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Examiners' report

GCSE

GATEWAY SCIENCE CHEMISTRY A

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

J248

For first teaching in 2016

J248/02 Summer 2025 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 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.

Paper 2 series overview

I248/02 is the second of two foundation tier papers for the revised specification for Chemistry A (Gateway Science). It assesses Topics C4-C7 and assumes some knowledge of Topics C1-C3.

The overall standard was similar to that in the 2024 examination series and there was no evidence that candidates were short of time.

In Section A many candidates annotated the paper to show the care they were taking to identify precisely what the question was asking, though fewer than normal did so in Section B. In some cases this meant that candidates identified one key word from the question but missed another, so in Question 19 (b) they spotted the term 'global warming' but then wrote about the causes rather than the consequences.

Many candidates showed their working for mathematical calculations and so gained partial credit even when they got the final answer wrong. It was this willingness to show their working that allowed examiners to identify the significant misunderstanding of formulae that was frequently demonstrated in Question 17 (b) (ii). Centres may wish to use calculations of this sort in their normal teaching to help identify what was clearly a frequent misconception, especially for lower scoring candidates.

As in previous years, many candidates describe laboratory procedures or equipment.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read the question carefully to make sure they understood what was being asked (**Questions 16 (c), 16 (d) (i), 19 (b)**) • knew basic chemical tests (**Questions 18 (c) (ii), 19 (c), 21 (a)**) • were familiar with basic laboratory procedures such as titrations (**Question 20**) • could balance chemical equations (**Questions 20 (d), 21 (c) (i)**) • could perform mass calculations where there were numbers both inside and outside a formula (**Question 17 (b) (ii)**).	• missed vital instructions that were given in the question (**Question 18 (c) (ii)**) • didn't show working in mathematical questions (**Questions 16 (b) (ii), 17 (b) (ii), 22 (b) (i), 23 (c) (ii)**) • seemed unfamiliar with basic laboratory procedures such as titrations (**Question 20**).

Section A overview

Section A is made up of objective questions, and almost all candidates very sensibly attempted all the questions. Many of the responses had been carefully annotated by candidates, showing the level of detailed thought that had gone in to selecting responses. This is an improvement on previous years.

Question 1

1 Butane is an alkane.

What is a **use** for butane?

A Ceramics

B Fertiliser

C Fuel

D Surfacing roads

Your answer ☐ **[1]**

Most candidates knew that butane is a fuel, with A and D the most common alternatives.

Question 2

2 A student adds sodium hydroxide to a solution containing copper ions.

Which colour **precipitate** is made?

A Blue

B Green

C Orange-brown

D White

Your answer ☐ **[1]**

Very few candidates knew that the copper forms a blue precipitate, many chose green or orange-brown.

Question 3

3 Which molecule can be cracked to make octane, C_8H_{18}?

A C_6H_{12}

B C_6H_{14}

C C_8H_{16}

D $C_{12}H_{26}$

Your answer ☐ **[1]**

Higher scoring candidates recognised that the molecule to be cracked must have more than 8 carbon atoms. Incorrect choices were fairly evenly spread, suggesting that candidates were not familiar with the link between formula, molecule size and cracking.

Question 4

4 What is a property of a **Group 1** metal?

A Brittle

B Does not conduct electricity

C Forms coloured compounds

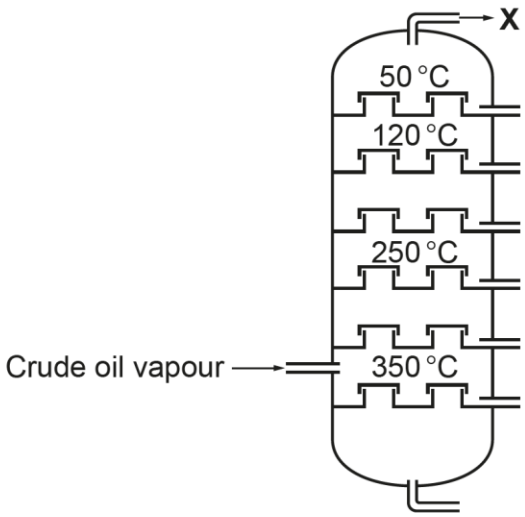
D Low density

Your answer ☐ **[1]**

Candidates found this very difficult to answer. B was probably the most common option, closely followed by C.

Question 5

5 Crude oil is separated into fractions by fractional distillation.



Which fraction is obtained at **X**?

A Bitumen

B Diesel

C LPG

D Petrol

Your answer ☐ **[1]**

This question was challenging for more than half of candidates, with D the most frequent incorrect choice.

Question 6

6 Magnesium reacts with excess hydrochloric acid.

What would **increase** the rate of the reaction?

A Use a larger volume of hydrochloric acid.

B Use a smaller beaker for the reaction.

C Use larger pieces of magnesium.

D Use more concentrated hydrochloric acid.

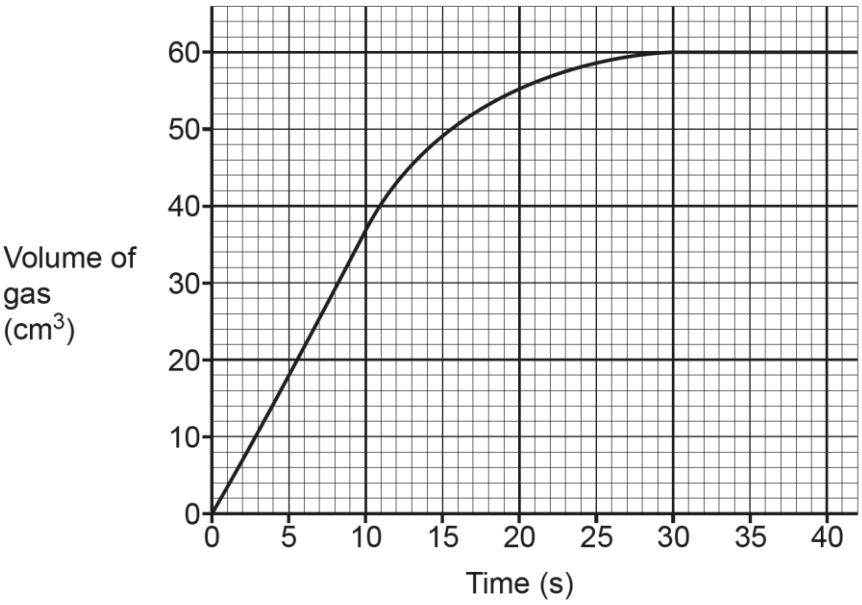
Your answer ☐ **[1]**

This question was well answered; C was the most popular alternative.

Question 7

7 A student measures the volume of gas made during a reaction.

The graph shows their results.



Which statement about the reaction is **not** correct?

A The final volume of gas made is 60 cm^3.

B The rate of reaction speeds up during the reaction.

C The reaction finishes at 30 s.

D The volume of gas made increases during the reaction.

Your answer ☐ **[1]**

This question was correctly answered by just over half of candidates. C was the most popular alternative.

Question 8

8 Which of the following formulas is for a **hydrocarbon**?

A $CH_2CH_2CH_2OH$

B $C_4H_8Cl_2$

C $C_6H_{12}O_6$

D $H_2C{=}CHCH_2CH_3$

Your answer ☐ **[1]**

Candidates had problems recognising the double bonded compound as a hydrocarbon. A and C were the most common incorrect responses.

Question 9

9 A solution of barium ions reacts with a solution of sulfate ions to form a white precipitate.

$Ba^{2+}(.....) + SO_4^{2-}(.....) \rightarrow BaSO_4(.....)$

What is the state symbol for each species?

	Ba^{2+}	SO_4^{2-}	$BaSO_4$
A	aq	aq	s
B	aq	l	s
C	l	aq	l
D	l	l	s

Your answer ☐ **[1]**

Candidates found this difficult to answer; B and C were the most popular alternatives.

Question 10

10 What are the products of the **complete** combustion of methane?

A Carbon and water

B Carbon, carbon monoxide, carbon dioxide and water

C Carbon dioxide and water

D Carbon monoxide and water

Your answer ☐ **[1]**

While many candidates correctly chose response C, D was a very popular alternative.

Question 11

11 The alkanes have the general formula C_nH_{2n+2}.

What is the formula for the alkane with 7 carbon atoms?

A C_7H_{14}

B C_7H_{16}

C C_7H_{18}

D C_7H_{20}

Your answer ☐ **[1]**

This question was very well answered by both high and medium scoring candidates.

Question 12

12 What is a **disadvantage** of using a hydrogen/oxygen fuel cell instead of petrol to power a car?

A Hydrogen is a renewable resource.

B Hydrogen is difficult to store.

C The fuel cell does not produce carbon dioxide.

D The fuel cell only produces water.

Your answer ☐ **[1]**

This question was very well answered by all candidates.

Question 13

13 The theoretical yield of a product in a reaction is 100 g.

The actual yield is 60 g.

What is the **percentage yield**?

A 40%

B 60%

C 67%

D 167%

Your answer ☐ **[1]**

This question was very well answered by all candidates

Question 14

14 Which row in the table shows the change in the percentage of each gas in the **Earth's atmosphere today** compared to the Earth's early atmosphere?

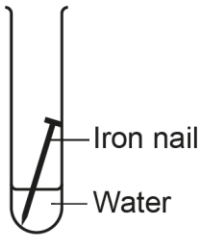
	Carbon dioxide	Oxygen
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	increased	increased

Your answer ☐ **[1]**

Many candidates found this difficult to answer, with C the most common incorrect alternative.

Question 15

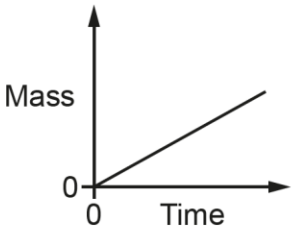
15 An iron nail is left in a test tube containing water.



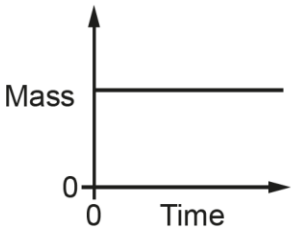
The iron nail rusts.

Which graph shows how the mass of the iron nail changes?

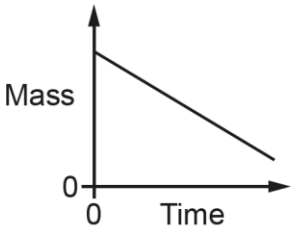
A



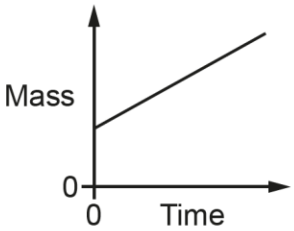
B



C



D



Your answer ☐ **[1]**

Candidates found this question difficult; C was the most common choice.

Section B overview

Section B contains a mixture of objective style questions and those requiring a longer response. The vast majority of candidates attempted most of the questions in this section, and this is part of a continued improvement on previous years. Answers showed a genuine effort to engage with the content of each question. However, in some cases examiners got the impression that candidates were writing what they knew about a topic rather than answering the specific requirements of the question itself (Questions 16 (d) (i), (ii), and 19 (b)).

Question 16 (a)

16 An alloy is a mixture of a metal and one or more other elements.

(a) Brass is an example of an alloy.

Complete the sentence about brass.

Use a word from the list.

iron	**magnesium**	**zinc**

Brass is an alloy of copper and ..... . **[1]**

High scoring candidates knew that brass contains zinc. Iron was the most frequent choice by everyone else.

Question 16 (b) (i)

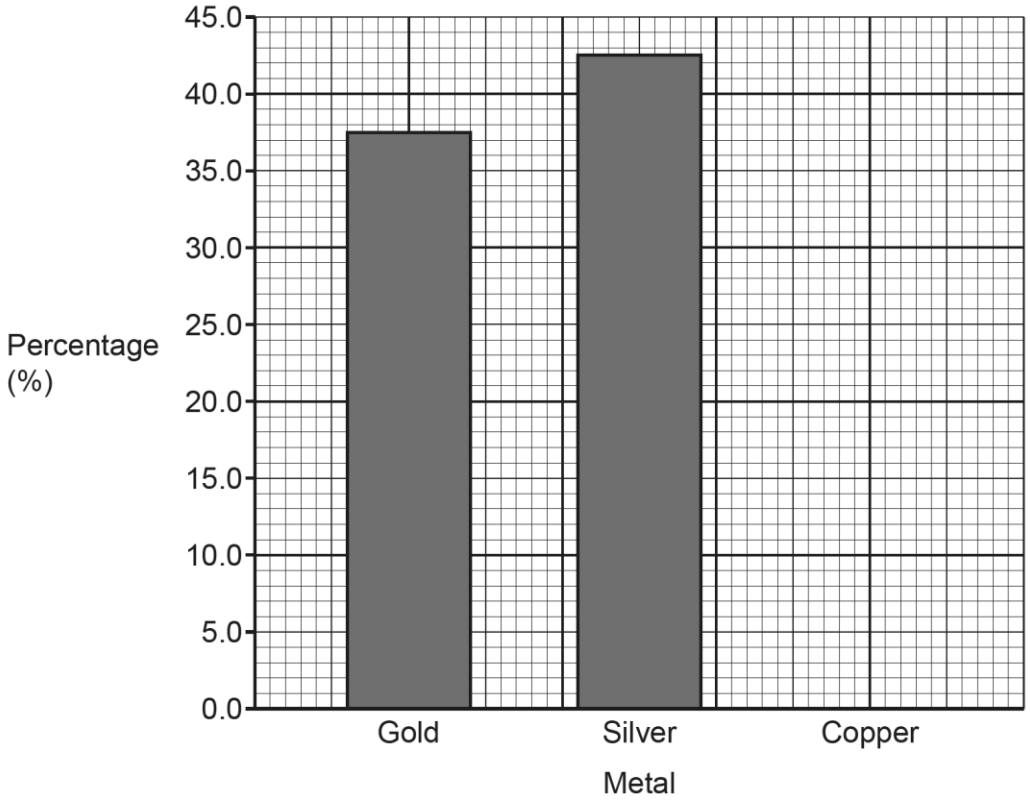
(b) A 9 carat gold ring is made from a mixture of metals.

Table 16.1 shows the percentage of the different metals in the ring.

Table 16.1

Metal	Percentage (%)
Gold	37.5
Silver	42.5
Copper	20.0

(i) Complete the bar chart by drawing the bar for copper.



[1]

This question was very well answered by all candidates.

Question 16 (b) (ii)

(ii) The ring has a mass of 5.0 g.

Calculate the mass of **gold** in the ring. Use **Table 16.1**.

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

Almost all candidates attempted this question, with high scoring candidates answering this well. Candidates who performed an iterative calculation seemed more likely to make mistakes than the others. Several candidates gained no marks because they didn't divide by 100.

Question 16 (c)

(c) Magnalium is an alloy of aluminium and magnesium.

Table 16.2 shows some information about aluminium, magnesium and magnalium.

Table 16.2

	Density (g/cm^3)	Relative strength	Resistance to corrosion
Aluminium	2.7	low	high
Magnesium	1.7	low	low
Magnalium	2.0	high	very high

Magnalium is used to make aircraft parts.

Explain why magnalium is used to make aircraft parts rather than pure aluminium or pure magnesium.

Use the information in **Table 16.2**.

.....

.....

.....

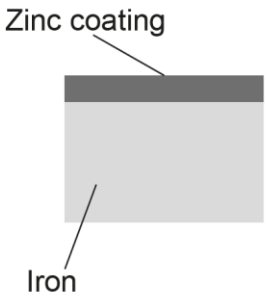
.....

..... **[3]**

This question was attempted by almost all candidates, with higher scoring candidates able to include a comparison of magnalium with pure aluminium and magnesium. Some candidates did not make a comparison and limited their answer to discussing the properties of magnalium as listed in the table, and did not gain credit. Others suggested that magnalium having a higher density than magnesium was an advantage, as it gave it higher strength.

Question 16 (d) (i)

(d) Iron can be protected from corrosion (rusting) by coating the iron with a layer of zinc.



(i) Explain how the layer of zinc acts as a barrier to protect the iron from corrosion.

.....

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

This was a very challenging question, with only the most confident candidates able to discuss oxygen and water. Most responses either omitted one of these or simply stated that zinc doesn't corrode. Some candidates made no mention of a barrier but discussed the reactivity of zinc here, where it was not relevant, instead of in the following section.

Question 16 (d) (ii)

(ii) Explain how the iron is protected from corrosion even if the layer of zinc is damaged.

.....

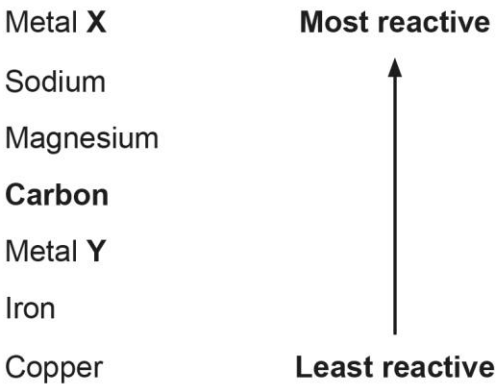
..... **[1]**

Most answers suggested that traces of the zinc barrier were still present, despite the wording of the question. Very few answers discussed the relative reactivities of zinc and iron in this part.

Question 17 (a)

17 This question is about metals.

Part of the reactivity series is:



(a) Draw **two** lines to connect each **metal** with the correct **method used to extract the metal**.

Use the reactivity series.

Metal	**Method used to extract the metal**
	extracted by electrolysis of a molten ionic compound
Metal **X**	
	extracted from its oxide by heating with carbon
Metal **Y**	
	extracted from the Earth as the metal itself

[2]

Most candidates gained at least 1 mark here. That metal Y would be extracted by heating the oxide with carbon was better known than metal X needing electrolysis.

Question 17 (b) (i)

(b) Metals can also be extracted from their metal oxide by reduction with hydrogen.

The equation shows how the metal molybdenum, Mo, is extracted using hydrogen.

$MoO_3 + 3H_2 \rightarrow Mo + 3H_2O$

(i) Explain how the equation shows that molybdenum oxide, MoO_3, is **reduced**.

.....

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

High scoring candidates did well on this question and showed a clear understanding of reduction as applied to this context. Many candidates said that the product Mo contained one oxygen.

Assessment for learning

Consider using molybdenum oxides, cobalt oxides and carbon monoxide in equation balancing exercises to help reinforce the significance of upper versus lower case 'O's.

Question 17 (b) (ii)

(ii) Calculate the atom economy for the reaction.

Use the equation:

$$\text{atom economy} = \frac{A_r \text{ of Mo}}{A_r \text{ of Mo} + M_r \text{ of } 3H_2O} \times 100$$

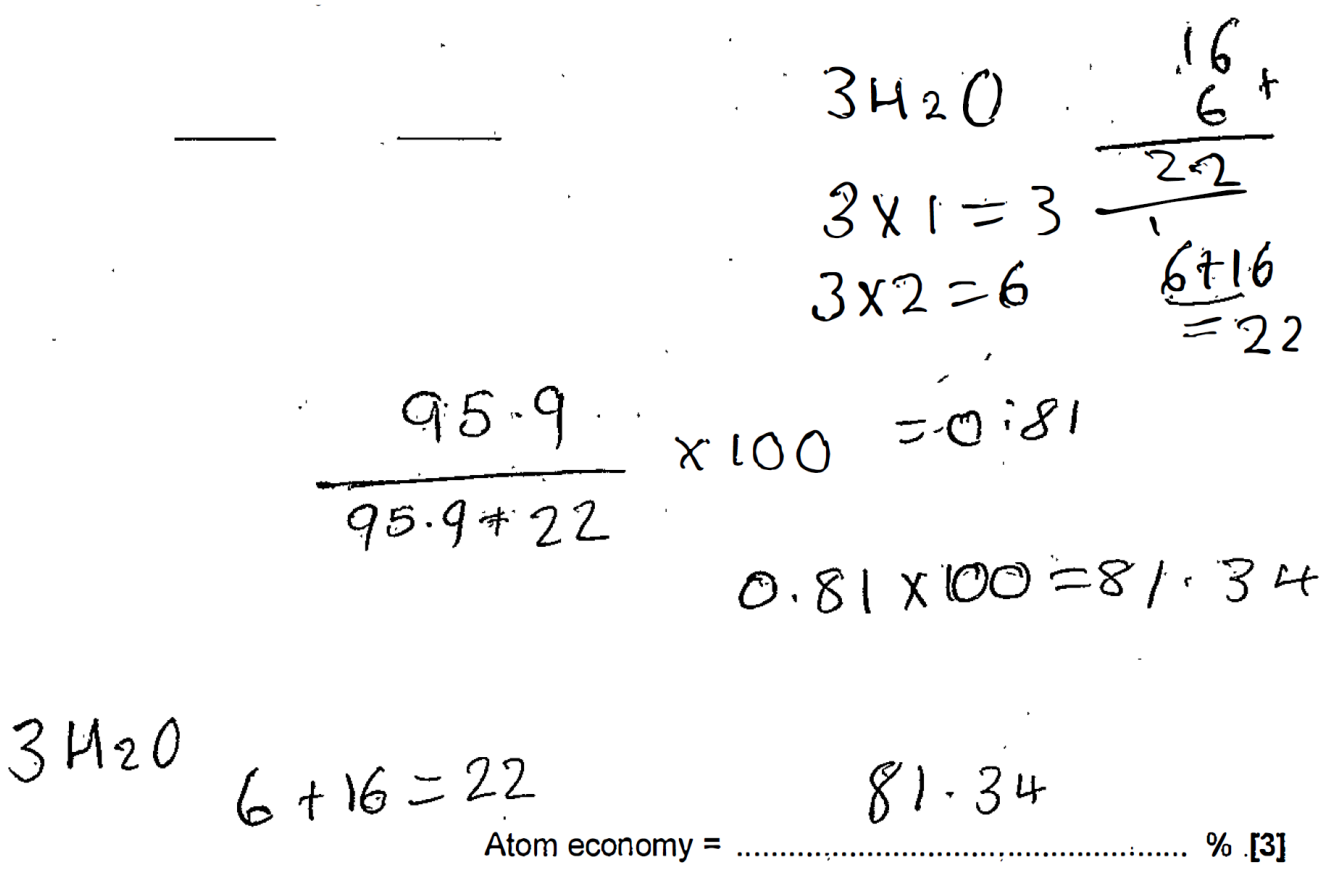
Relative atomic mass (A_r): H = 1.0 O = 16.0 Mo = 95.9

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

Atom economy = ... % **[3]**

High scoring candidates did well. A very common mistake was to calculate the mass of $3H_2O$ as 22, i.e. $(3 \times 2) + 16$. However, a large number of candidates who gave the wrong answer still gained partial credit for showing their working and for giving their answer to two significant figures.

Exemplar 1



This answer shows a very common mistake, yet credit is still possible as the working is shown. Had the candidate rounded their answer to two significant figures then a second mark would have been awarded.

Assessment for learning

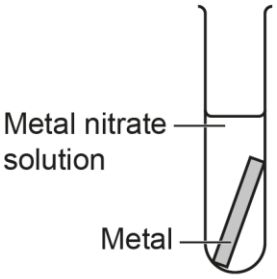
The misconception appears to arise when the number in front of the formula is in close proximity to a subscript, e.g. XA_nB where X and n are numbers.

It might be worth practising this style of mass calculation, not least as a diagnostic for candidates' understanding of the meaning of formulae.

Question 17 (c) (i)

(c) A student investigates the reactivity of four different metals, **A**, **B**, **C** and **D**.

The student adds a piece of each metal to a metal nitrate solution of each of the metals.



(i) State **one** observation that would show that a reaction took place.

.....

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

This question was well answered. Bubbling was the most common suggestion, followed by colour change.

Question 17 (c) (ii)

(ii) The table shows the student's results.

	Metal nitrate solution			
Metal	**Metal A nitrate**	**Metal B nitrate**	**Metal C nitrate**	**Metal D nitrate**
A	✘	✘	✓	✘
B	✓	✘	✓	✘
C	✘	✘	✘	✘
D	✓	✓	✓	✘

✓ means a reaction took place
✘ means a reaction did **not** take place

Write the four different metals, **A**, **B**, **C** and **D**, in order of reactivity.

..... **Most reactive**

.....

.....

..... **Least reactive**

[2]

This was very well answered. A few candidates put the sequence the other way round, almost nobody put the letters in any other order.

Question 17 (c) (iii)

(iii) Explain why you placed the metals in this order of reactivity.

.....

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

The question was generally answered well, even though lower scoring candidates often did not express their ideas clearly enough to gain credit.

Question 17 (d)

(d) Copper is a transition metal.

Potassium is a Group 1 metal.

Identify **two** differences between copper and potassium.

Tick (✓) **two** boxes.

Copper has a lower melting point. ☐

Copper is harder. ☐

Copper is less dense. ☐

Copper is less reactive. ☐

Copper is less strong. ☐

[2]

The question was generally answered well. 'Copper is least reactive' was ticked more often than 'copper is harder.' The most common incorrect response was that copper has a lower melting point.

Question 18 (a)

18 A life-cycle assessment is an analysis of the overall environmental impact that a product may have throughout its lifetime.

(a) The life-cycle assessment is broken down into different stages.

The first stage is looking at obtaining the **raw materials**.

State **one** other stage in a life-cycle assessment.

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

High scoring candidates had a good grasp of the different stages of life cycle assessment. Lower scoring candidates usually had an intuitive understanding but focused on small details such as 'processing raw materials' rather than showing a grasp of the larger picture.

Question 18 (b)

(b) A company does a life-cycle assessment to investigate two possible materials for making a single-use takeaway food container.

Table 18.1 gives some of the information the company uses.

Table 18.1

	Aluminium	Poly(propene)
Mass of raw materials (g)	8	31.5
Energy used (MJ/kg)	61	73
Percentage recycled (%)	54	11
Cost per kg (£)	1.40	0.98

The company decides to use aluminium to make the food container.

Explain why using aluminium is better than using poly(propene).

Use information from **Table 18.1**.

.....

.....

.....

.....

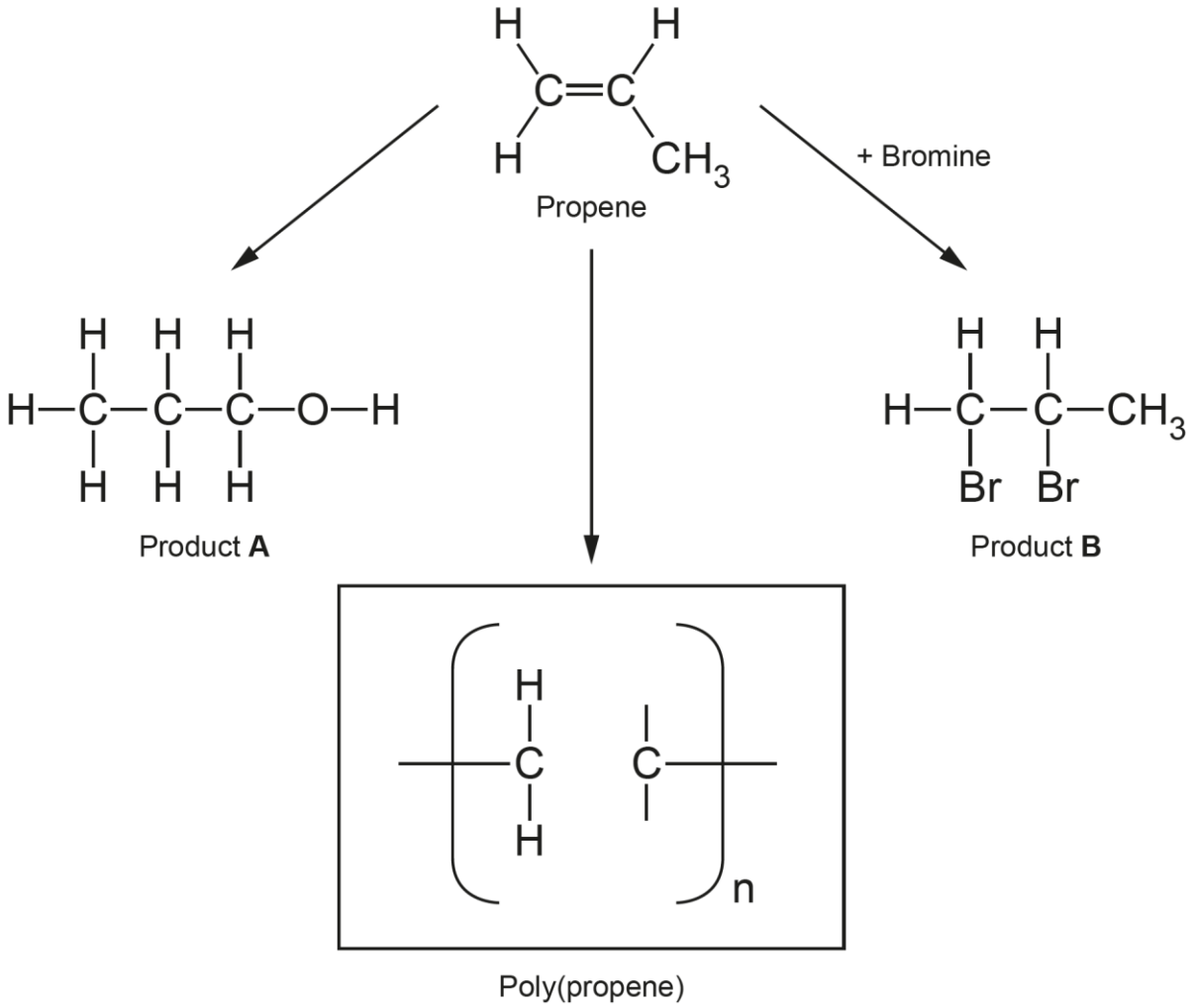
..... **[3]**

The comparison here was usually better constructed than for Question 16 (c). A few candidates suggested that the higher price would be an advantage as the manufacturers could charge more.

Question 18 (c) (i)

(c) **Fig. 18.1** shows some reactions of propene.

Fig. 18.1



(i) State the name of product **A**.

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

Candidates found this very difficult to answer. Many did recognise that the substance was an organic chemical and suggested an organic name, often one of the alkanes or an invented name that sounded similar. Others gave more random suggestions such as 'hydrogen dioxide'.

Question 18 (c) (ii)

(ii) State the colour change when bromine is added to propene to make product **B**.

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

Candidates found this very difficult to answer. Most gave a single colour, a small minority suggested a colour *change* of some form, but very few knew that the orange colour is decolourised.

Question 18 (c) (iii)

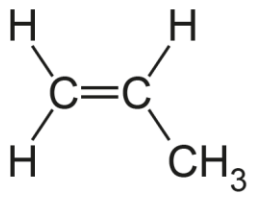
(iii) Poly(propene) is made by addition polymerisation of propene monomers.

Complete the structure of poly(propene) in the box on **Fig. 18.1**. **[2]**

Candidates found this question very challenging to answer. Sometimes a double bond was drawn between the two carbons, but just as often that part was left blank. The part where candidates most often got credit was for correctly drawing the rest of the structure including the CH_3.

Question 18 (d) (i)

(d) Propene is an alkene.



(i) Propene reacts with hydrogen to make propane, C_3H_8.

Describe how the structure of propane is different from propene.

Use ideas about covalent bonds.

Propane .....

Propene .....

[2]

The double bond in propene was well known, even though many candidates said that propane had 'no double bond' without saying what it did have. Lower scoring candidates often said that the difference was one of bond strength.

Question 18 (d) (ii)

(ii) **Table 18.2** shows the boiling points of the first four alkenes.

Table 18.2

	Boiling point (°C)
Ethene	–104
Propene	–47
Butene	–6
Pentene	30

State what happens to the boiling point as the number of carbon atoms in the alkene increases.

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

This question was well answered. A minority of candidates experienced difficulty with the negative numbers and thought that the boiling point decreased.

Misconception

Some candidates thought that larger negative numbers denoted higher temperatures.

Question 19 (a)

19 In the last 75 years there has been an increase in both

- the world population
- the concentration of carbon dioxide in the atmosphere.

(a) Why may the increase in the world population have caused the increase in the concentration of carbon dioxide in the atmosphere?

Tick (✓) **one** box.

More fossil fuels are being burned. ☐

More people are cycling instead of driving. ☐

More trees are being planted. ☐

More wind turbines are being used. ☐

[1]

This question was very well answered. A few candidates gained no marks because they ticked two boxes.

Question 19 (b)

(b) A problem with an increase in the concentration of carbon dioxide is global warming.

State **two** problems caused by global warming.

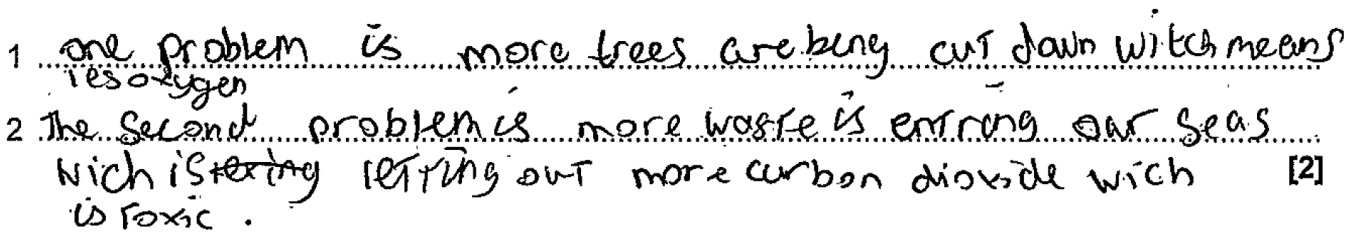
1 .....

2 .....

[2]

Most answered this very well and many topical references were made. Some candidates discussed causes of global warming rather than problems resulting from it. Low scoring candidates often rephrased the wording of the stem and wrote that global warming meant that the world would get hotter.

Exemplar 2



This is an example of a candidate who has engaged with the question but under the stress of the examination has suggested a cause **of** global warming rather than a problem caused **by** global warming.

Question 19 (c)

(c) Describe the test for carbon dioxide gas.

Test .....

Result .....

[2]

High scoring candidates were familiar with the use of lime water. Some said a lighted splint would be extinguished, which was close but not enough to gain credit. Many suggested the 'squeaky pop' test.

Question 20 (a) (i)

20 A student plans a titration experiment to find the concentration of a solution of sulfuric acid.

This is their method:

- Fill the burette with dilute sulfuric acid.
- Add 25.0 cm^3 of 0.50 mol/dm^3 sodium hydroxide solution to a conical flask.
- Add 5 drops of indicator to the sodium hydroxide solution.
- Add the dilute sulfuric acid to the sodium hydroxide solution until the indicator changes colour.
- Repeat the titration.

(a)
(i) Which piece of equipment should the student use to accurately measure the 25.0 cm^3 of sodium hydroxide solution?

Tick (✓) **one** box.

Beaker ☐

Dropping pipette ☐

Measuring cylinder ☐

Volumetric pipette ☐

[1]

The measuring cylinder was by far the most popular choice, regardless of the candidate's final mark.

Question 20 (a) (ii)

(ii) State a suitable indicator for the student to use in the titration.

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

High scoring candidates correctly suggested either methyl orange or phenolphthalein. Examiners allowed a range of spellings for these two. Most candidates incorrectly suggested universal indicator or iodine.

Question 20 (a) (iii)

(iii) Suggest an improvement to the student's method.

.....

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

Higher scoring candidates showed familiarity with titrations and made sensible suggestions. Some candidates suggested replacing the burette with the measuring cylinder, and many rephrased the last statement from the stem and wrote 'do the experiment again.'

In addition to those suggesting repeats, other candidates also suggested a series of experiments rather than how to improve on the method given. These included varying the volumes or the concentrations, using different reagents, and varying the temperature.

Exemplar 3

Repeat experiment 3 times

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

This information effectively repeats the stem but was a common response in one form or another and so did not gain credit.

Question 20 (b)

(b) The reading at the start of the rough titration is 0.0 cm^3.

At the end of the rough titration the student reads the volume of dilute sulfuric acid added from the burette.

What is the volume of dilute sulfuric acid added?

Give your answer to **1** decimal place.

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

Higher scoring candidates had no problem in reading the burette, others often put 25.4 or 24.6.

Misconception

There was significant misunderstanding on whether to read to the top of the meniscus or the bottom, as well as which direction to read it in. The frequent answer of 25.4 probably reflects both misunderstandings. It might be worth using diagrams similar to the one above as teaching exercises.

Question 20 (c)

(c) After the rough titration the student repeats the experiment four more times.

The table shows their results.

Titration number	1	2	3	4
Volume of dilute sulfuric acid added (cm^3)	24.40	24.50	24.50	24.40

Calculate the mean volume of dilute sulfuric acid added.

Give your answer to **2** decimal places.

Mean volume of dilute sulfuric acid = ... cm^3 **[2]**

The question was very well answered.

Question 20 (d)

(d) Write the **balanced symbol equation** for the reaction between sulfuric acid, H_2SO_4, and sodium hydroxide, NaOH.

Sodium sulfate, Na_2SO_4, and water are made.

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

Most candidates were able to write the four formulae correctly, and high scoring candidates went on to balance the equation. Low scoring candidates often experienced difficulty in copying the formulae given in the question.

Question 21 (a)*

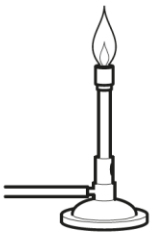
21

(a)* A teacher finds an unlabelled beaker containing a white solid.

They think the solid is one of the following:

- lithium bromide
- lithium iodide
- sodium carbonate.

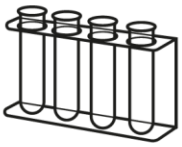
In the laboratory the teacher has:



A lit Bunsen burner

Wooden splints

Pipette



Test tubes and rack

Plan a series of experiments the teacher can do to identify the white solid.

Include the results of each experiment.

.....

.....

.....

.....

.....

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

Most candidates, including those with a high overall score, found this question to be challenging. Answers usually did no more than suggest putting each solution into a separate test tube and adding a different solid to each. Some remembered the existence of flame tests and gave a partial description. Those that did do well on this question were able to discuss in partial detail a series of tests relevant to the task in hand; they not only knew the flame colours but also made some reference to suitable anion tests.

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A number of the GCSE Examiner Reports this year have raised the concern that candidates' practical skills and knowledge is in decline. OCR has produced a wealth of practical resources to support teachers as part of our Purposeful Practicals materials, including integrated instructions and disciplinary and procedural knowledge assessment opportunities. Find them on Teach Cambridge now.

Question 21 (b)

(b) Instrumental methods of analysis can be used to analyse chemical substances.

State **two advantages** of instrumental methods of analysis.

1 .....

2 .....

[2]

High scoring candidates had a good grasp of the advantages of instrumental analysis. 'Accurate' and 'fast' were the most popular correct responses.

Question 21 (c) (i)

(c) Chlorine, Cl_2, reacts with lithium bromide, LiBr.

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

$$Cl_2 + 2LiBr \longrightarrow \text{.....} + \text{.....}$$

[2]

Most candidates found this question difficult. It was common to see Li + ClBr, LiCl + Br, $LiBr_2$ + Cl_2 or even Cl_2 + 2LiBr as the products. Even candidates who correctly wrote 2LiCl often then wrote 2Br rather than Br_2.

Question 21 (c) (ii)

(ii) Chlorine, bromine and iodine are in Group 7.

Cl Chlorine
Br Bromine
I Iodine

Iodine, I_2, does **not** react with lithium bromide.

Explain why.

.....

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

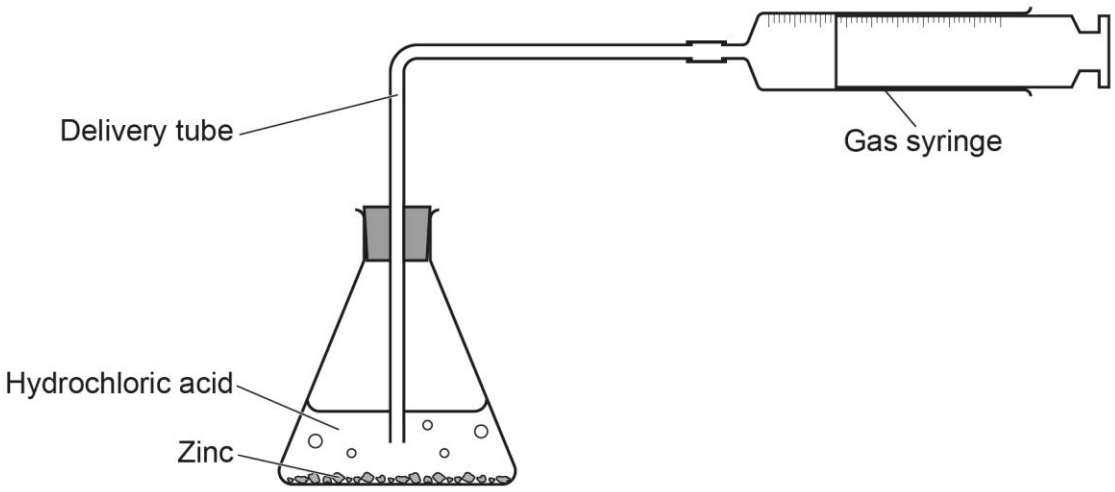
Many candidates didn't discuss the reactivity of bromine compared to iodine but instead they gave more general answers about reactivity or about full outer shells. These didn't answer the question but did show genuine engagement with the topic.

High scoring answers discussed differences in reactivity of bromine and iodine and tied it to displacement.

Question 22 (a)

22 A student investigates the rate of the reaction between zinc and an excess of hydrochloric acid.

The diagram shows the equipment the student uses.



(a) The student has made a mistake setting up the delivery tube in their experiment.

Describe the mistake and the problem this will cause.

Mistake .....

.....

Problem .....

.....

[2]

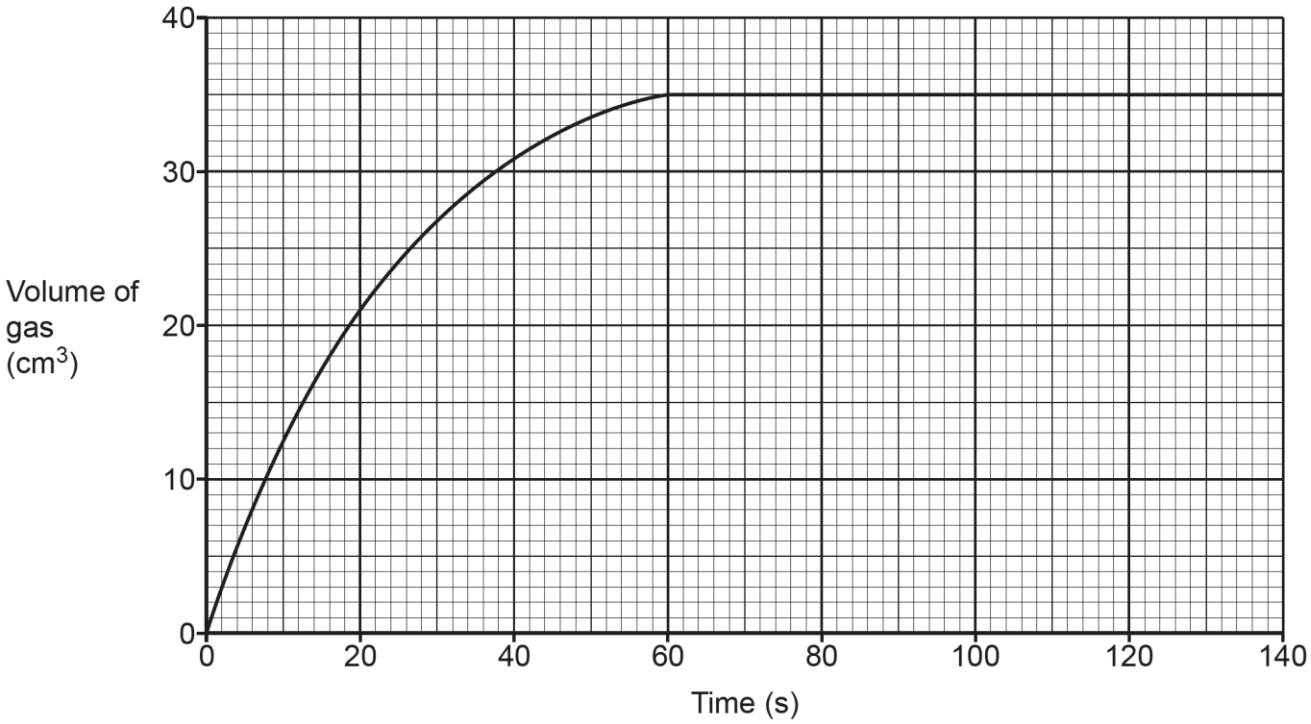
The question discriminated well. Many candidates appreciated that the delivery tube should not be in the acid, even though they found it harder to explain why. Some low achieving candidates suggested that there shouldn't be a right angle bend in the tube. The rest didn't talk about the delivery tube but said either the gas syringe was not set at zero or that a stand and clamp hadn't been used.

Question 22 (b) (i)

(b) The student sets up the experiment correctly.

They measure the volume of gas every 20 seconds.

The graph shows their results.



(i) Calculate the mean rate of reaction between 0 seconds and 60 seconds.

Use the graph and the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas}}{\text{time}}$$

Give the units for your answer.

Mean rate of reaction = ... Units ..... **[4]**

The question was well attempted, with the main difficulty being the units. Even when candidates got the calculation wrong, many candidates gained credit for some aspect of their working.

Some candidates calculated the average of three mean rates, those at 20, 40 and 60 seconds.

Question 22 (b) (ii)

(ii) The student repeats the experiment.

They use the same mass of zinc, but in **smaller** pieces.

Draw a line on the graph to show the student's results. **[2]**

High and middle scoring candidates showed a curve that was steeper at the start, and high scoring candidates went on to finish their curve at 35cm^3. A sizeable minority of candidates did not attempt this question.

Question 22 (c)

(c) The reaction is faster when **more concentrated** hydrochloric acid is used.

Explain why.

.....

.....

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

Candidates who gained credit discussed the number of particles in a given volume and increased collision frequency. Most answers were in terms of 'more' particles rather than more in a given volume, and 'more' collisions rather than 'more frequent' collisions.

There was the usual collection of misunderstandings such as particles gaining energy as a result of collision, concentration is a catalyst, higher concentrations give the reactants more energy, etc.

Question 23 (a)

23 Ammonia is made from nitrogen and hydrogen in the Haber process.

The word equation for the reaction is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

(a) What does the symbol $\rightleftharpoons$ tell you about the reaction?

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

This was very well answered with all but low scoring candidates using some form of words to describe the reaction as reversible.

Question 23 (b) (i)

(b) A catalyst is used in the Haber process.

(i) What is the catalyst used?

Tick (✓) **one** box.

Iron	☐
Manganese(IV) oxide	☐
Nickel	☐
Platinum	☐

[1]

Manganese(IV) oxide was by far the most popular choice, with many candidates missing out on this mark.

Question 23 (b) (ii)

(ii) Explain how the catalyst speeds up the reaction.

.....

.....

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

Most found this question difficult and gave general answers about increased reactivity. High scoring candidates discussed activation energy. Some candidates wrote about 'more frequent collisions' here instead of in Question 22 (c) where it would have gained a mark.

Question 23 (c) (i)

(c) Ammonia is used in the manufacture of fertilisers.

NPK fertilisers contain the essential elements nitrogen, phosphorus, and potassium.

The table shows the percentages of nitrogen, phosphorus, and potassium in four different fertilisers.

Fertiliser	Percentage (%) of essential element		
	Nitrogen	Phosphorus	Potassium
A	12	6	36
B	8	8	30
C	12	12	17
D	15	5	12

Plants do **not** grow well if they get too little of these essential elements because:

- too little nitrogen can cause yellow leaves
- too little phosphorus can cause poor root growth
- too little potassium can cause poor fruit growth.

(i) Which fertiliser is best at preventing yellow leaves **and** poor fruit growth?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

[1]

This question was well answered, even though a few high scoring candidates appeared to see complexities that weren't there.

Question 23 (c) (ii)

(ii) A farmer buys a 25 kg bag of fertiliser **C**.

Calculate the mass of **potassium** in the bag of fertiliser.

Mass of potassium = ... kg **[2]**

This question was well answered. Few candidates scored partial credit - they either answered well or they added some of the numbers from the table and divided by 4, 17 or 25.

Question 23 (c) (iii)

(iii) Fertilisers are made in industry using a continuous process.

Fertilisers can be made in a school laboratory using a batch process.

State **one advantage** of using a continuous process.

.....

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

This question was well answered, even though 'it's more accurate' was a frequent response suggesting some confusion with the automated analysis of Question 21 (b).

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