Pearson Edexcel

Examiners' Report June 2024

Int GCSE Chemistry 4CH1 1C

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Introduction

Paper 1C proved to be an accessible paper with many candidates performing well overall.

Candidates performed well in questions related to the reactivity series in Q02. They were also very successful in interpreting a chromatogram (Q05(a)(ii)), but found some of the other questions, especially those explaining the practical setup, more challenging. Multiple-choice questions linked to recall performed well, but candidates found Q07(d)(i) comparatively more demanding, suggesting that constructing chemical formulae can be a problem even when presented with options.

The extended response questions were the biggest challenge for candidates, with many not having the necessary precision to score top marks in Q02(b)(iii), Q04(c), and Q07(d)(ii). Unusually, candidates struggled with Q01(a), the first question on the paper, despite selecting from provided answers. This question identified some key misconceptions held by many candidates.

Most candidates were able to secure at least some marks in the calculation questions, with many achieving ECF for their efforts to see their answers through to the end.

Question 1 (a)

Most candidates managed to score 3 or more marks in this question. Where marks were lost it was because candidates did not realise they could use the same response more than once which meant they selected incorrect responses when they needed to use lithium for a second time. A large number of candidates chose water as the answer for 'a good conductor of electricity' and some missed the word 'element' in the 'an element that is a liquid at room temperature' and so also chose water for this response. Other common errors included candidates selecting chlorine as the element which is a liquid at room temperature and methane as the substance which can form a polymer.

Question 1 (b)

The question regarding the test for chlorine gas was generally well answered, with a large number of candidates able to correctly describe the use of litmus paper and scoring full marks. Unfortunately, many candidates mistakenly described the test for chloride ions, involving silver nitrate, instead of the test for chlorine gas. Other incorrect answers included tests for other gases, such as using limewater or relighting a glowing splint. Some candidates also incorrectly stated that red litmus paper turns blue and then bleaches, or that blue litmus turns red without mentioning bleaching.

(b) Describe a test for chlorine.

(2)

Add some hydrochloric acid and silver chloride, and if chlorine cas are present, ~~the solution will go~~ a white precipitate ~~it~~ will be formed.

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Examiner Comments

There are a range of issues with this response which would not have scored even if the question had been asking about chloride ions. A number of candidates cannot successfully distinguish between chlorine and chloride.

ResultsPlus
Examiner Tip

Encourage candidates to take care with terminology linked to Group 7 elements and give them opportunities to consider the difference between chlorine and chloride across the topics in the specification.

Question 2 (a)(iii)

Most candidates gained 1 mark on the question, with a relatively common error being the identification of water as the other product instead of hydrogen. Many candidates erroneously wrote water, oxide, or hydroxide as the product, and there were also frequent mentions of aluminium hydroxides. A number of candidates provided chemical equations instead of word equations, which would have potentially gained them credit but very few of these candidates identified correct formulae or balanced the equation correctly.

Some candidates provided a chemical equation instead of the **word** equation.

(iii) Give a word equation for the reaction between aluminium and hydrochloric acid.

(1)

al + 3HCL → alCL$_3$ + 3H

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Examiner Comments

This was a harder route to take so marks would have been awarded if this had been correctly completed but very few candidates achieved a full balanced equation with the correct formulae.

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Examiner Tip

When candidates are asked to write an equation make sure they check whether the question is looking for a word, chemical or ionic equation as they could be making the question harder for themselves.

Question 2 (a)(iv)

The question was generally well answered, with most candidates providing correct responses. Gold was the most common answer, followed by copper and silver. A number of candidates mistakenly provided non-metals as answers, often listing halogens. Some candidates also confused the least reactive metals with the most reactive, giving Group 1 metals such as potassium, possibly confusing it with platinum. There were also instances of iron being incorrectly mentioned.

Question 2 (a)(v)

The question was well answered, with most candidates identifying the reaction between Q and dilute HCl as dangerous or explosive. Common errors included stating that Q didn't need testing with HCl due to its reaction with water, or incorrectly describing Q as unreactive. Some candidates were too vague or gave incorrect answers such as hydrogen or chlorine being present. A number of candidates scored zero for using the terms vigorous or volatile which were not creditworthy.

Question 2 (b)(i)

The question was generally well answered, but many candidates referred to energy without specifying thermal or heat energy. Some candidates provided definitions involving bond breaking and making, while others incorrectly defined endothermic reactions.

Question 2 (b)(ii)

This question was very well answered overall, with the majority of candidates correctly identifying aluminium as more reactive than iron. However, a few candidates attempted to explain the reactivity difference in terms of electronic structure, leading to some confusion. Despite these minor errors, most responses were accurate, demonstrating a clear understanding of the relative reactivity of aluminium and iron.

Question 2 (b)(iii)

The question on redox reactions posed challenges for many candidates, with few scoring full marks. Common mistakes included stating "iron loses oxygen" instead of specifying "Fe_2O_3 loses oxygen", demonstrating confusion between iron and the oxide form. Another common misconception was incorrectly suggesting that Fe had been reduced rather than Fe^{3+}. Many responses lacked clarity regarding which substances were undergoing oxidation or reduction, often simply stating that both processes were occurring without specifying the substances involved. For the candidates who did score 1 mark, it was for correctly noting that "aluminium gains oxygen and is oxidised.".

(iii) Explain why this reaction is a redox reaction.

(2)

It involves both oxidation and reduction. The aluminium gets oxidised and the iron (III) oxide gets reduced.

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Examiner Comments

This clip scores 1 mark as they correctly identify the species being oxidised and reduced but they do not provide a reason for the choice.

(iii) Explain why this reaction is a redox reaction.

(2)

Because ~~the~~ aluminium ~~oxidise~~ loses electrons and iron gains electrons, so aluminium is oxidised and iron is reduced. This happens at the same time so it redox.

ResultsPlus
Examiner Comments

This is another example of a clip that scores 1 mark. The candidate has incorrectly suggested that 'iron gains electrons' rather than iron ions/Fe^{3+}.

Question 3 (a)(iii)

This question was well answered by candidates with an equal number giving answers using magnesium (MgF_2) and the letter z (ZF_2). The most common errors encountered were the use of Fl instead of F for fluorine and giving the ions in a 1:1 ratio (eg ZF). Calcium was also a common error that could have been avoided if candidates had used the letter z.

(iii) Give the formula of the compound that forms when Z reacts with fluorine.

CaF_2 (ZF_2)

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Examiner Comments

This candidate has correctly given the formula using Z but this is after producing an incorrect formula using calcium rather than magnesium, resulting in them scoring 0 marks.

Question 3 (b)

The question received generally good responses, with most candidates accurately calculating the number of electrons in one mole of atoms of Z. However, a common error included dividing Avogadro's number by 12 instead of multiplying, though these candidates still earned 1 mark if they successfully evaluated the calculation. Overall, the majority of candidates found the question straightforward and answered in standard form.

(b) One mole of Z contains 6.0×10^{23} atoms.

Calculate the number of electrons in one mole of atoms of element Z.

Give your answer in standard form.

(2)

Z has 11 electrons

$6 \times 10^{23} \times 11 = 66 \times {}^{18}10^{2}$ $\quad 6.6 \times 10^{24}$

number of electrons = 6.6×10^{24}

ResultsPlus Examiner Comments

Even though the number of electrons is incorrect, this answer still scored 1 mark for ECF.

(b) One mole of Z contains 6.0×10^{23} atoms.

Calculate the number of electrons in one mole of atoms of element Z.

Give your answer in standard form.

(2)

Neutrons : 12   ratio = 1 : 1 : 1

Protons = 12 2.0×10^{23} = electrons

electrons = 12 $6.0 \div 3 = 2.0$

number of electrons = 2.0×10^{23}

ResultsPlus
Examiner Comments

This example scored 0 marks because the number of electrons is incorrectly identified (3) with no ECF as they have then divided rather than multiplied using this number.

Question 3 (c)

The question was generally well answered, with most candidates successfully achieving all 4 marks. However a common error included failing to round answers to 1 decimal place. Some candidates did not correctly calculate the mass number and used atomic numbers, giving an answer of 12.3 and limiting their score to a maximum of 3 marks.

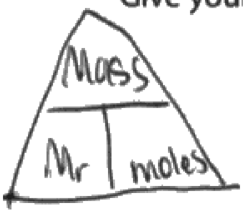
(c) A sample of element Z contains three isotopes. The table shows the numbers of particles in the nucleus of each isotope and the percentage abundance of each isotope.

Isotope	Number of protons	Number of neutrons	Percentage abundance
1	12	12	79.0
2	12	13	10.0
3	12	14	11.0

Use the information in the table to calculate the relative atomic mass (A_r) of element Z.

Give your answer to one decimal place.

(4)



$$\frac{(12 \times 79) + (13 \times 10) + (14 \times 11)}{100}$$

$$= 12.32$$

A_r = 12.3

ResultsPlus
Examiner Comments

An example where a candidate has incorrectly used the number of protons rather than calculating the mass number to be used in the calculation. This response scored 3 marks.

ResultsPlus
Examiner Tip

The number of marks can often indicate how much work needs to be done for a question. 4 marks suggests that there are quite a few steps involved and candidates should pause to consider whether 'use information in the table' could mean more than just the %.

Question 4 (a)(ii)

The majority of candidates were able to correctly determine the Mr of caffeine with the small number of incorrect answers usually a result of further unnecessary steps. Examples of errors included dividing 194 by 100, forgetting to include hydrogen resulting in a calculation of 184, and using atomic numbers instead of atomic masses.

(ii) Calculate the relative formula mass (M_r) of caffeine.

(2)

$\frac{\text{Mass}}{\text{RFM}}$ $(12 \times 8) + 10 + (14 \times 4) + (16 \times 2) = 194$

$\frac{24}{194} = 0.123$

$M_r =$ 0.123

ResultsPlus
Examiner Comments

When candidates attempted but didn't score on this question it was often due to additional unnecessary steps that lost them mark(s).

(ii) Calculate the relative formula mass (M_r) of caffeine.

$8(12) + 10(1) + 4(14) + 2(16) = 196$

$M_r =$ 196

ResultsPlus
Examiner Comments

This answer scored M1 but an incorrect evaluation lost them M2.

ResultsPlus
Examiner Tip

Encourage candidates to show their method as this can gain them marks that otherwise would have not been scored if they had just written the wrong answer.

Question 4 (a)(iii)

Most candidates successfully identified the empirical formula of caffeine. For those who didn't score, errors included giving the molecular formula instead of the empirical formula, presenting ratios of atoms without element symbols, and confusing alkane or alkene general formulas with specific empirical formulas.

(iii) Give the empirical formula for caffeine.

Carbon 8 Hydrogen 10 Nitrogen 4, Oxygen

ResultsPlus
Examiner Comments

Some candidates were confused by the terminology 'empirical formula' when asked in a straightforward 1 mark question rather than as a calculation.

ResultsPlus
Examiner Tip

It would be beneficial for candidates to practice converting between the different formulae they are expected to know for the specification.

Question 4 (b)(i)

Most candidates were able to identify simple distillation with only a small number of candidates losing marks by suggesting it was fractional distillation.

Question 4 (b)(ii)

Most candidates correctly identified condensation and mentioned cooling in their answers demonstrating a good understanding of how simple distillation works. Candidates who only scored 1 mark often did not explicitly state the role of cooling, which was necessary for full marks. Common mistakes included naming the condenser without explaining how it cools the ethanol vapor and occasional confusion regarding the condensation of water instead of ethanol.

(ii) Describe what happens to the ethanol vapour in apparatus X.

(2)

- Apparatus X condenses ethanol vapour, turning it back into a liquid state/form which is then collected in the end beaker.

ResultsPlus
Examiner Comments

This answer scores only M2 as there is no reference to cooling.

Question 4 (c)

Q04(c) posed challenges for a number of candidates due to their **incorrect** identification of the type of bonding for each substance. While the type of bonding was often commented upon, many candidates overlooked specifying the giant ionic and simple molecular structures for M1 and M3. Common issues also included suggesting $CaBr_2$ contained (strong) intermolecular forces, mentioning intermolecular forces between bonds or atoms in caffeine, or incorrectly stating covalent bonds had been broken in caffeine. A notable number of candidates still struggled with the direct comparison of energy requirements between structures and provided contradictory responses.

(c) Calcium bromide is an ionic compound.

The table shows the formulae and melting points of caffeine and calcium bromide.

Name	Formula	Melting point in °C
caffeine	$C_8H_{10}N_4O_2$	235
calcium bromide	$CaBr_2$	730

The relative formula mass of calcium bromide is similar to the relative formula mass of caffeine.

Explain why calcium bromide has a much higher melting point than caffeine.

(5)

~~Bd~~ $CaBr_2$ has a higher melting point because it is held togethe by strong electrostatic forces of attraction between oppositely charged ions, which require lots of energy to break, meaning a high heat is required.
However caffeie is held together by weak inter molecule forces, which are easy to break apart, requiring less energy, lowering the ~~boiling~~ boiling point.

ResultsPlus
Examiner Comments

This is an example of a good answer which has not included any reference to the structure of the substances resulting in it only scoring 3 marks.

The relative formula mass of calcium bromide is similar to the relative formula mass of caffeine.

Explain why calcium bromide has a much higher melting point than caffeine.

(5)

Calcium bromide has a much higher melting point because ~~to~~ it has a giant ionic structure that contains many strong electrostatic forces of attraction between oppositely charged ions that requires a higher amount of energy to break. This is different to caffeine which has a simple molecular structure which contains very strong covalent bonds within the molecules but has very weak intermolecular ~~forces~~ forces of attraction which require little energy to break. Hence Calcium bromide has a greater melting point than caffeine.

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Examiner Comments

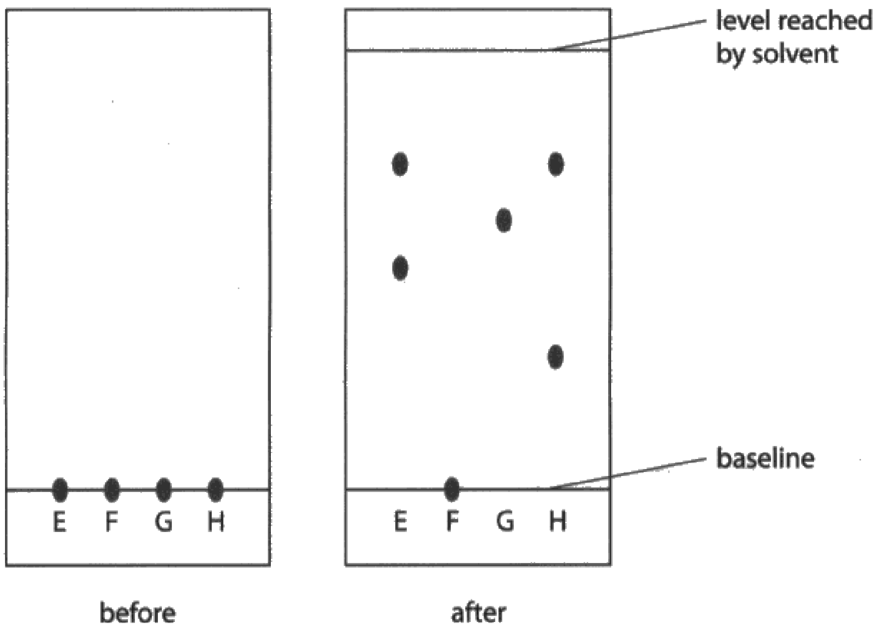
An excellent answer which scored 5 marks as it covered all the key areas and included a comparison of the energy required.

Question 5 (a)(i)

Many candidates scored 1 out of 2 marks on this question. The second mark was usually lost because candidates did not go into enough detail and didn't reference whether dyes would travel up the paper. Responses often focused on the dyes not dissolving in the solvent or potentially interfering with the experiment, which typically scored 1 mark but was insufficient for 2 marks.

5 A student uses paper chromatography in an experiment to separate the dyes in four different felt tip pens, E, F, G and H.

The diagram shows the appearance of the paper before and after the experiment.



(a) (i) The chromatography paper is placed in a solvent. Explain why the spots on the baseline are placed above the level of the solvent.

(2)

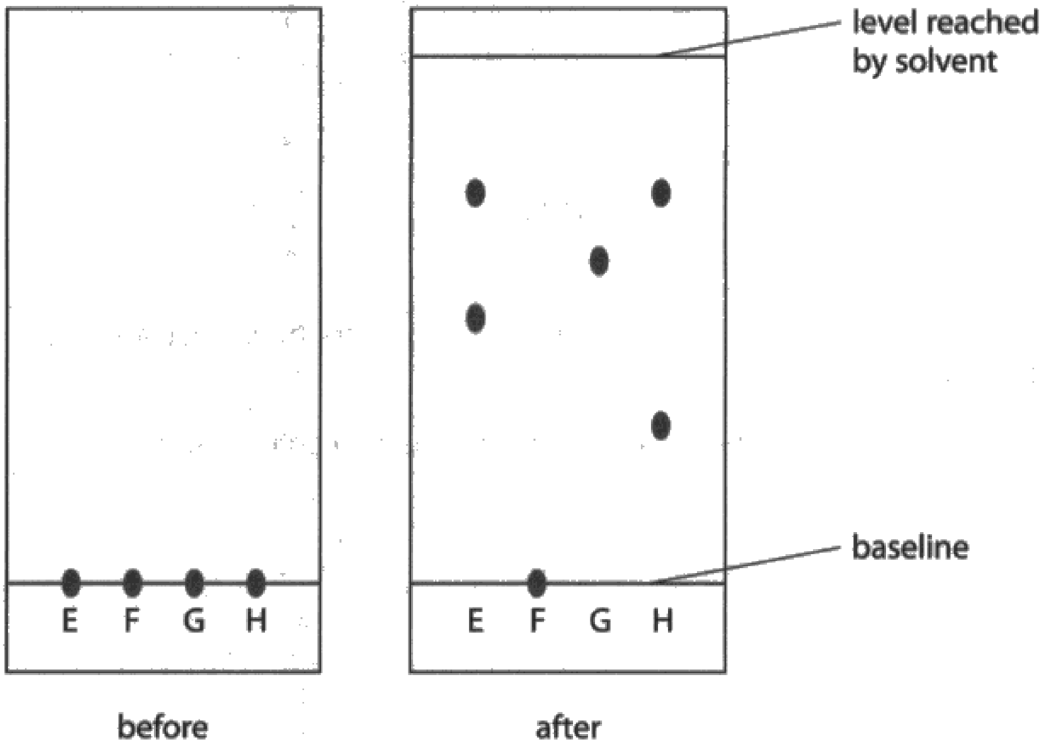
So the spots don't dissolve into the solvent and contaminate other spots ~~of~~ on the paper. The experiment also won't work as the dyes need to be "picked up" by the solvent as it travels up the paper.

ResultsPlus Examiner Comments

This candidate scored 2 marks as they went into sufficient detail.

5 A student uses paper chromatography in an experiment to separate the dyes in four different felt tip pens, E, F, G and H.

The diagram shows the appearance of the paper before and after the experiment.



(a) (i) The chromatography paper is placed in a solvent. Explain why the spots on the baseline are placed above the level of the solvent.

(2)

So that they do not dissolve into the solvent

ResultsPlus Examiner Comments

This candidate only scored 1 mark as they didn't provide enough of an explanation.

ResultsPlus Examiner Tip

Centres should suggest that candidates consider whether their answer has provided enough detail based on the number of marks available. 2 marks usually requires 2 good points from candidates.

Question 5 (a)(ii)

Most candidates successfully identified that felt tip pens E and H contained the same dye, although fewer were able to articulate their reasoning clearly. Many explanations did correctly centre around the observation that both dyes reached the same level from the baseline but some candidates did not explicitly mention spots or dyes at all. Additionally, a small number of candidates incorrectly explained their choice by linking it to both inks having two spots on the chromatogram.

(ii) Explain which two felt tip pens contain the same dye.

(2)

Pens E and H contain the same dye as both dyes travel the same distance on the chromatography paper. 5cm

ResultsPlus
Examiner Comments

An example of one of the stronger candidate responses which scored 2 marks.

ResultsPlus
Examiner Tip

Encourage candidates to think carefully about their answer before they start writing, this will help make answers clearer.

Question 5 (a)(iii)

The majority of candidate responses scored 1 out of 2 marks. Most candidates achieved the second mark by explaining that F did not move or was insoluble. Only a few candidates correctly acknowledged that felt tip pen G only had one dye as there was only one spot when it moved. Many answers confidently stated "they can be sure of G" without specifying that it moved up and remained as one spot.

(iii) The student thought that both F and G contained only one dye.

Explain why the student can only be certain about one of these dyes.

(2)

The student cannot be certain about F, because it did not dissolve and move up the paper in the solvent, so it could contain multiple dyes that didn't dissolve and seperate

ResultsPlus
Examiner Comments

An example of a candidate response where they have focused entirely on F but given no comment about why we can be certain about G. This response scored 1 mark.

(iii) The student thought that both F and G contained only one dye.

Explain why the student can only be certain about one of these dyes.

(2)

The student can be certain for G, as only one dye appeared as a spot on the paper. ~~after the experiment~~. However, F was not soluble in the solvent used, hence why the student cannot tell the number of dyes in F.

ResultsPlus
Examiner Comments

An example of a candidate response that scored 2 marks as it included a comment related to both G and F.

(iii) The student thought that both F and G contained only one dye.

Explain why the student can only be certain about one of these dyes.

(2)

He can be sure about G, but not F because ~~the~~ F is insoluble, but may contain multiple insoluble dyes.

ResultsPlus
Examiner Comments

This candidate response starts by mentioning G but does not give a reason. They do provide a reason for F which meant this response scored 1 mark.

Question 5 (b)

Most candidates earned at least 1 mark due to showing their calculations for Q05(b). However, there were frequent issues with incorrect rounding and some confusion over measuring distances accurately, such as recording the full chromatogram distance rather than baseline to solvent front. Errors like dividing distances incorrectly, inverting the equation or converting correct answers into percentages incorrectly all impacted the candidates scores.

(b) Calculate the R_f value for the dye in G.

Show your working.

(3)

solvent = 6.5

G = ~~8~~ 4

$$\frac{\text{ink dist}}{\text{solvent dist}} \qquad \frac{4}{6.5} = 0.6153$$

R_f value = ~~0.61~~ 0.62

ResultsPlus
Examiner Comments

This is an example of a candidate response which scored 2 marks. Both values were within the acceptable range which were used to determine the correct Rf.

(b) Calculate the R_f value for the dye in G.

Show your working.

(3)

$$\frac{\text{distance moved by solvent}}{\text{distance moved by solute}} = \frac{6.5}{4}$$

$$= 1.625$$

⊛ measure from based line

R_f value = 1.625

ResultsPlus
Examiner Comments

This was a common problem and seen in a number of candidate responses. Only 2 marks are scored as the correct values are not correctly used to determine the Rf.

ResultsPlus
Examiner Tip

Discuss with candidates why the Rf cannot have a value greater than 1 which may help them to spot errors like these in their workings.

(b) Calculate the R_f value for the dye in G.

Show your working.

Rf $\frac{\text{distance moved}}{\text{distance from solvent to base line}}$

(3)

$$\frac{40}{65} = 0.615$$

R_f value = 0.615

ResultsPlus
Examiner Comments

Calculations using mm were less common than those in cm. This answer is still correct and the candidate scored 2 marks for this response.

Question 6 (a)(i)

Q06(a)(i) was generally well answered and most candidates scored 2 marks. Where marks were lost, some candidates erroneously listed bubbling, fizzing, and effervescence as separate observations. A number of responses often included mentions of flames, sometimes describing various colours like yellow, lilac, or white which were ignored. A significant number of candidates provided three or more observations when only two were required.

6 This question is about some Group 1 elements and their compounds.

(a) A teacher adds a small piece of sodium to a trough of water.

(i) Give two observations that are made when sodium reacts with water.

1 It fizzes across the surface of the water

2 It melts into a ball

ResultsPlus
Examiner Comments

An example of a response which scored 2 marks and where there are 3 correct observations rather than 2.

ResultsPlus
Examiner Tip

Try not to encourage candidates to provide more than the number of necessary responses, the 'list principle' when marking means that if one of these answers is wrong then marks can be lost.

Question 6 (a)(ii)

Overall, responses were generally well done. Most candidates successfully identified the formation of a hydroxide, though some incorrectly believed the resulting solution would be acidic. Typically, candidates lost M1 for stating incorrect colours like blue or purple, possibly confusing phenolphthalein with indicators like litmus or universal indicator. The majority of candidates achieved M2 by correctly addressing the alkaline nature rather than specific mention of hydroxide ions.

(ii) After the reaction has stopped, the teacher adds a few drops of phenolphthalein to the solution in the trough.

Explain the colour of the phenolphthalein after it is added to the solution.

(2)

The phenolphthalein would be the colour blue because OH^- ions would have formed in the solution, making it alkaline.

ResultsPlus
Examiner Comments

This candidate scored only 1 mark due to correctly identifying that hydroxide ions form but did not score 2 marks due to an incorrect colour observation.

Question 6 (b)(i)

Candidates often scored 1 mark for this question as many didn't link the impact of the impurities on the flame colour, resulting in them not achieving the second mark. Some candidates mentioned sterilising the wire or removing microorganisms rather than considering the context of the question when giving their answer.

(b) A student does a flame test to see if a white solid contains lithium ions.

They clean a platinum wire before using it for the flame test.

(i) Explain why the student needs to clean the platinum wire.

(2)

it needs to be clean otherwise it could affect the results as it may have residue of other ions on it.

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Examiner Comments

This is an example of a response that scored 1 mark as 'could affect the results' is too vague and needed further detail related to the flame colour.

Question 6 (c)(i)

Candidates demonstrated a reasonable understanding in this question, with most able to score at least 1 mark for providing two correct ions. Fewer candidates achieved 2 marks due to common errors such as missing charges on an ion, incorrect charges for an ion, or using incorrect formulas like sulfide instead of sulfate.

(c) Potassium aluminium sulfate can be used in baking.

Anhydrous potassium aluminium sulfate has the formula $KAl(SO_4)_2$

(i) Give the formula of each ion in potassium aluminium sulfate.

potassium ion

K

aluminium ion

Al

sulfate ion

SO

ResultsPlus Examiner Comments

An example of a response where the candidate scored 0 marks as no charges are given for any of the answers and the sulfate ion is also incorrect.

(c) Potassium aluminium sulfate can be used in baking.

Anhydrous potassium aluminium sulfate has the formula $KAl(SO_4)_2$

(i) Give the formula of each ion in potassium aluminium sulfate.

potassium ion

K^+

aluminium ion

Al^{3+}

sulfate ion

S^{2-}

ResultsPlus
Examiner Comments

A common error where sulfate was replaced with sulfide. This response scored 1 mark for the first two ions which are correct.

(c) Potassium aluminium sulfate can be used in baking.

Anhydrous potassium aluminium sulfate has the formula $KAl(SO_4)_2$

(i) Give the formula of each ion in potassium aluminium sulfate.

potassium ion

K^-

aluminium ion

~~al~~ ~~a~~ Al^{+3}

sulfate ion

$(SO_4)^-$

ResultsPlus
Examiner Comments

This response scored 0 marks due to both the charges on the potassium and sulfate ions being incorrect. Aluminium would **not** have been penalised (3+ rather than +3) and could have contributed towards a mark if there had been another correct ion given.

Question 6 (c)(ii)

It was encouraging to see that many candidates had been well taught, resulting in a high proportion scoring full marks for this question. However, some struggled to apply their calculations to find the correct ratio, which prevented them from scoring M4. Some candidates also mistakenly calculated moles using the hydrated salt instead of the anhydrous salt, affecting their ratios and subsequent marks.

(ii) Potassium aluminium sulfate is normally found as a hydrated salt, with the formula $KAl(SO_4)_2.xH_2O$

When 23.7 g of the hydrated salt is heated to remove all the water, 12.9 g of the anhydrous salt is formed.

Calculate the value of x.

[for $KAl(SO_4)_2$, $M_r = 258$ for H_2O, $M_r = 18$]

(4)

$23.7g - 12.9 = 10.8$

$\frac{258}{12.9} = 20$ $\frac{18}{10.8} = 1.6$

$\cancel{\frac{258+18}{2} =}$

x = ...

ResultsPlus Examiner Comments

This candidate only scored 1 mark for the correct calculation for the mass of water.

ResultsPlus Examiner Tip

For candidates who find questions like this overwhelming, encourage them to do some of the simpler calculations so that they benefit from scoring at least the first mark.

(ii) Potassium aluminium sulfate is normally found as a hydrated salt, with the formula $KAl(SO_4)_2.xH_2O$

When 23.7 g of the hydrated salt is heated to remove all the water, 12.9 g of the anhydrous salt is formed.

Calculate the value of x.

[for $KAl(SO_4)_2$, M_r = 258 for H_2O, M_r = 18]

(4)

Mass of water =
23.7 − 12.9 = 10.8

	$KAl(SO_4)_2$	H_2O
m	12.9	10.8
mr	258	18
n	0.05	1.35
	1	27

n m/mr

$\frac{1.35}{0.05}$

x = 27

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Examiner Comments

This response scored 3 marks. M1 for the correct mass of water, M2 for the correct moles of the salt, no M3 as incorrect moles for the water but then they go on to score M4 for ECF and giving the value to a whole number.

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Examiner Tip

Remind candidates that ECF does apply to many calculation questions so always continue with a question even if the numbers don't necessarily look correct.

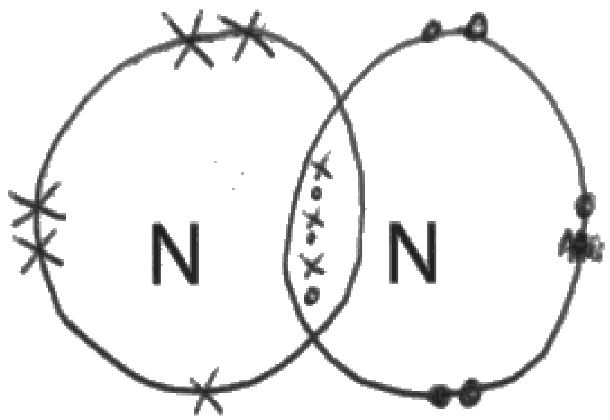
Question 7 (b)

A larger number of candidates than anticipated successfully scored 2 marks for their diagrams depicting the structure of nitrogen gas. However, there were notable challenges including incorrectly drawing electrons for a single covalent bond without consideration for the number of outer electrons, while other candidates incorrectly gave a double bond between the nitrogen atoms instead of a triple bond. Many of the diagrams did correctly show the appropriate number of electrons around each nitrogen atom, although their arrangement was sometimes incorrect or cramped.

(b) Complete the dot-and-cross diagram for a molecule of nitrogen.

Show outer electrons only.

5 on the outer shell

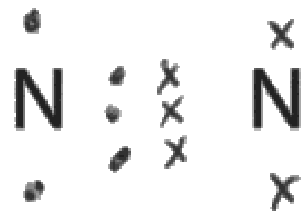


ResultsPlus Examiner Comments

This response scored 1 mark for the correct number of shared electrons. Unfortunately, the candidate goes on to include too many electrons on the rest of the atoms, losing the 2nd mark.

(b) Complete the dot-and-cross diagram for a molecule of nitrogen.

Show outer electrons only.



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Examiner Comments

The drawing of circles/shells was not necessary as long as the number of electrons were correct, resulting in this example scoring 2 marks.

Question 7 (c)(i)

Most candidates were able to correctly identify some of the reactants, mainly nitrogen and oxygen, but this alone was not sufficient to score. Some candidates gave nitrogen dioxide as a product rather than a reactant and a significant number of errors occurred writing the correct formulas for nitric acid. Many candidates mistakenly gave formulas such as H_2NO_3, HNO_2, NO, or N_2O instead of HNO_3. Balancing the equation proved to be another hurdle, with a large proportion of candidates struggling to achieve marks. Common mistakes included placing additional molecules like O_2 or H_2O on either side of the equation where they did not belong. Overall this question proved a challenge and wasn't performed well by the majority of candidates.

(c) Nitrogen dioxide produced in car engines reacts with water vapour and oxygen in the atmosphere to form nitric acid.

(i) Give a chemical equation for this reaction.

$NO_2 + 2H_2O + O_2 \rightarrow NH_4 + 3O_2$

ResultsPlus
Examiner Comments

An example where a candidate was able to correctly write formulae for the reactants but struggled with nitric acid and the balancing of the equation. This response scored 0 marks.

(c) Nitrogen dioxide produced in car engines reacts with water vapour and oxygen in the atmosphere to form nitric acid.

(i) Give a chemical equation for this reaction.

(2

$NO_2 + H_2O + O_2$

ResultsPlus Examiner Comments

Many candidates started but did not finish their answer resulting in 0 marks.

Question 7 (c)(ii)

In Q07(c)(ii) most candidates were able to correctly identify an environmental effect of acid rain. However, some answers were vague, lacking details like the specific ecosystems affected. Some candidates mistakenly referenced global warming or the ozone layer.

(ii) Nitric acid forms acid rain.

State one environmental effect of acid rain.

(1)

releases toxic carbon monoxide into the air

ResultsPlus
Examiner Comments

There weren't many candidate responses that misunderstood the question but examiners still saw answers that suggested the candidate hasn't fully read the question, such as this one which scored 0 marks.

Question 7 (d)(ii)

A wide range of responses were seen from candidates for this question. The test for ammonium ions was challenging for many candidates, as there was some confusion between ammonium and ammonia gas. A number of candidates failed to demonstrate the presence of a gas and/or applied the test reagent incorrectly to the solution. Conversely, the carbonate ion test was better understood, with more candidates successfully scoring marks for this half of the question. Many candidates erroneously mentioned adding additional substances like silver nitrate or barium chloride when testing for carbonates. While many candidates provided satisfactory 6-mark answers, some struggled due to initial errors in applying the correct reagents, leading to difficulties in scoring.

(ii) A technician finds an unlabelled bottle on a shelf that could be ammonium carbonate solution.

Describe tests that the technician should do to confirm that the solution contains ammonium ions and carbonate ions.

(6)

to test for ammonium :-
add sodium hydroxide,
then put red damp litmus paper,
if it turns blue then it contains
ammonium

ResultsPlus
Examiner Comments

This response scored 1 mark for the addition of sodium hydroxide. There is no suggestion that they are testing a gas or ammonia instead linking the test back to ammonium so there was no further marks scored.

(ii) A technician finds an unlabelled bottle on a shelf that could be ammonium carbonate solution.

Describe tests that the technician should do to confirm that the solution contains ammonium ions and carbonate ions.

(6)

To test for ammonium ions the technician should aqueous sodium hydroxide to a sample of the bottle. ~~They should then~~ This then releases NH_3 gas ~~The technician~~ if there is ammonium ~~th~~ ions present. They should then put the gas on damp red litmus paper. If the litmus paper turns ~~there~~ blue then ammonium ions are present.

To test for ~~cab~~ carbonate ions, the technician should add dilute hydrochloric acid to a sample from the bottle. If the solution fizzes the CO_2 bubbles are produced. To fully test whether the bubbles contain ~~carbo~~ carbonate ions, they should bubble the solution through limewater. If the solution turns cloudy then carbonate ions are present.

(Total for Question 7 = 13 marks)

ResultsPlus Examiner Comments

This response scored 4 marks. M1, M2 and M3 were scored for the correct reagent and test given. For the carbonate ion test only M4 was scored as the answer states that 'they should bubble the solution through limewater' which meant M5 and M6 could not be scored.

(ii) A technician finds an unlabelled bottle on a shelf that could be ammonium carbonate solution.

Describe tests that the technician should do to confirm that the solution contains ammonium ions and carbonate ions.

(6)

To test for ammonium ions : first we add sodium hydroxide to form ammonia and ammonia can be tested by a ~~dry~~ damp red litmus paper that will turn to ~~[illegible]~~ Blue

To test of carbonate ions : first we add HCl (hydrochloric acid) to remove impurities and look for a fizzing of a gas, then the gas is taken and bubbled into a lime water if cloudy, milky colour formed that indicated it a CO_2 (carbon dioxide).

ResultsPlus Examiner Comments

This is an example of an excellent response which scored 6 marks.

(ii) A technician finds an unlabelled bottle on a shelf that could be ammonium carbonate solution.

Describe tests that the technician should do to confirm that the solution contains ammonium ions and carbonate ions.

(6)

Test for ammonium ions : (NH_3^{+1})

1- add sodium hydroxide

2- test gas produced with red litmus paper

3- red litmus paper turns blue due to formation of NH_3 gas . (only alkaline gas)

Test for CO_3^{-2} ions :

1 add HCl to the solution

2 bubble gas produced into limewater

3 lime water should turn milkey or cloudy due to presence of CO_2 (formation of $CaCO_3$)

ResultsPlus
Examiner Comments

Another excellent 6 mark response.

ResultsPlus
Examiner Tip

A layout such as this is a good way for candidates to check that they have covered all the key points. Candidates can use bullet points to help make their answers clearer and to ensure they have given 6 good points for a 6 mark question.

Question 8 (a)(i)

Most candidates managed to earn at least 1 mark when giving the definition of an isomer, but there were common errors such as providing definitions of isotopes or discussing monomers and polymers. A number of candidates used terms like empirical formula, general formula, or chemical formula interchangeably with molecular formula, which reduced the marks awarded. A smaller number of candidates started by incorrectly saying 'elements with the same molecular formula'.

8 This question is about hydrocarbons.

(a) The molecular formula C_4H_8 represents all the isomers of an alkene.

(i) Explain what is meant by the term **isomers**.

(2)

Isomes are the elements /compounds with the same molecular formula.

ResultsPlus
Examiner Comments

This response is an example where sometimes writing more terms ('elements/compounds') doesn't necessarily result in more marks as it scored 0 marks.

ResultsPlus
Examiner Tip

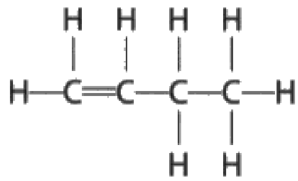
Candidates should be encouraged to work on choosing the correct terminology when answering a question and consider selecting one term rather than listing a few.

Question 8 (a)(ii)

Most candidates generally understood what was being asked of them when drawing isomers but there were some common errors with the answers given including:

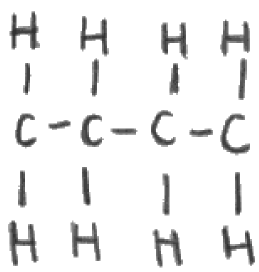
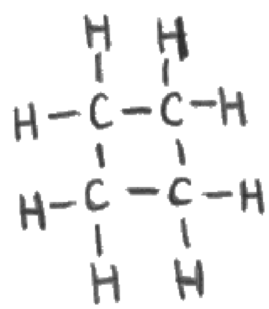
1. **Redrawing the Same Molecule with a Bend or Different Orientation.**
2. **Errors in Carbon Bonding**: Some candidates mistakenly added extra bonds to carbon atoms, resulting in structures where carbon had five bonds.
3. **Lack of Double Bonds in Some Structures.**
4. **Cycloalkane Structures**: Some candidates mistakenly drew cycloalkanes rather than another alkene as requested in the question.

(ii) The displayed formula of one of the isomers of the alkene is shown.



Draw displayed formulae for two other alkene isomers with the molecular formula C_4H_8

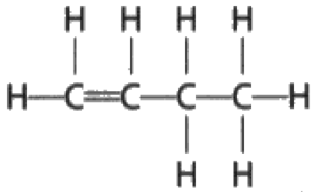
(2)

alkene isomer 1	alkene isomer 2
	

ResultsPlus
Examiner Comments

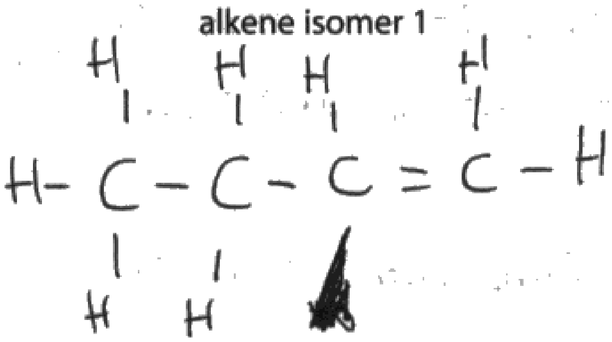
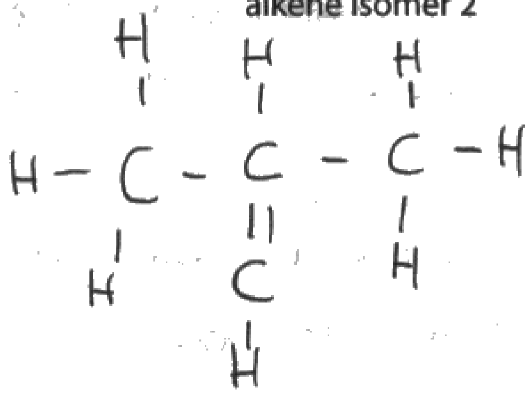
This response scored 0 marks. Isomer 1 is lacking the double bond and as a result has carbons with only 3 bonds. Whilst cyclobutane is an isomer of but-1-ene the question asks for 'two other alkene isomers' so this does not fit the requirement.

(ii) The displayed formula of one of the isomers of the alkene is shown.



Draw displayed formulae for two other alkene isomers with the molecular formula C_4H_8

(2)

alkene isomer 1	alkene isomer 2
	

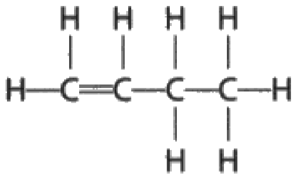
ResultsPlus
Examiner Comments

This response scored 0 marks. Isomer 1 is still but-1-ene but drawn backwards compared to the diagram and Isomer 2 has carbons with 3-5 bonds.

ResultsPlus
Examiner Tip

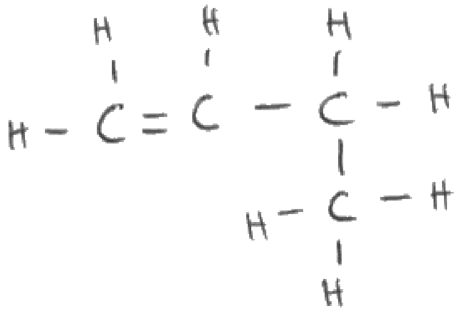
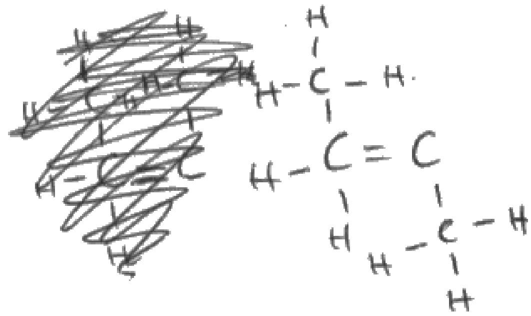
Ensure candidates check that their carbon atoms are drawn with 4 bonds attached when checking through their work. This is a good exercise when they review their paper at the end of the exam if they have time remaining.

(ii) The displayed formula of one of the isomers of the alkene is shown.



Draw displayed formulae for two other alkene isomers with the molecular formula C_4H_8

(2)

alkene isomer 1	alkene isomer 2
	

ResultsPlus
Examiner Comments

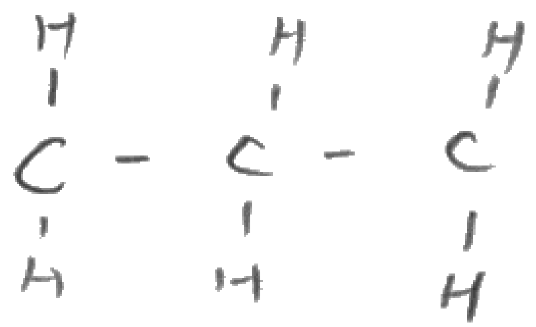
This response also scored 0 marks. The first isomer given is still but-1-ene but with the structure drawn at an angle so does not score. The second isomer would be but-2-ene and score if they had ensured that all their C's had 4 bonds. Some of the C's in isomer 2 have 3 bonds and others have 5 bonds which is most commonly seen with C's which form part of the double bond.

Question 8 (c)(i)

Very few candidates successfully scored 1 mark for this question. Most candidate responses featured an unbranched chain of a three carbon alkane with trailing bonds. Some candidates also gave answers which still contained a double bond.

(c) The alkene C_3H_6 can be polymerised to form the polymer poly(propene).

(i) Draw the repeat unit of poly(propene).



ResultsPlus
Examiner Comments

This scored 0 marks and was one of the most common responses seen – both with and without trailing bonds.

Question 8 (c)(ii)

The majority of candidates were able to achieve at least 1 mark when providing environmental issues for the two methods. Method one, landfill, was more poorly answered, with many responses focusing on issues like soil, water pollution, visual impact, odour, deforestation and disruption to ecosystems rather than specifically addressing polymer disposal. Method two, burning, received better responses, although concerns about 'harmful gases' were commonly cited and there was a prevalence of answers mentioning climate change and global warming that were not linked to the emission of greenhouse gases from burning polymers.

(ii) These are two methods for disposing of polymers such as poly(propene).

method 1 burying them in landfill sites

method 2 burning them to release heat energy

State one environmental problem linked to each of these methods of disposal.

(2)

method 1

They don't decompose so they will be there forever.

method 2

burning them releases harmful greenhouse gases into the environment

ResultsPlus
Examiner Comments

An example of a good response that scored 2 marks.

(ii) These are two methods for disposing of polymers such as poly(propene).

method 1 burying them in landfill sites

method 2 burning them to release heat energy

State one environmental problem linked to each of these methods of disposal.

(2)

method 1

~~animals feeding on~~ explosive so it can destroy habitats.

method 2

global warming

ResultsPlus
Examiner Comments

An example of a response that scored 0 marks. Global warming was not credited unless it was linked to greenhouse gases being produced, a link to burning polymers was needed to qualify for the mark.

Question 8 (d)

Many candidates successfully earned 2 marks for accurately determining the values of y and z in their calculations but found calculating x from these values a challenge and lost the final mark. When calculating x, some candidates added y and z together, occasionally they stated 28 (not factoring in that oxygen is diatomic) or gave arbitrary numbers. A few candidates were confused by the layout of their calculations and started trying to calculate the lowest ratio of x and y and then giving the answer of 1 for each; these candidates could still have scored a mark for the correct calculation of x with ECF but this was uncommon. A notable number of candidates left this question blank.

(d) Complete combustion of one mole of an alkane produces 396 g of carbon dioxide and 180 g of water.

This is the equation for the reaction.

$$\text{alkane} + xO_2 \rightarrow yCO_2 + zH_2O$$

Calculate the values of x, y and z.

[for CO_2, $M_r = 44$ for H_2O, $M_r = 18$]

(3)

	CO_2	H_2O
Mass	396	180
Mole	$\frac{396}{44}$	$\frac{180}{18}$
Ratio	1	1
Ratio		

$\frac{9}{9} = 1$ $\frac{10}{9} =$ 1.1 $= 1$

x = 1

y = 1

z = 1

ResultsPlus
Examiner Comments

An example of a response where candidates had calculated y = 9 and z = 10 but then they go on to determine the lowest ratio between them coming up with an answer of 1 for each. ECF means x could have gained credit but unfortunately the value given is incorrect.

Question 8 (e)(i)

Most candidates struggled to score 2 marks for this question. The most common error was incorrect state symbols, such as indicating carbon as a gas (g) instead of solid (s). Water was also frequently incorrectly labelled as aqueous (aq). Typically marks were achieved through successfully balancing the equation but accurately applying state symbols proved to be a significant challenge.

Question 8 (e)(ii)

Most candidates correctly identified carbon monoxide (CO) as a product which would cause a problem to humans and described its binding to haemoglobin, reducing oxygen transport in blood. However, some candidates omitted naming CO or discussed unrelated gases like carbon dioxide (CO_2) or global warming. Overall, responses were generally accurate but varied in clarity.

(ii) Explain one problem for humans caused by a product of this incomplete combustion.

(2)

~~A~~ limited supply of oxygen can lead to humans dying. ~~If petrol engines~~ If there is a limited supply of oxygen and petrol engines keep using incomplete combustion cars will not be able to run.

(Total for Question 8 = 15 marks)

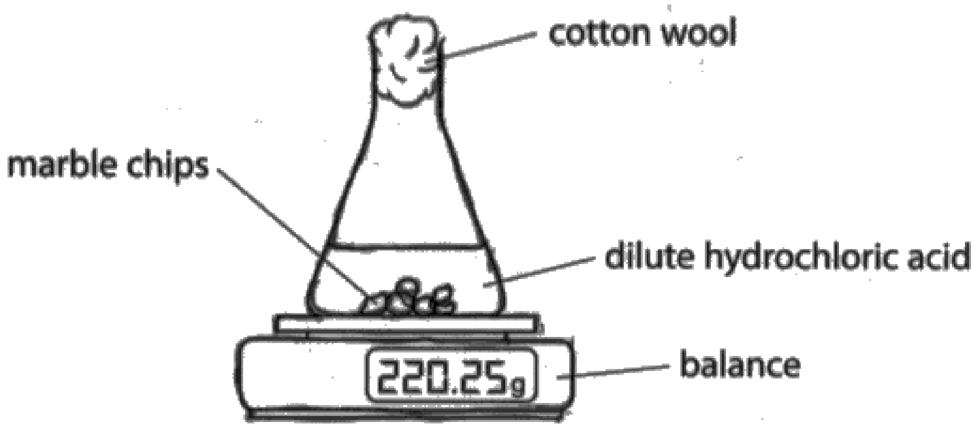
ResultsPlus
Examiner Comments

This is an example of a response which scored 0 marks. Candidates missing the point to this extent was quite uncommon as candidates commonly scored 2 marks.

Question 9 (a)(i)

Most candidates were able to identify that a gas was released during the experiment. However, there were instances where some mistakenly identified the gas as hydrogen, oxygen, or water vapor. Heat loss was also cited by some candidates as a factor affecting the mass loss. The main misconception was the belief that the loss of mass occurred due to marble chips dissolving, rather than the gas escaping from the reaction vessel.

9 A student uses this apparatus to investigate the rate of reaction between marble chips and dilute hydrochloric acid.



This is the equation for the reaction.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

(a) During the reaction the reading on the balance decreases because mass is lost from the flask.

(i) State why mass is lost from the flask.

- marble chips and dilute hydrochloric acid is reacting.

ResultsPlus
Examiner Comments

Responses from some candidates suggested that because the marble chips had 'disappeared' or had reacted that the mass must have decreased rather than linking it to a gas escaping from the flask. This response scored 0 marks.

Question 9 (a)(ii)

Many candidates misunderstood the purpose of the cotton wool in the experiment. Common incorrect responses included suggestions that the cotton wool was used to prevent spillages, trap gas inside the flask, prevent heat loss, catch water vapor, or prevent contamination from outside sources. Some candidates contradicted their own answers from the previous question (Q09(a)(i)) by stating that the cotton wool limited the loss of CO_2, which was incorrect in the context of the experiment.

(ii) State the purpose of the cotton wool.

To seal the top while still letting ~~oxygen in~~ gas in and out

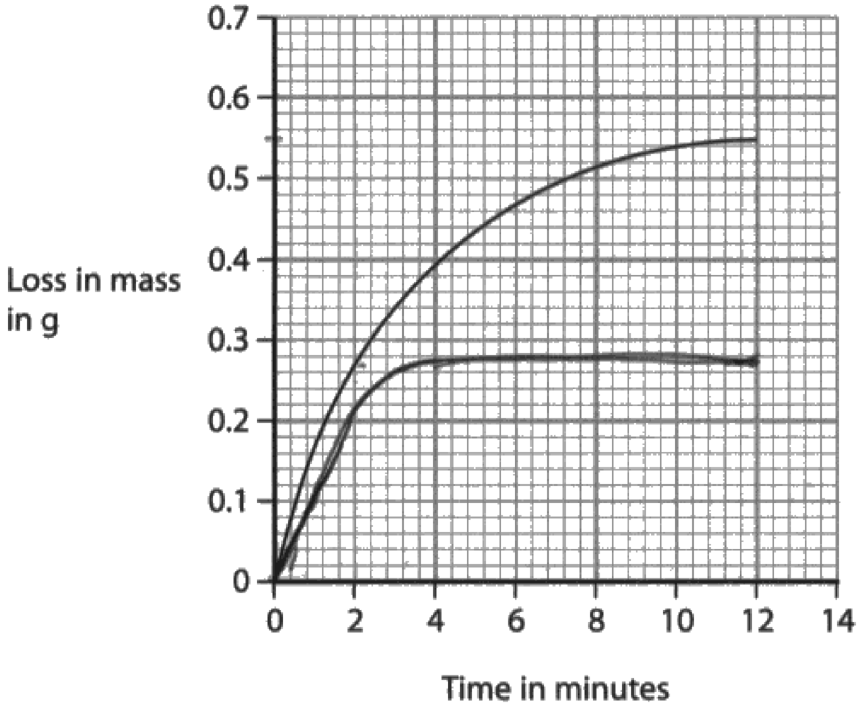
ResultsPlus Examiner Comments

This response scored 0 marks as it doesn't explain why we would want to 'seal the top'. 'Seal' is also not a preferred term for the answer to this question.

Question 9 (b)(i)

The question proved challenging for many candidates as they often focused on discussing the rate of reaction rather than describing the shape of the graph. Marks were frequently lost due to a lack of reference to the declining concentration of HCl, with some candidates mistakenly attributing the plateau in the graph to factors like all marble chips having reacted or the acid becoming saturated. Despite the question specifying that marble chips were in excess, there were still misconceptions about their role in the experiment. Few candidates successfully earned full marks.

(b) This is a graph of the student's results.



(i) Explain the shape of the graph.

You should assume that the marble chips are in excess.

(4)

for the first two minutes, there is a large loss in mass in a short amount of time. This is because there is a high concentration of HCl availible to react with the marble chips.

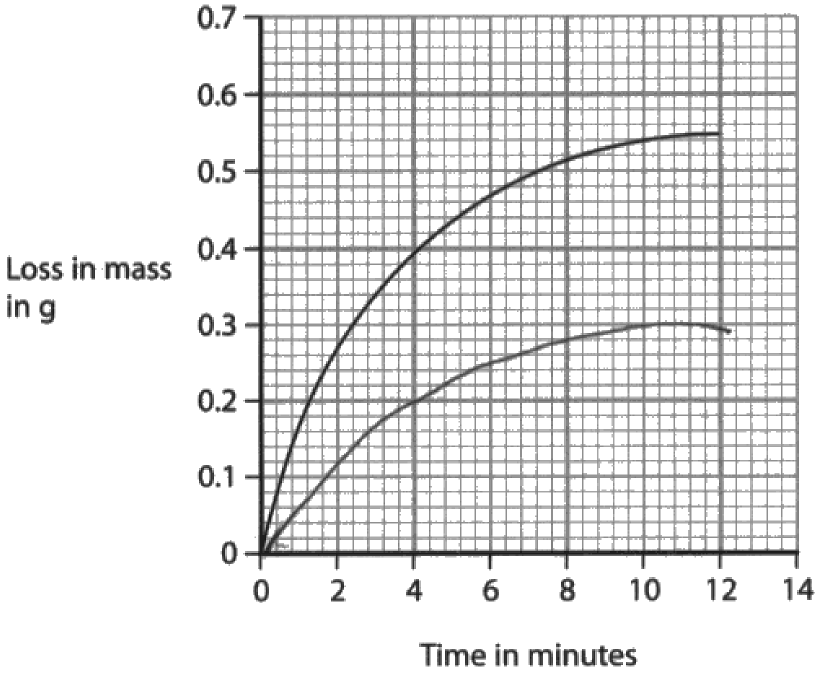
Between 4 and 10 minutes, the loss in mass decreases, shown when the gradient decreases - because there is less unreacted HCl availible to ~~[illegible]~~ react with marble chips.

for the last minute the reaction stops - there is no more HCl availible to react

ResultsPlus
Examiner Comments

This is an example of a response that scores 4 marks. The candidate correctly links the shape of the graph to a reason related to HCl at several different points.

(b) This is a graph of the student's results.



(i) Explain the shape of the graph.

You should assume that the marble chips are in excess.

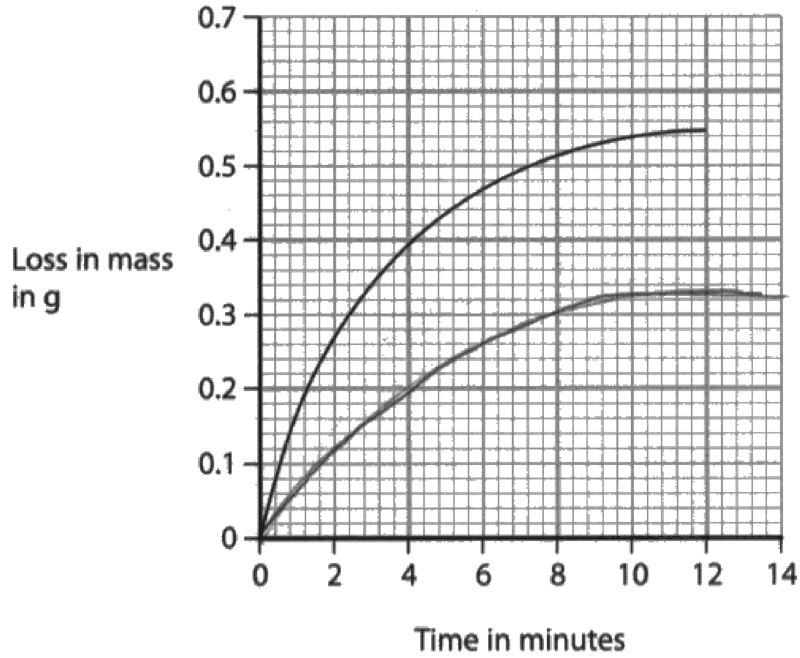
(4)

the line shown on the graph is a curve,
Which means that the loss in not constant.
Since it is a curved line rather than a
straight line, this also means that there is
no stable gradient. What is most noticable is
that in the first 4 minutes of the reaction,
that is when the most was lost from the reaction.
And past that point, there was still loss in
mass, it just was not as significant and it
was over a longer period of time.

ResultsPlus
Examiner Comments

This response scored 2 marks for a correct description of the shape of the graph at two different points but there was no accompanying explanation for this shape – M1 and M3 scored.

(b) This is a graph of the student's results.



(i) Explain the shape of the graph.

You should assume that the marble chips are in excess.

(4)

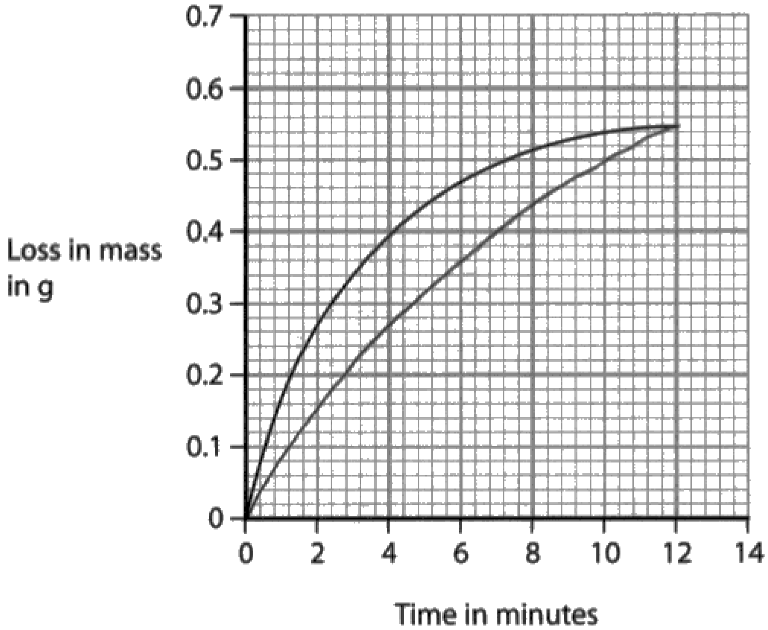
At the start of the reaction, there is a large volume of both acid and marble chips, and so the reaction is faster and the graph is steeper. The graph slowly becomes less steep as more acid reacts ~~to~~ with the marble chips because the volume ~~of acid~~ is or surface area of acid is decreasing and therefore the reaction slows. The ~~of~~ graph levels out at the end ~~is~~ ~~be~~ as there is no acid left to react, and so the reaction stops.

An example where a candidate has secured all 4 marks.

Question 9 (b)(ii)

Most candidates earned 1 out of 2 marks for positioning the line below and to the right of the original curve. However, many candidates did not realise that the line should level off at half the height of the original curve.

(b) This is a graph of the student's results.



(i) Explain the shape of the graph.

You should assume that the marble chips are in excess.

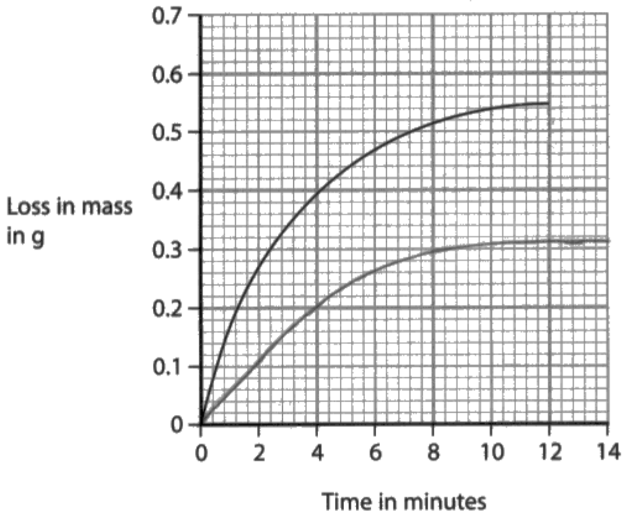
(4)

as first it is incresting until minutes it's speed started to deerse at minute 10 ~~it have reacted~~ ~~atl~~ the mass stopped duo to the reaction have stopped

ResultsPlus
Examiner Comments

A common answer which scored only 1 mark for the shallower gradient.

(b) This is a graph of the student's results.



(i) Explain the shape of the graph.

You should assume that the marble chips are in excess.

The graph is a curve, as time is not directly proportional to loss in mass. At the beggining of the reaction, the line is very steep because there is a high number of HCl particles, increasing the chances of collisions. The concentration is higher so the particles are closer together ~~Fore~~ and there are more frequent collisions and thus more frequent successful collisions. As time passes the line becomes less steep as the rate of reaction decreases so less HCL lost. That's because there are less ~~R~~ HCl particles left and thus less frequent collisions (as particles are further apart) and thus less frequent successful collisions. The reaction stops at 12 minutes ~~and the line becomes horizontal~~, as all the HCl particles have been used up, so no collisions are taking place. ~~and the mass remains constant at 0.54 since the reaction is done.~~ Highest rate of reaction at the start

(4)

(ii) On the grid, draw the curve you would expect to obtain if the student uses the same volume of hydrochloric acid but with half the concentration.

Assume that all other conditions are kept the same.

(2)

ResultsPlus
Examiner Comments

Some candidates weren't precise enough and even though they had considered that the overall loss in mass should be roughly half the height, they needed to be more precise with where their line finished. This response scored only 1 mark.

Question 9 (c)

Most candidates answered this question effectively and demonstrated an understanding of the effect of increased surface area on reaction rate. Some answers included misconceptions such as the use of energy in their response and also incorrectly suggesting that the surface area had decreased. Overall, the majority of responses were well-handled with many candidates achieving 3 marks. The most commonly missed mark was for not specifying that the collisions **per unit time/frequency** of collisions increases with smaller marble chips.

(c) The student repeats the experiment using the same mass of smaller marble chips.

Explain, using particle collision theory, how using smaller marble chips would affect the rate of this reaction.

Assume that all other conditions are kept the same as in the initial experiment.

(3)

Since marble chips are smaller, they have a higher surface area, so more area to react with. Therefore, the kinetic energy of particles will increase and they will ~~collide~~ cause succesful collisions more frequently per unit time, thereby the rate of reaction would increase.

ResultsPlus
Examiner Comments

An example of a response which included kinetic energy and as a result meant the maximum the candidate could score was 1 mark.

(c) The student repeats the experiment using the same mass of smaller marble chips.

Explain, using particle collision theory, how using smaller marble chips would affect the rate of this reaction.

Assume that all other conditions are kept the same as in the initial experiment.

(3)

So the marble chips have large surface area. And the namber of marble chips has increased. So successful partick collision will also increase. Therefore the rate of reaction will increase.

ResultsPlus
Examiner Comments

This response only scored 2 marks. The candidate mentions 'successful collision' but they miss out the key part of 'per unit time' or the use of 'frequent'.

Question 10 (a)

Candidates struggled to correctly score 1 mark in this question and it was only well done by
those who have a strong grasp of the course. Many candidates incorrectly wrote "$MgNO_3$" instead of "$Mg(NO)_2$ " and confused "H_2" with "H_2O".

10 A student investigates the reaction between magnesium and nitric acid.

The student uses this method.

- add 40 cm^3 of dilute nitric acid to a glass beaker
- record the temperature of the acid
- find the mass of a strip of magnesium ribbon
- add the magnesium ribbon to the nitric acid
- when all the magnesium has reacted, record the highest temperature reached

(a) Complete the chemical equation for this reaction.

$Mg + 2HNO_3 \rightarrow$ MgNO3 + H2

ResultsPlus
Examiner Comments

Incorrect formula for magnesium nitrate so this response scored 0 marks.

10 A student investigates the reaction between magnesium and nitric acid.

The student uses this method.

- add 40 cm^3 of dilute nitric acid to a glass beaker
- record the temperature of the acid
- find the mass of a strip of magnesium ribbon
- add the magnesium ribbon to the nitric acid
- when all the magnesium has reacted, record the highest temperature reached

(a) Complete the chemical equation for this reaction.

$Mg + 2HNO_3 \rightarrow$ MgNO3 + 3H2O

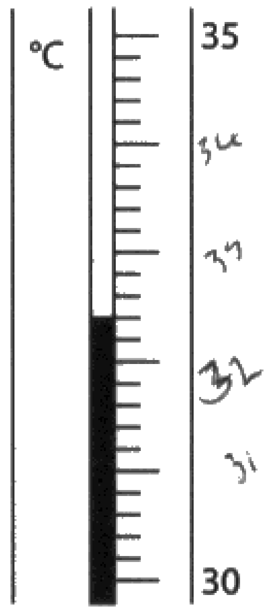
ResultsPlus
Examiner Comments

More than one error in this response but this was common.

Question 10 (b)

Many candidates successfully identified the temperature readings from the thermometer as 32.4°C and 16.0°C. However, a significant number of candidates omitted the decimal point when recording temperatures, writing "16" instead of "16.0". This mistake cost them marks, as precision to the nearest 0.1°C was required.

(b) The thermometer shows the highest temperature reached.



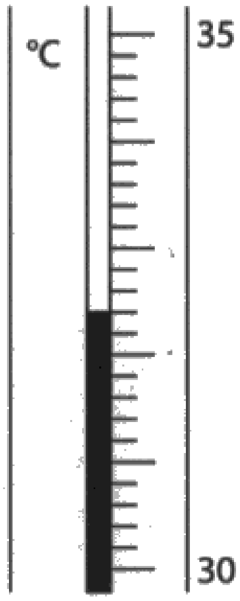
Complete the table by giving the temperatures to the nearest 0.1°C

starting temperature of the acid in °C	16
highest temperature reached in °C	32.4
temperature rise in °C	16.4

ResultsPlus
Examiner Comments

An example of a response that scored 1 mark and lost the second mark due to a lack of precision.

(b) The thermometer shows the highest temperature reached.



Complete the table by giving the temperatures to the nearest 0.1°C

starting temperature of the acid in °C	32.4
highest temperature reached in °C	48.8
temperature rise in °C	16.4

ResultsPlus
Examiner Comments

In this example the candidate has recorded the highest temperature in the diagram as the starting temperature in the table. In this instance the candidate scored 1 mark for ECF.

Question 10 (c)

In Q10(c)(i), the majority of candidates correctly used the temperature rise as 16.4°C, though there were instances where some mistakenly used 16°C.

In Q10(c)(ii), responses were generally strong with many candidates demonstrating a clear understanding of the calculations required. However, marks were often lost due to answers not being rounded to two significant figures, overlooking the negative sign or incorrect approaches when applying moles to Q.

(c) (i) Show that the heat energy change (*Q*) for this reaction is about 2800 J.

[for 1.0 cm^3 of solution, mass = 1.0 g]

[for the solution, c = 4.2 J/g/°C]

(2)

$4.2 \times 40 \times 16.4 = 2755.2 \simeq 2800\,J$

(ii) The mass of magnesium used by the student was 0.12 g.

Calculate the value of the enthalpy change (ΔH), in kJ/mol, for the magnesium reacting with nitric acid.

Give your answer to two significant figures, including a sign in your answer.

(4)

mr = 24

mole = $\frac{0.12}{24} = 0.005$

$\frac{2800 \div 1000}{0.005} = 560$ KJ/mol

ΔH = 560 kJ/mol

ResultsPlus Examiner Comments

An example where only 1 mark is lost by the candidate and this is for not including a negative sign to show the reaction is exothermic.

(c) (i) Show that the heat energy change (Q) for this reaction is about 2800 J.

[for 1.0 cm³ of solution, mass = 1.0 g]

[for the solution, c = 4.2 J/g/°C]

(2)

$Q = \Delta T \times m \times c$

$\rightarrow Q = 16 \times 40 \times 4.2$

$= 2688$

$\approx 2800\text{J}$

(ii) The mass of magnesium used by the student was 0.12 g.

Calculate the value of the enthalpy change (ΔH), in kJ/mol, for the magnesium reacting with nitric acid.

Give your answer to two significant figures, including a sign in your answer.

(4)

~~Q = 16 × 0.12 × 4.2~~

$\frac{0.12}{24} = 0.005$ mols of Mg

$\frac{40}{63} = 0.634\ldots$ mols of HNO_3

$\frac{2688 \; \cancel{2800}}{0.005} = 537{,}600 \; \cancel{560{,}000}$

ΔH = 537.6 ~~560~~ ~~560,000~~ kJ/mol

ResultsPlus
Examiner Comments

In this example the candidate has not used the correct temperature change in Q10(c)(i), losing a mark.

In Q10(c)(ii) they can score ECF but have lost the final mark due to an incorrect sign and not giving a response to 2 significant figures.

Question 10 (d)

In Q10(d), nearly all candidates correctly identified polystyrene as an insulator, earning them the first mark. Candidate responses were lower in quality when explaining why polystyrene was a better insulator than a glass beaker, with a number of candidates struggling to provide a comparative explanation. Common errors included stating that no heat was lost rather than acknowledging a reduction in heat loss compared to glass. Responses that did score included points about polystyrene trapping heat effectively or preventing heat loss to the surroundings.

(d) Explain why using a polystyrene cup, instead of a glass beaker, would give a more accurate result.

(2)

Because polystyrene is an insulator of heat, so heat would not escape to surroundings, so it will have an accurate result. Glass is a conductor of heat and heat would be lost to surroundings by it.

(Total for Question 10 = 11 marks)

ResultsPlus
Examiner Comments

This response only scored 1 mark due to the candidate suggesting that a polystyrene cup would stop any heat escaping.

Paper Summary

Based on their performance in this paper, candidates should:

- Ensure they have provided enough detail in extended response answers to secure maximum marks.
- Not be afraid to use bullet points to help check they aren't repeating themselves and to set out their work clearly.
- Learn chemical tests carefully.
- Practice interpreting graphs and explaining what the results show.
- Consider the gradient and end point of curves when drawing on graphs.
- Consider the terminology they are choosing when writing their answers.