extra teacher guidance and a range of activities to use in the classroom.

Question 10 (a) (i)

10 Jamal has a sample of copper sulfate crystals.

The copper sulfate crystals have been accidentally mixed with graphite powder. Graphite is a form of carbon.

(a) Jamal dissolves the sample of copper sulfate crystals in water.

(i) Complete the sentence to explain why graphite can be separated by filtering it out.

Use **one** word from the list.

aqueous	**insoluble**	**non-aqueous**	**soluble**

Graphite can be separated by filtering it out because graphite is .... in water.

[1]

Most candidates correctly chose 'insoluble', although examiners did wonder if some candidates were double-thinking themselves on this question.

Question 10 (a) (ii)

(ii) Jamal is using mixtures and pure substances.

Complete **Table 10.1** to identify which are mixtures and which are pure substances.

Tick (✓) **one** box in each row.

	Mixture	**Pure substance**
Copper sulfate crystals		
Graphite powder		
Copper sulfate mixed with graphite powder		

Table 10.1

[2]

While graphite powder and copper sulfate mixed with graphite were correctly identified, candidates found it a challenge to classify copper sulfate crystals correctly.

Question 10 (b)

(b) **Table 10.2** shows **two** tests Jamal does on the copper sulfate solution:

Test	**Result**
Add sodium hydroxide solution	....
Add acidified barium chloride solution	....

Table 10.2

Complete the results in **Table 10.2** by writing what Jamal sees when he does the tests.

[2]

There were very few correct responses here. Those candidates who attempted it usually made intelligent guesses such as 'a colour change', but few suggested precipitation.

Question 11 (a)

11 Mia investigates the rate of reaction when zinc reacts with dilute sulfuric acid.
She adds zinc pieces to dilute sulfuric acid at room temperature.

Fig. 11.1 shows the apparatus she uses:

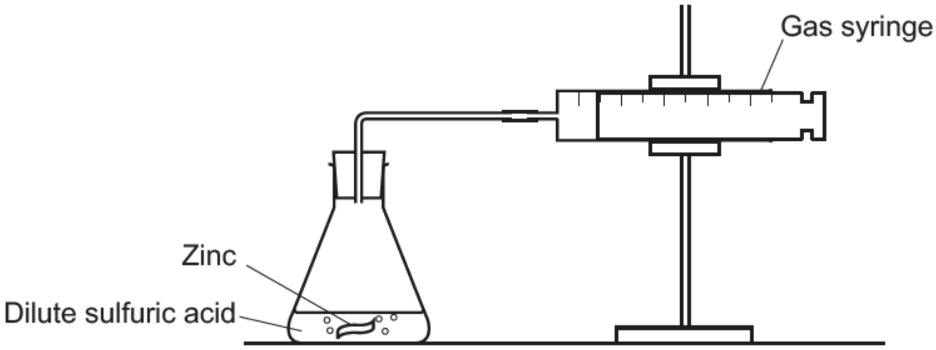


Fig. 11.1

(a) Complete the symbol equation for the reaction.

Include a **state symbol**.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + ...$$

[2]

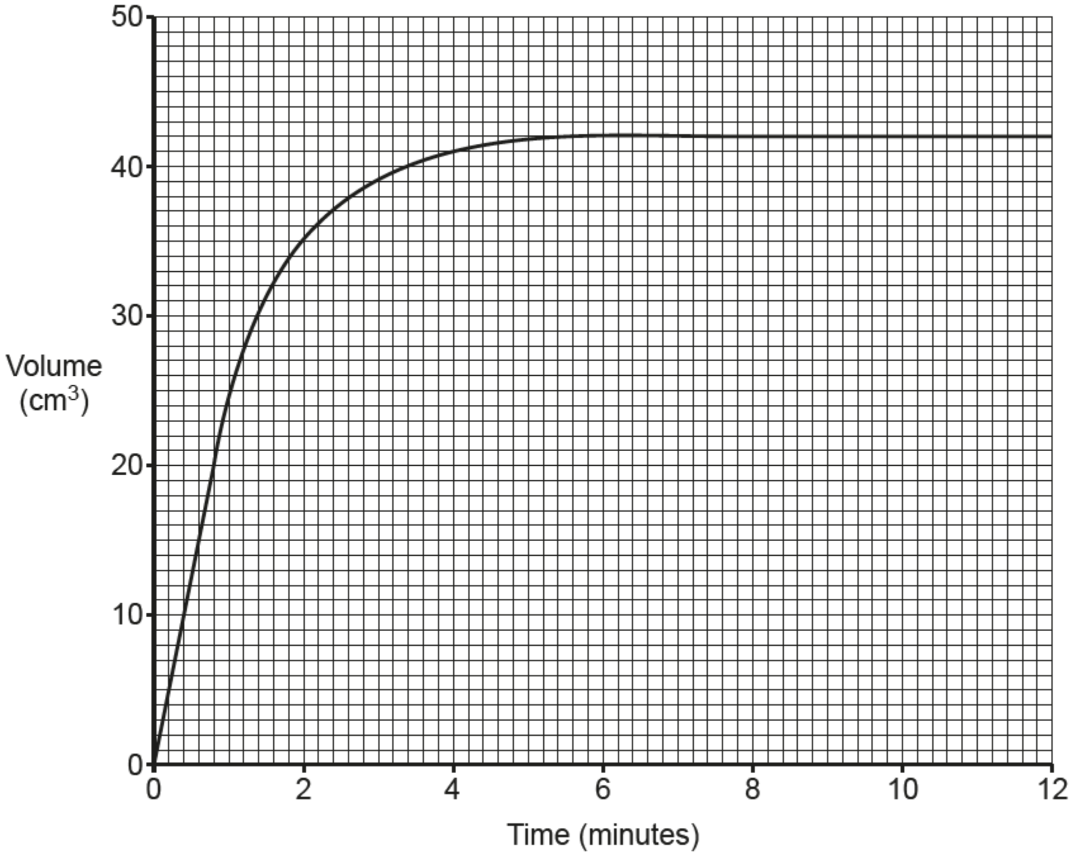
This question was the first of the two questions which were common to the Higher Tier paper, and so was expected to be more difficult than the rest of the paper.

H_2 was identified by many candidates, the state symbol by the most successful only.

Question 11 (b) (i)

(b) Mia measures the volume of gas in the gas syringe every two minutes.

Fig. 11.2 shows a graph of her results:



(i) Calculate the rate of reaction during the first minute, using **Fig. 11.2**.

Give your answer in cm^3/s.

Rate of reaction = ... cm^3/s **[3]**

Highly successful candidates carried out this calculation without too much difficulty, although many lost marks by making a simple mistake, getting the wrong answer, and not showing their working. Far more candidates were able to gain some credit from their working despite their incorrect final answer.

Question 11 (b) (ii)

(ii) Explain why the mass of the flask and its contents decreases during the reaction.

....

.... **[1]**

The most successful candidates understood that the mass of the flask decreased due to loss of gas.

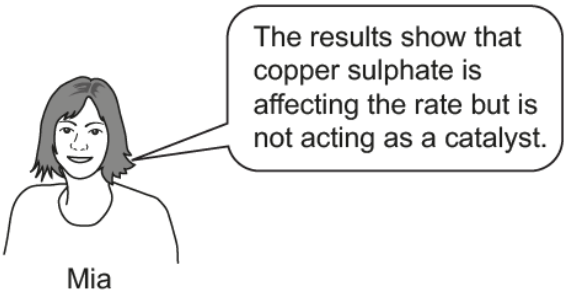
Question 11 (c)

(c) Mia repeats the experiment at the same temperature.
She adds a few drops of blue copper sulfate.

Her results show that:

- more gas is produced in the first minute, than in the first experiment.
- the blue colour changes to colourless during the reaction.

Mia makes a statement about the results:



How do the results support Mia's statement?

Explain your answer.

....

....

....

....

....

.... **[3]**

Mia's statement contains several components, and candidates were required to discuss each component to gain full credit.

Firstly, the effect of copper sulfate on rate must be recognised. Secondly, that catalysts are not 'used up' in a chemical reaction and thirdly, candidates should show they understand what the change in colour of the copper sulfate is telling them.

Candidates often appeared to understand one or two of these points although, even then, many had problems expressing their ideas clearly enough to be given credit.

Exemplar 3

The copper sulfate helps to speed up the rate of reaction but it is used up in the process meaning it cannot be a catalyst. ✓ A catalyst cannot be used up in the reaction and we see the copper sulphate used up when it's colour changes to colourless.

This candidate clearly states the effect of the copper sulfate on reaction rate, gives a brief reason why it cannot be acting as a catalyst, and then quotes the colour change as evidence. This response was given 3 marks.

Question 11 (d)

(d) Mia repeats the experiment at a **higher** temperature.

Which statements explain why the reaction is faster at a higher temperature?

Tick (✓) **two** boxes.

The particles move faster. ☐

There are more frequent collisions. ☐

The yield is higher at a higher temperature. ☐

The particles are closer together. ☐

The zinc breaks down into smaller pieces. ☐

[2]

Most candidates were able to score at least 1 mark here, and many scored both.

Question 12 (a)

12 The table shows some properties of metals, polymers and clay ceramics:

Type of material	Effect of force on material	Electrical conductivity	Hardness
Metals	malleable	good	hard
Polymers	flexible	poor	soft
Clay ceramics	snaps	....	....

(a) Complete the table by adding the two missing properties of clay ceramics. **[2]**

This was the second question which was common with the Higher Tier paper.

Higher attaining candidates scored both marks, and many others gained at least 1 mark. The most common mistake was to describe ceramics as soft.

Question 12 (b)

(b) Layla has three different water jugs.
The jugs are made from aluminium, poly(ethene) and pottery (clay ceramic).

Draw lines to connect each **material** with its correct **property**.

Material	Property of jug
	Softens easily when heated.
Aluminium	
	Goes out of shape if dropped.
Poly(ethene)	
	Breaks if dropped.
Pottery	
	Rusts quickly.

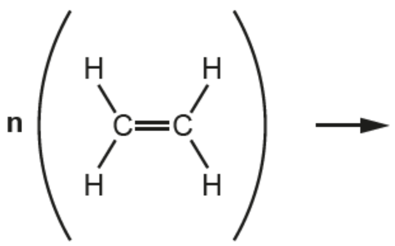
[3]

Many candidates found this question challenging. The fact that rusting is a property which only applies to iron caused great confusion, with almost all candidates linking it to aluminium. Other candidates were often uncertain how to classify poly(ethene). However, that pottery broke when dropped was well known.

Question 12 (c)

(c) Poly(ethene) is made from ethene.

Complete the equation by drawing the structure of the repeating unit of poly(ethene).



Ethene **Poly(ethene)**

[1]

The repeating unit is a concept that continues to be challenging for many candidates, and this year was no exception. Even the higher scoring candidates experienced great difficulty here.

Question 12 (d)

(d) Genes are made from the natural polymer DNA.

Which monomers make DNA?

Tick (✓) **one** box.

Cellulose ☐

Nucleotides ☐

Sugars ☐

Unsaturated hydrocarbons ☐

[1]

This part was well answered by all candidates.

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