PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 9: SEPARATE CHEMISTRY 2 (PACK 1)

SCORE	PERCENTAGE
/120	%

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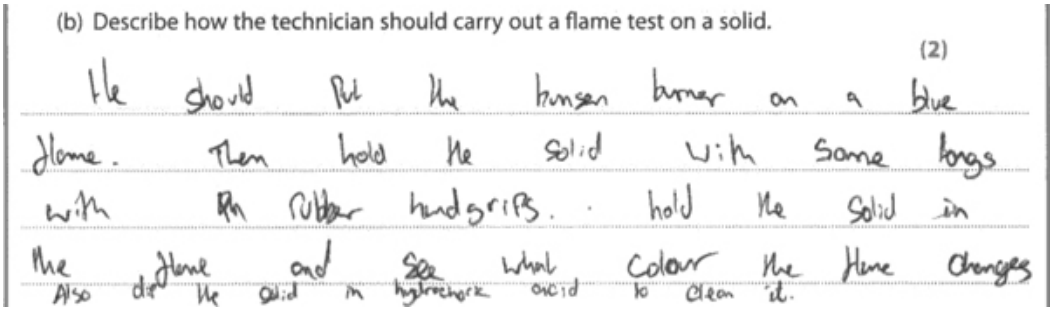
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Q1.

This was poorly answered on the whole.

Few candidates were able to recall a correct procedure for flame testing, either by the use of the wire loop or dampened splint. Invariably 1 mark was scored, due to the use of the incorrect apparatus, typically 'tongs', but correctly mentioning **'in**the flame'. Many candidates attempted to use safety / yellow flames or incorrectly mentioned holding samples 'over or under the flame'.


(b) Describe how the technician should carry out a flame test on a solid.

(2)

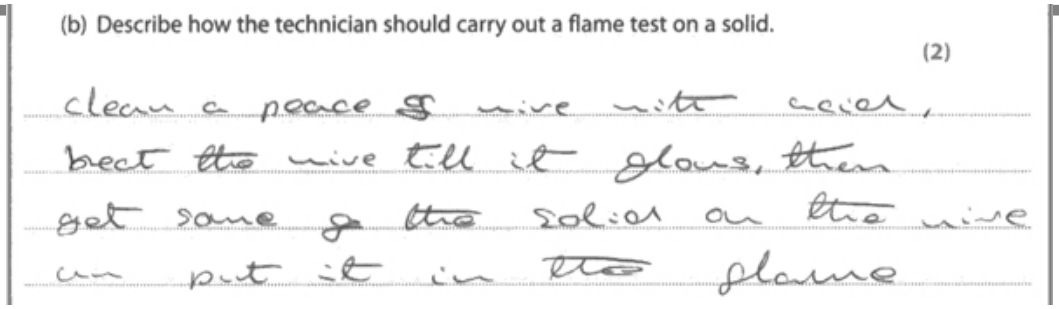
He should Put the bunsen burner on a blue flame. Then hold the solid with some tongs with the rubber handgrips. hold the solid in the flame and see what colour the flame changes Also dip the solid in hydrochloric acid to clean it.

Results Plus: Examiner Comments

This is a typical 1 mark maximum answer where the 'test' mark was scored only, since the wrong apparatus, namely 'tongs', has been used.

Results Plus: Examiner Tip

This is commonly asked question on the examination, make sure that you are able to recall the flame test accurately and the correct colours of the flames for specific metal ions.


(b) Describe how the technician should carry out a flame test on a solid.

(2)

clean a peace of wire with water, heat the wire till it glows, then get some of the solid on the wire an put it in the flame

Results Plus: Examiner Comments

A good example of a correct answer. All the three possible marking points have been mentioned, so this scored 2 marks.

Q2.

(ii)

Only a few candidates scored both marks for describing how to correctly carry out a flame test on a solid. Generally the candidates that scored 1 mark did so for 'putting 'it' into flame' or putting a solid on a rod/loop/splint. Many held the solid OVER or under (?) a flame or just stated 'over a Bunsen'. There were few real attempts to describe the test accurately; the majority described using inappropriate equipment e.g. tongs, spatulas, tweezers, spoons, clamps. Very few mentioned the need to clean the wire loop before carrying the flame test.

(ii) Describe how a flame test is carried out on a solid.

(2)

a bunson burner is used/lit. Then with gloves and tongs you would pickup the solid and hover it over the flame and the colour should appear

Results Plus: Examiner Comments

Incorrect equipment (tongs) as well as 'hover it over the flame' do not attract marks for carrying out the flame test. 0 marks awarded here.

(ii) Describe how a flame test is carried out on a solid.

(2)

you put a chosen solid in the blue flame and see what colour the flame goes above the solid

Results Plus: Examiner Comments

1 mark was given for putting the solid into a blue (Bunsen) flame.

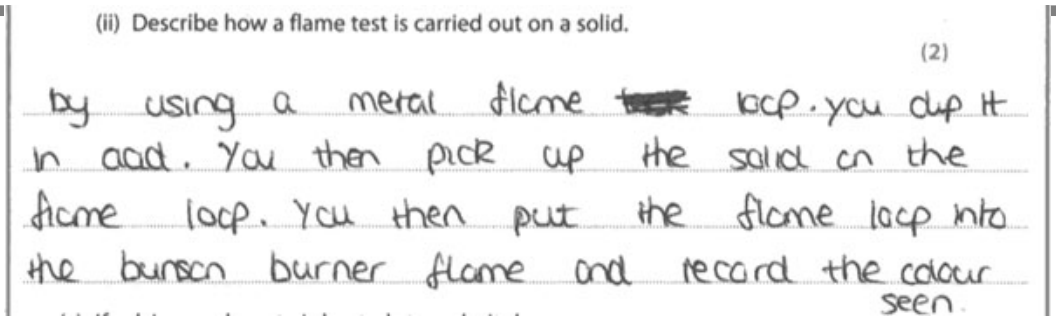
(ii) Describe how a flame test is carried out on a solid.

(2)

you dip a piece of water into your solid, then place the wire in the hottest part of the Bunsen Burner and watch the COLOUR

Results Plus: Examiner Comments

If only the candidate could re-read their answer! Unfortunately similar errors were often seen in answers to this question.


(ii) Describe how a flame test is carried out on a solid.

(2)

by using a metal flame [redacted] loop. you dip it in acid. You then pick up the solid on the flame loop. You then put the flame loop into the bunsen burner flame and record the colour seen.

Results Plus: Examiner Comments

An answer like this was rarely seen. This was very pleasing to see and 2 marks were given for this answer.

Results Plus: Examiner Tip

The three steps involved in a flame test are:

1. Clean the flame testing rod with hydrochloric acid.

2. Dip the rod into the acid and then into the solid being tested.

3. Put the end of the testing rod into a Bunsen flame with the air hole half open.

Learn the steps involved to carry out a flame test and the colours that are obtained for the ions Na^+, K^+, Ca^{2+} and Cu^{2+}.

Q3. No Examiner's Report available for this question

Q4.

(ii)

Although many candidates did know how to test for ammonia, there were many poor descriptions. A significant number omitted to heat the mixture. A surprising number thought that ammonia would turn blue litmus red or even bleach it. A common error was to place red litmus in the solution with sodium hydroxide rather than in the gas.

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

sodium hydroxide solution could be added to substance X. If a white precipitate is formed then ammonium ions are present.

Results Plus: Examiner Comments

This candidate has not learnt the test for ammonium ions so has not scored a mark.

Results Plus: Examiner Tip

Learn all the tests for the ions that are listed in the specification.

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

Add a few drops of sodium hydroxide solution to substance X and, if aluminium ions are present, a white precipitate should form. To make sure they are aluminium ions and not calcium ions, add more sodium hydroxide solution. The precipitate should redissolve leaving a colourless solution.

Results Plus: Examiner Comments

This candidate has described the test for aluminium ions and has not scored any marks as the question asks for ammonium ions.

Results Plus: Examiner Tip

Read the questions carefully.

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

Sodium hydroxide solution can be added to substance X, no precipitate will form but it heated, will give off ammonia, this can be tested by the smell and ~~red litm~~ blue litmus paper as it will turn red.

Results Plus: Examiner Comments

This candidate knows that the mixture should be heated and has remembered that litmus is used to test for ammonia. However, ammonia is an alkaline gas so the colour change in this description is wrong and the answer scored 1 mark.

Results Plus: Examiner Tip

Learn the colour changes for litmus in acidic and alkaline substances.

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

Add sodium hydroxide solution to the substance and boil. A smell of ammonia would be produced and damp red litmus paper ~~to~~ would turn blue.

Results Plus: Examiner Comments

This is a very good answer, scoring both marks.

Results Plus: Examiner Tip

When you are asked to describe a test, always describe how you would carry out the test and the observation that would be made.

Q5.

(i)

Generally candidates were able to score at least 1 of the 2 marks available. With the wide range of possible marking points, most candidates referred to '(both) contain hydrogen and carbon (only)' and/or that '(both only) have single bonds/no double bonds'. Pleasingly, examiners noted that many candidates were able to recall the general formula for alkanes. Common errors seen throughout were: responses referring to alkanes having 'similar properties' as opposed to specifically 'similar chemical properties', or to alkanes having the 'same formula' as opposed to 'same general formula'. In many responses there was a clear misunderstanding of the terms 'saturated' and 'unsaturated', such as stating incorrectly that alkanes are unsaturated hydrocarbons and contain only single bonds. Consequently, these responses did not score this marking point.

(b) Propane, C_3H_8, and butane, C_4H_{10}, are members of the same homologous series, called the alkanes.

(i) Explain why both propane and butane are alkanes.

(2)

They are both alkanes because they are saturated and have single bonds.

Results Plus: Examiner Comments

This response only scored 1 mark, since by stating the fact that both alkanes are 'saturated' and 'have single bonds' is effectively the same marking point.

(b) Propane, C_3H_8, and butane, C_4H_{10}, are members of the same homologous series, called the alkanes.

(i) Explain why both propane and butane are alkanes.

(2)

because they both follow the same formulae C_nH_{n+2}.

Results Plus: Examiner Comments

This response did not score. A reference to the alkanes having the 'same formula' is incorrect. Also, although very close, the attempt at the general formula, 'C_nH_{n+2}' for an alkane, is also incorrect.

Results Plus: Examiner Tip

Make sure you learn the key definitions of a homologous series, such as the alkanes. If stated, check the general formula for the alkanes is correct.

(b) Propane, C_3H_8, and butane, C_4H_{10}, are members of the same homologous series, called the alkanes.

(i) Explain why both propane and butane are alkanes.

(2)

Propane and butane both have the same general formula and chemical properties.

Results Plus: Examiner Comments

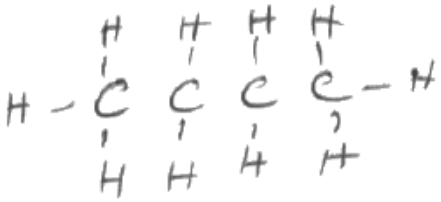
This response scored 2 marks for correct references to 'same general formula' and 'same chemical properties'.

(ii)

The majority of candidates were able to draw the fully correct structure for butane. Occasionally, some candidates were unable to score since they missed out bonds between the carbon atom skeleton or had drawn double bonds in the carbon skeleton.

(ii) Draw the structure of a molecule of butane, C_4H_{10}, showing all covalent bonds.

(2)

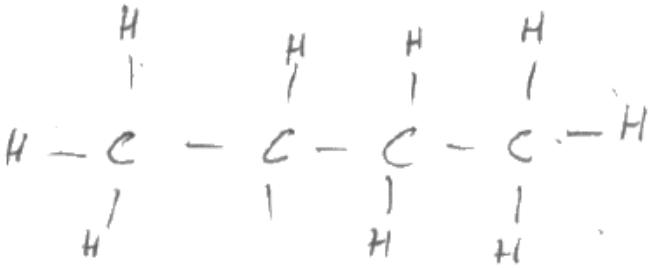


Results Plus: Examiner Comments

This response did not score. The first marking point was not scored since the single covalent C-C bonds have been omitted from the carbon skeleton. Unfortunately, even though all the C-H bonds are shown, this cannot score the second marking point since it is dependent on the first having been scored.

(ii) Draw the structure of a molecule of butane, C_4H_{10}, showing all covalent bonds.

(2)

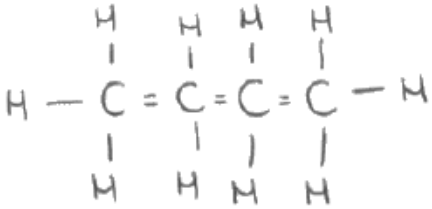


Results Plus: Examiner Comments

This response scored 1 mark only, for the first marking point, since there are four carbon atoms joined by single bonds. The second marking point was not scored since one 'H' has been omitted from the structure.

(ii) Draw the structure of a molecule of butane, C_4H_{10}, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

This response did not score. The first marking point was not scored since there are double carbon to carbon (C=C) bonds shown in the carbon skeleton. Even though all the C-H bonds have been shown, since the second marking point is dependent on the first, this cannot gain credit.

Q6.

(a)

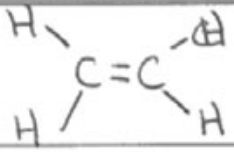
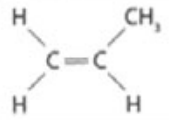
This question elicited a relatively poor response, with a few candidates scoring both marks (and a large number scoring none at all). Some perfect answers were seen for the structure of ethene, but, as one examiner commented, every possibility was seen. Errors included only showing a single bond between the carbons; showing methane; carbons with more or less than four bonds; carbons (and hydrogens) looking like an 'E' or 'e'. Overall, there were a significant number of very untidy/careless diagrams with bonds not clearly drawn. The better candidates did score 1

mark for naming propene. One common error was methene.

4 (a) The table shows information about two alkenes.

Complete the table to show the names and structures of these alkenes.

(2)

name	structure of a molecule
ethene	
~~Ethene~~ Propene	

Results Plus: Examiner Comments

This candidate was lucky to score 2 marks as the top right symbol is not clear.

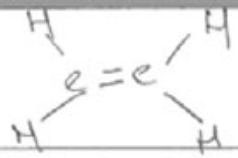
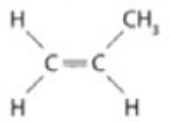
Results Plus: Examiner Tip

Take time to draw clear structures.

4 (a) The table shows information about two alkenes.

Complete the table to show the names and structures of these alkenes.

(2)

name	structure of a molecule
ethene	
carbon hydrogen	

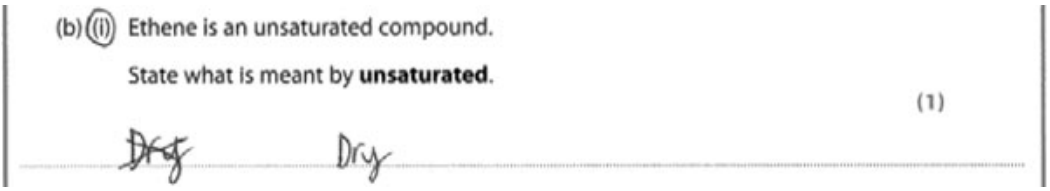
Results Plus: Examiner Comments

Are these C or e?

(b) (i)

This basic recall question was poorly answered, with a great many candidates having no notion at all of what 'unsaturated' means. Unfortunately, some wrote the answer the wrong way round ("has no double bond"). Others suggested that unsaturated meant "not saturated" - true, but this

is never going to get a mark. Other errors included: not mixed with anything else, answers related to fats, still room for more atoms/bonds. There were a large number of answers related to water e.g. "no water", "unreactive to water", "no added water".


(b) (ii) Ethene is an unsaturated compound.

State what is meant by **unsaturated**.

(1)

~~Dry~~ Dry

Results Plus: Examiner Comments

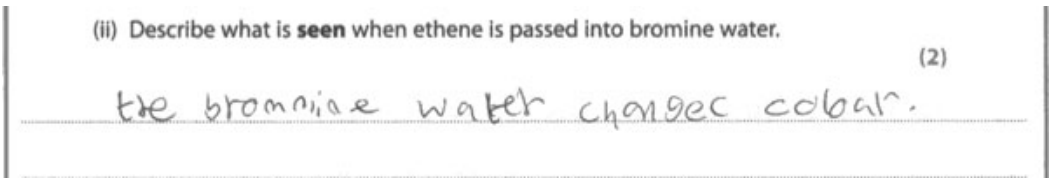
This was not acceptable as an answer to a question on a chemistry paper.

Results Plus: Examiner Tip

Learn the meaning of common chemical terms.

(b) (ii)

In this question the starting colour of bromine was less commonly seen than the end colour. Many responses correctly stated that the bromine water went colourless, however there were other incorrect descriptions of what happened: bubbles, goes cloudy, milky, orange, brown or yellow. Some answers stated that a colour change occurs, but did not specify the colours. It is disappointing to still see many answers where "clear" or "transparent" are used rather than colourless.


(ii) Describe what is **seen** when ethene is passed into bromine water.

(2)

the bromine water changes colour.

Results Plus: Examiner Comments

Correct - but the colours must be given.

Results Plus: Examiner Tip

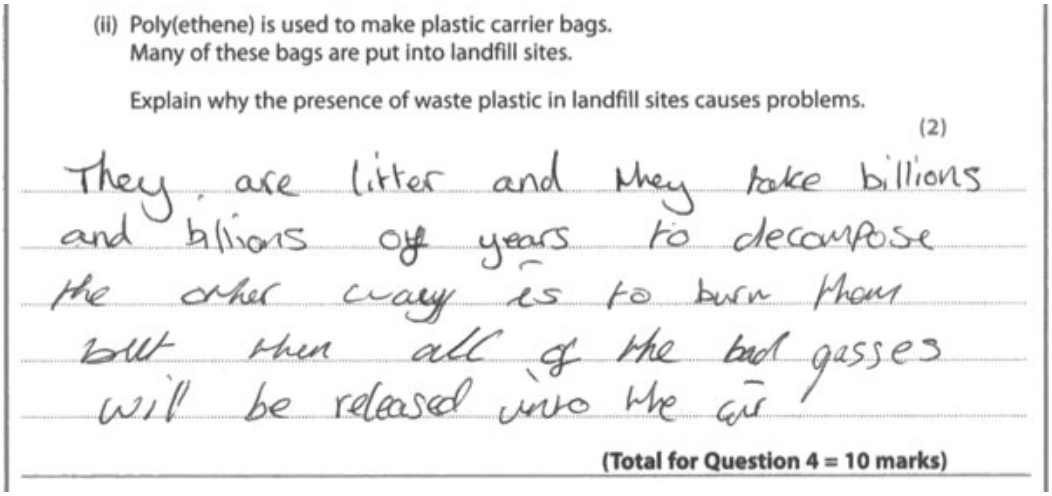
Tests occur often in exams and learning these carefully will be credited.

(c)

Many of the answers identified that something was 'broken down', however most did not identify that a long chain alkane is broken down into a smaller chain alkane and an alkene. A lot of candidates scored a mark for being aware of the idea that this is done to create products that are more useful. Some candidates had clearly learned a specific definition to gain full marks. There was much unclear language and answers could refer equally to fractional distillation as much as to cracking ("split up the fractions" or "fractions are separated"). Confusion occurred between alkanes and alkenes, alkenes being broken down. Other things being broken down included atoms or elements.

(d) (ii)

Most answers scored 2 marks here, with almost everyone scoring 1 mark, mainly for saying that plastic does not biodegrade. There were very few blanks – everyone had a view! It was clear that some candidates did not direct themselves to the question, and did not focus specifically on plastics or on landfill, by writing about landfill problems in general, such as noise, machinery or by advocating recycling as a better alternative. Others failed to answer the question by going off at a tangent about the effect of burning on plastic, giving toxic gases.



(ii) Poly(ethene) is used to make plastic carrier bags.
Many of these bags are put into landfill sites.

Explain why the presence of waste plastic in landfill sites causes problems.

(2)

They are litter and they take billions and billions of years to decompose the other way is to burn them but then all of the bad gasses will be released into the air

(Total for Question 4 = 10 marks)

Results Plus: Examiner Comments

This answer has identified one relevant issue but has given much irrelevant material.

Results Plus: Examiner Tip

It's worth reading the question twice to check that you know what is being asked. Burning is not asked about in this question.

Q7.

(i)

This question was very poorly answered on the whole, with a significant majority of responses not scoring any of the 2 marks available.

A significant number of candidates were unable to interpret what was required in terms of explaining why the test for a given ion must be unique to that ion.

Most candidates simply repeated the stem of the question.

In those responses which did gain credit, candidates rarely mentioned that the test only detects one ion, but did often refer to the correct idea of avoiding confusion with other ions, to gain 1 mark only.

(ii)

This question was not well answered, with approximately half of the responses scoring the 1 mark available.

Although the test for carbonate ions was described in the stem of the question and many candidates were able to correctly recall the gas produced, namely carbon dioxide, many candidates clearly did not recognise this test and simply stated the names of other gases mentioned in the specification such as hydrogen, oxygen or chlorine.

(iii)

This question was generally well answered on the whole with two thirds of candidates gaining at least 1 of the 3 marks available.

Most candidates were able to link at least one of the descriptions of tests for three anions to a correct observation. The test which most commonly appeared to be answered correctly across the range of responses was that for the chloride ion.

In very few cases, candidates drew more than one line from each of the three descriptions, despite clear instructions in the question and this being a tried and established question style in this and in many of the previous examination series.

Q8.

Generally very well answered, with the majority of responses scoring the 1 mark available.

Many responses clearly indicated that candidates were aware of one, or often more, of the advantages of instrumental methods – 'improve accuracy' being the most common response.

Instrumental methods are often used for analysis.

Give a reason why instrumental analysis may be better than other methods of analysis.

(1)

It improves sensitivity, speed and accuracy

Results Plus: Examiner Comments

This response scored the 1 mark available.

All three reasons would have equally scored the mark.

Instrumental methods are often used for analysis.

Give a reason why instrumental analysis may be better than other methods of analysis.

(1)

They're more precise at reading the data

Results Plus: Examiner Comments

This response was not creditworthy.

The reference to 'more precise' is ignored and does not score.

Q9.

(i)

Most answers correctly gave a value from the interpreting the graph in the acceptable range to score the 1 mark available. Incorrect responses were either wildly out of range or just outside the range.

(ii)

This question was very well answered on the whole and most responses scored the 1 mark available. A few candidates were able to gain credit for giving the reverse argument. Incorrect answers often gave the opposite trend or referred to arguments based on bond breaking.

(ii) State how the boiling points of these alkanes change as the number of carbon atoms in one molecule of each alkane increases.

(1)

the boiling point increases.

Results Plus: Examiner Comments

A commonly seen correct response, so this scored 1 mark.

(ii) State how the boiling points of these alkanes change as the number of carbon atoms in one molecule of each alkane increases.

(1)

because more carbon atoms need to be broken

Results Plus: Examiner Comments

A commonly seen incorrect response, in this case referring to 'carbon atoms need to be broken', so this did not score.

Q10. No Examiner's Report available for this question

Q11.

Candidates often scored 2 marks for mentioning carbon dioxide and describing a correct limewater test. However the need to add acid to the calcium carbonate or to heat it to produce the carbon dioxide was often omitted with a large number of candidates suggesting that the calcium carbonate should be added directly to the limewater. Some candidates described a flame test approach to identify calcium ions rather than the carbonate in calcium carbonate and so gained no credit.

3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

Add the calcium carbonate to limewater. After stirring, the limewater will turn cloudy if a carbonate is present.

Results Plus: Examiner Comments

Quite a common answer which was awarded one mark for the result of a limewater test.

3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

Firstly, add dilute ~~acid~~ nitric acid to the calcium carbonate. Then, pass the gas given off through limewater, if it turns milky carbonate ions are produced/present.

Results Plus: Examiner Comments

A good answer worth all three marks.

3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

Carbonates give off carbon dioxide when heated. If you heat the calcium carbonate the tube off what gases are released into limewater, the lime water will turn milky.

Results Plus: Examiner Comments

An acceptable method of heating the calcium carbonate to produce the carbon dioxide and then correctly testing for it and so worth 3 marks.

Q12.

(a)

Nearly half of the candidates could write the correct balanced equation given the information in the question; a further one third scored one mark for a partly correct word equation. It was disappointing to see that so many could not copy the reactants correctly; 'calcium solution' and 'sodium solution' were commonly seen as reactants. Many candidates used just the information and formed the products 'calcium carbonate + salt' or more frequently 'calcium carbonate + another salt'. A small number thought they had to write a balanced equation and invariably failed as they were making up formulae for the substances, e.g. SC for sodium carbonate. Candidates should be advised that where a word equation is asked for, they are not expected to write a balanced equation using chemical formulae.

4 (a) Calcium nitrate solution reacts with sodium carbonate solution.
The products are calcium carbonate and another salt.

Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

Results Plus: Examiner Comments

Quite a common answer. However, 1 mark was score for the correct reactants.

4 (a) Calcium nitrate solution reacts with sodium carbonate solution.
The products are calcium carbonate and another salt.

Write the word equation for this reaction.

(2)

Calcium carbonate + Sodium nitrate → Calcium nitrate + Sodium Carbonate

Results Plus: Examiner Comments

All the correct substances, but in the wrong places. This scored 0 marks.

4 (a) Calcium nitrate solution reacts with sodium carbonate solution.
The products are calcium carbonate and another salt.

Write the word equation for this reaction.

(2)

$CaN_3 + NaC_3 \longrightarrow CaC_3 +$ Salt.

Results Plus: Examiner Comments

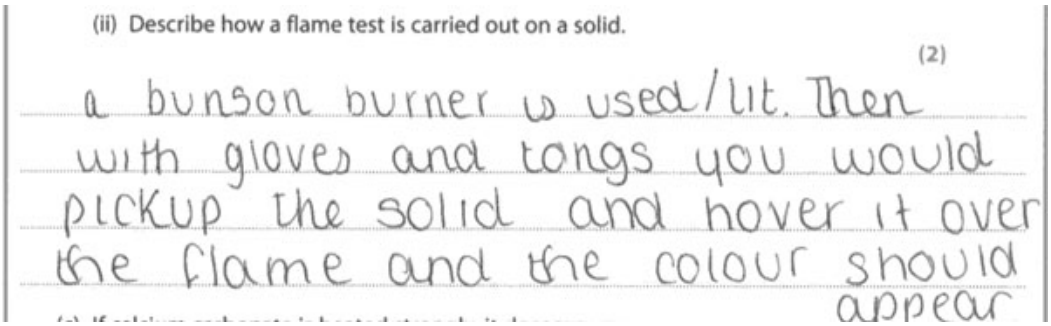
Here is an attempt to write a balanced equation using invented chemical formulae. Answers like this can only be awarded 0 marks.

Results Plus: Examiner Tip

When word equations are asked for, do not attempt to write a balanced equation using chemical formulae. Use the information in the question to help in the construction of the word equation.

(b) (ii)

Only a few candidates scored both marks for describing how to correctly carry out a flame test on a solid. Generally the candidates that scored 1 mark did so for 'putting 'it' into flame' or putting a solid on a rod/loop/splint. Many held the solid OVER or under (?) a flame or just stated 'over a Bunsen'. There were few real attempts to describe the test accurately; the majority described using inappropriate equipment e.g. tongs, spatulas, tweezers, spoons, clamps. Very few mentioned the need to clean the wire loop before carrying the flame test.

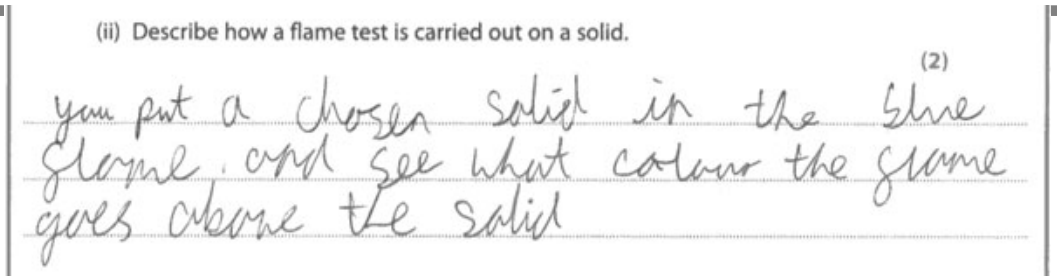

(ii) Describe how a flame test is carried out on a solid.

(2)

a bunson burner is used/lit. Then with gloves and tongs you would pickup the solid and hover it over the flame and the colour should appear

Results Plus: Examiner Comments

Incorrect equipment (tongs) as well as 'hover it over the flame' do not attract marks for carrying out the flame test. 0 marks awarded here.

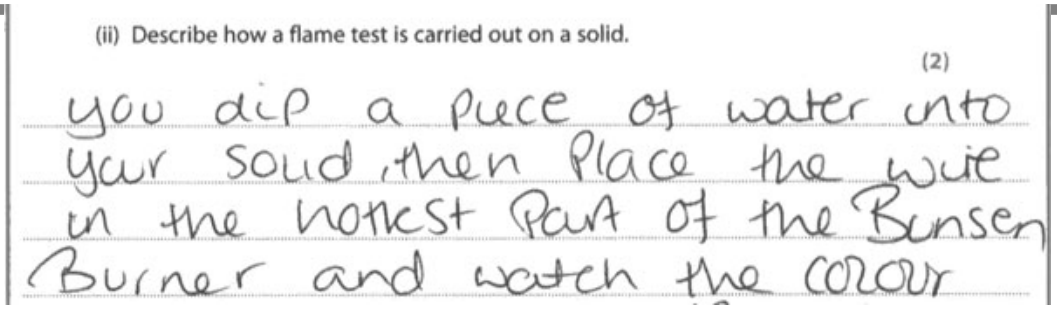

(ii) Describe how a flame test is carried out on a solid.

(2)

you put a chosen solid in the blue flame and see what colour the flame goes above the solid

Results Plus: Examiner Comments

1 mark was given for putting the solid into a blue (Bunsen) flame.


(ii) Describe how a flame test is carried out on a solid.

(2)

you dip a piece of water into your solid, then place the wire in the hottest part of the Bunsen Burner and watch the COLOUR

Results Plus: Examiner Comments

If only the candidate could re-read their answer! Unfortunately similar errors were often seen in answers to this question.

(ii) Describe how a flame test is carried out on a solid.

(2)

by using a metal flame [redacted] loop. you dip it in acid. You then pick up the solid on the flame loop. You then put the flame loop into the bunsen burner flame and record the colour seen.

Results Plus: Examiner Comments

An answer like this was rarely seen. This was very pleasing to see and 2 marks were given for this answer.

Results Plus: Examiner Tip

The three steps involved in a flame test are:

1. Clean the flame testing rod with hydrochloric acid.

2. Dip the rod into the acid and then into the solid being tested.

3. Put the end of the testing rod into a Bunsen flame with the air hole half open.

Learn the steps involved to carry out a flame test and the colours that are obtained for the ions Na^+, K^+, Ca^{2+} and Cu^{2+}.

(c) (i)

It was clear that most candidates did not know how to calculate the percentage yield as very few candidates obtained the correct answer, however some achieved only one mark because their answer was approximated to 90% from 90.91%. Some had the ratio of mass inverted and obtained an answer of 110% without thinking about the implication. Other incorrect answers were seen using various mathematical processes involving the numbers 40, 44 and 100. The answer of 100 – 40 = 60% was commonly seen.

(c) If calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

If 100 g of calcium carbonate is heated a calculation shows that 44 g carbon dioxide should be formed.

(i) In an experiment 100 g of calcium carbonate was heated and only 40 g carbon dioxide was formed.

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

Percentage yield = actual yield / theoretical yield × 100 Ans = 90

100% = 40/44 = 0.909... × 100

percentage yield of carbon dioxide = 90 %

Results Plus: Examiner Comments

A correctly calculated percentage yield. Sadly the candidate then approximated the answer to 90 rather than 91% and so only 1 mark could be given for this.

(c) If calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

If 100 g of calcium carbonate is heated a calculation shows that 44 g carbon dioxide should be formed.

(i) In an experiment 100 g of calcium carbonate was heated and only 40 g carbon dioxide was formed.

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

44/40 × 100

actual yield / theoretical yield × 100 44/40 × 100

percentage yield of carbon dioxide = 110 %

Results Plus: Examiner Comments

Candidates who had the ratio inverted didn't stop to think about the consequence of their answer. Here, 1 error had been made - the inverted ratio - so 1 mark was awarded in these instances.

(c) If calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

If 100 g of calcium carbonate is heated a calculation shows that 44 g carbon dioxide should be formed.

(i) In an experiment 100 g of calcium carbonate was heated and only 40 g carbon dioxide was formed.

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

100g − 40g = 60g

percentage yield of carbon dioxide = 60 %

Results Plus: Examiner Comments

This answer (or that which showed 100 - 44 = 56) was often seen, showing that the candidate did not understand how to calculated the percentage yield of a product. 0 marks were awarded.

Results Plus: Examiner Tip

Know that percentage yield = (actual yield) x 100 / (theoretical yield), and that this value will always be less than 100%. If you have obtained an answer greater than 100, check your calculation to see where you have made an error.

(c) (ii)

This question was fairly open in terms of the possible responses as shown by the command word 'suggest' in the question. However, to account for a difference between theoretical and actual yields, self-deprecating possibilities such as 'human error', 'spillage', 'anomalies', 'not weighed out accurately', 'wrong equipment' and 'gas escaping' were often cited but would not gain credit and candidates should be advised of this. Some referred to calculation only being a prediction and actual yields were always wrong. Some offered the vague term 'not heated properly'. There was also some confusion with incomplete combustion, as some stated 'there was not enough oxygen being present for a reaction'.

However, almost a quarter of candidates cited a correct reason here and referred to 'not heating it for long enough', 'the reaction not being complete', 'the flame not being hot enough' or 'the calcium carbonate contained impurities'.

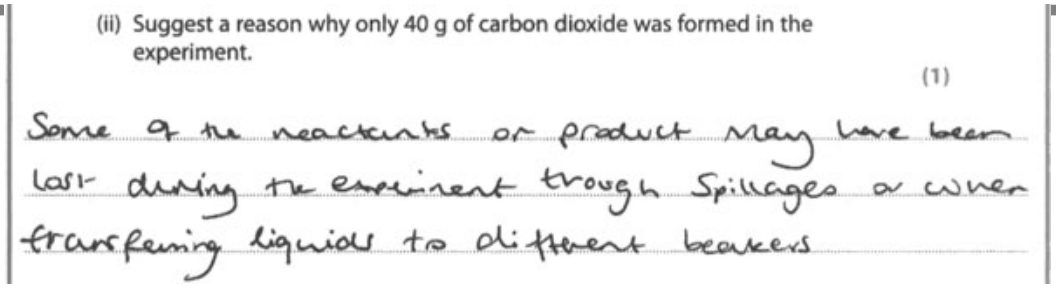
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

Some of the carbon dioxide could have been lost during the experiment.

Results Plus: Examiner Comments

The candidate had not thought about what was happening during the reaction. All the carbon dioxide was being lost during the reaction. This answer scored 0.



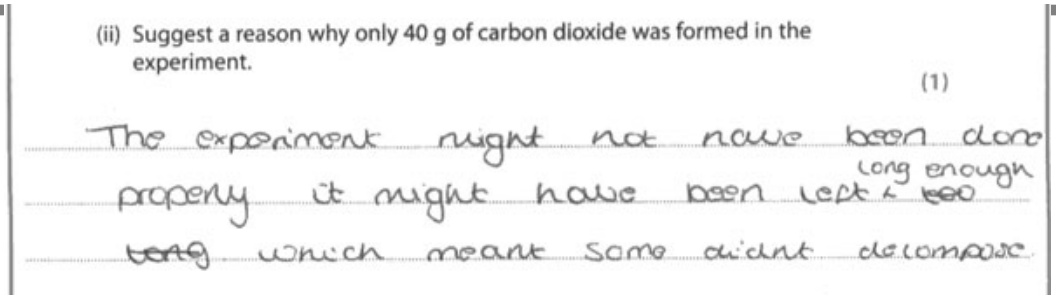
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

Some of the reactants or product may have been lost during the experiment trough Spillages or when transfering liquids to different beakers

Results Plus: Examiner Comments

The candidate had not thought through the process. A solid was being heated to form another solid with the loss of a gas, so loss of transferring liquids could not possibly happen in this situation. 0 marks given.



(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

The experiment might not have been done properly it might have been left a long enough ~~long~~ which meant some didnt decompose

Results Plus: Examiner Comments

Although not phrased very well to start with, 'might not have been done properly' was ignored and the second part of the answer was very good and scored the 1 mark.

Results Plus: Examiner Tip

To account for yield being less than 100%, there are three main reasons:

a) Incomplete reaction - not all reactants used up.

b) Product lost during the reaction - usually when transferring liquids from one container to another.

c) Other unwanted reactions - usually to make a different product.

Think about the reaction when applying these ideas.

Q13. No Examiner's Report available for this question

Q14. No Examiner's Report available for this question

Q15.

Despite the **bold** statement in the question a few candidates still calculated the mass that did react. The better candidates were able to properly round their answers to two significant figures. This was not understood by all – some not rounding at all, and it was a pity that a response of 17.5 rounded to 18.0 was seen.

Q16.

Just under a third of the candidates scored both marks for the calculation. Those scoring just one mark obtained for the number of moles of sucrose but then missed the ratio of moles of sucrose to moles of ethanol (1:4) from the second step of the calculation. Of the rest, those that attempted some form of calculation appeared not to know what to do.

Q17.

This question was not well answered on the whole, with only half of responses scoring typically 1 mark out of the 2 marks available.

Many candidates struggled to understand what was required for this calculation. It was clear that from most responses, candidates were unable to identify that the two values needed to be multiplied together.

In many responses, candidates simply divided the number of molecules by the relative formula mass, namely 24600/42 = 586, and scored 1 mark for the mathematical skill of rounding their (incorrect) answer to 3 significant figures.

Many candidates struggled with the need to round their answers to 3 significant figures possibly due to the large numbers involved in this calculation. Typically, in many responses the correct answer was calculated, namely 1033200, which was then incorrectly rounded to 103.

Calculate the relative formula mass of the poly(propene) molecule made from joining together 24 600 molecules of propene, C_3H_6.
(relative formula mass: $C_3H_6 = 42.0$)

Give your answer to three significant figures.

(2)

42 x 24,600 = 1,033,200

relative formula mass = 1033200

Results Plus: Examiner Comments

This response scored 1 mark only.

Although the calculation is correct, the final answer has not been rounded to 3 significant figures.

Results Plus: Examiner Tip

With calculation questions, read the question carefully to check whether the answer needs to be rounded to a specific number of significant figures or decimal places.

$\frac{24600}{42.0} = 586$

relative formula mass = 586

Results Plus: Examiner Comments

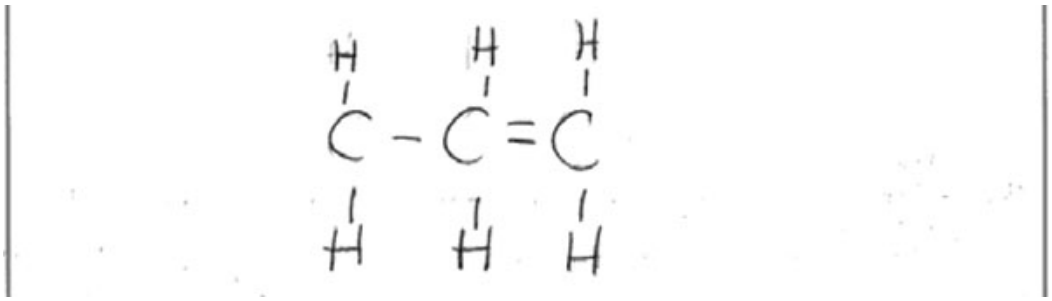
A typical example of a response where 1 mark was scored for the mathematical skill of rounding to 3 significant figures, as required by the question.

The candidate has (incorrectly) divided the two numbers from the question. However, the answer, 586, has been correctly rounded to three significant figures.

Q18.

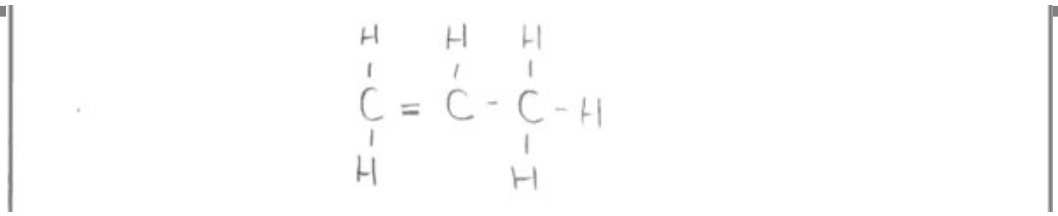
b

Many candidates could correctly draw the carbon backbone of propene, including the correct number of carbons and the double bond for 1 mark but then lost the second mark as they did not add the correct number hydrogens to each carbon.



Results Plus: Examiner Comments

This response gained one mark for the correct carbon backbone, but did not score the second marking point as the number of hydrogens on the second carbon is incorrect.



Results Plus: Examiner Comments

Fine for 2 marks.

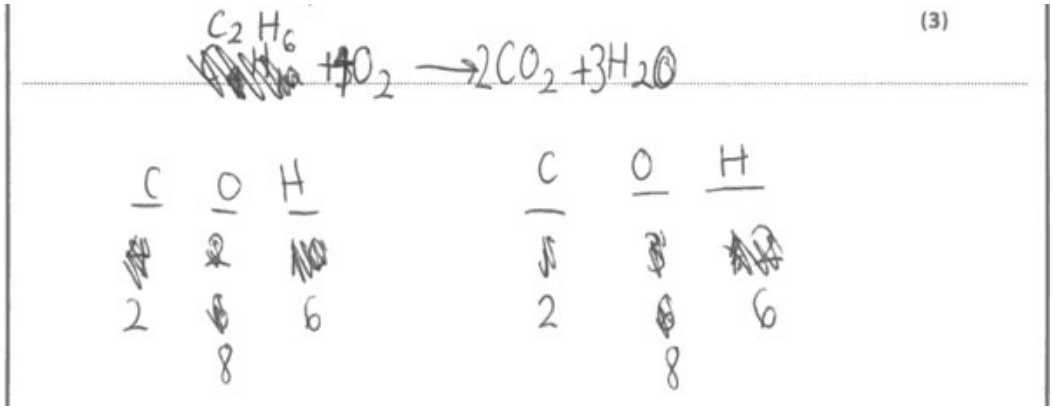
c

Many candidates lost out here as they did not know the formula of methane, with many writing it as Me. Many candidates gained one mark for the correct formula of carbon dioxide and water, however only the very best candidates were able to score full marks for writing the complete balanced equation successfully.



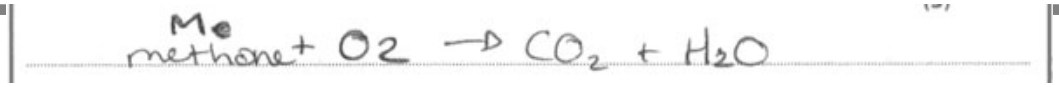
Results Plus: Examiner Comments

Perfect for 3 marks, reactants (1), products (1) balancing (1).



Results Plus: Examiner Comments

Just one mark here for the correct formulae for the products.



Results Plus: Examiner Comments

Just one mark here, for the formulae of the products.

Results Plus: Examiner Tip

It is important that the formulae of the common compounds in the unit are learnt.

d

Candidates performed well on this extended writing question, most gave a good set of advantages and disadvantages of using bio-methane over natural gas as a form of energy. Candidates are still showing the misconception that bio-methane does not produce any carbon dioxide when it is burnt.

Advantage: ,It is a renewable resource.

,It is Fairly cheap to produce

• Better overall For the environment

• Provides more jobs

• Less money will be needed to make things such as oil rigs and tankers.

Disadvantage: Many animals used For making bio - ~~met~~ methane such as cow's are responsable For a lot of global warming.

• Not very efficient

• Larger areas of land needed.

• Food will need to be provided for animals

• Less job will be needed. **(Total for Question 6 = 12 marks)**

Results Plus: Examiner Comments

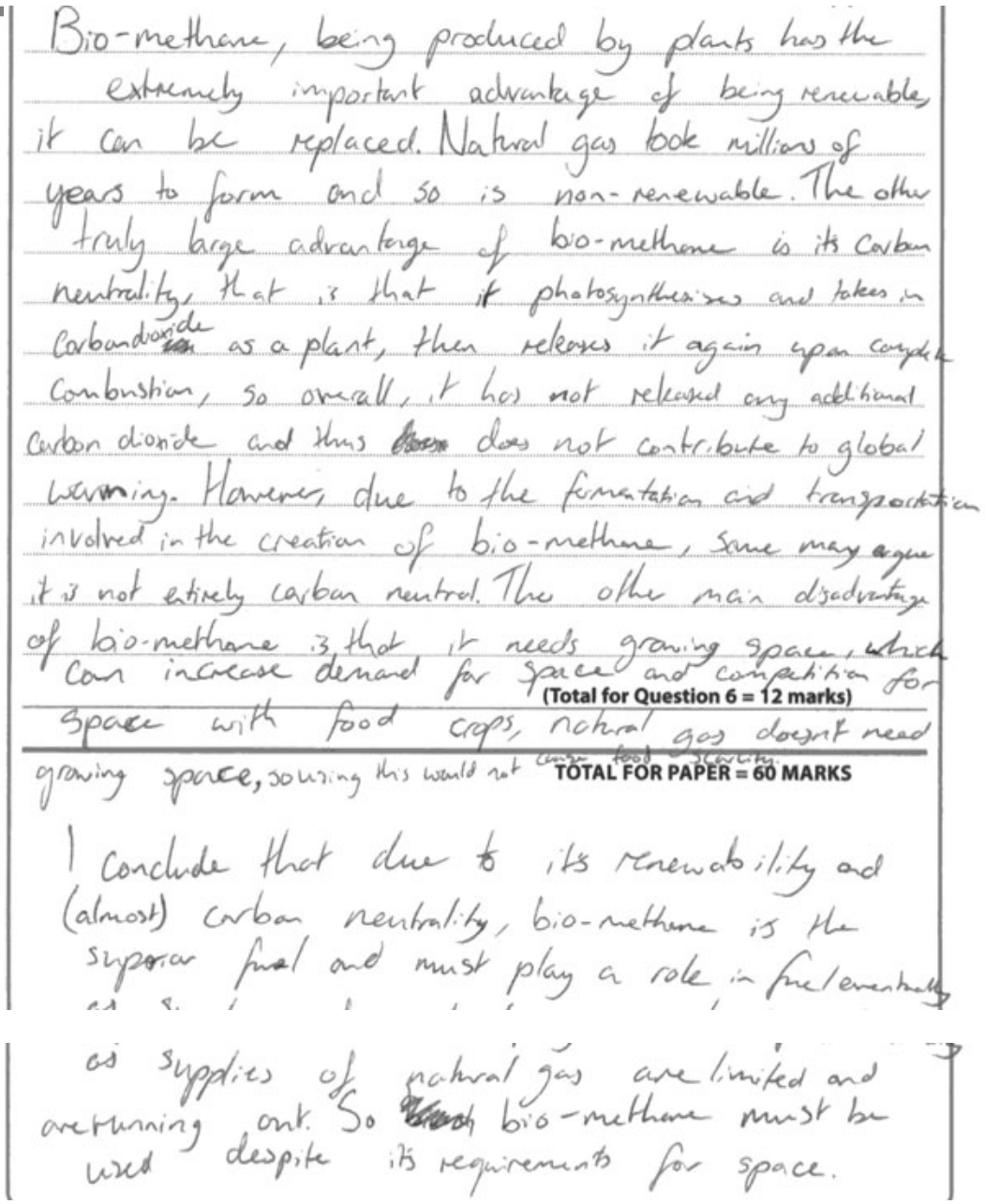
A level 2 answer, although many advantages and disadvantages have been given, many are not relevant to this question and so are not given credit.

Biomethane is a biofuel meaning it is a fuel made from living organisms. This doesn't release as much ~~CO~~ carbon dioxide as fossil fuels. It doesn't increase pollution in the atmosphere. The space for growing crops would be taken up for fermentation to make biofuels.

Disadvantages are that it may ~~need~~ release ~~the~~ carbon dioxide to produce it when extracting and electricity. Not all cars ~~can~~ use biomethane meaning they would have to change the mechanics of cars releasing in the making carbon dioxide. Not much sufficient energy is being released. **(Total for Question 6 = 12 marks)**

Results Plus: Examiner Comments

A level 1 answer, whilst some ideas are creditworthy, such as the space for growing crops is taken up, much of the answer has incorrect or irrelevant ideas.



Bio-methane, being produced by plants has the extremely important advantage of being renewable, it can be replaced. Natural gas took millions of years to form and so is non-renewable. The other truly large advantage of bio-methane is its carbon neutrality, that is that it photosynthesises and takes in carbon dioxide as a plant, then releases it again upon complete combustion, so overall, it has not released any additional carbon dioxide and thus does not contribute to global warming. However, due to the fermentation and transportation involved in the creation of bio-methane, some may argue it is not entirely carbon neutral. The other main disadvantage of bio-methane is that it needs growing space, which can increase demand for space and competition for space with food crops, natural gas doesn't need growing space, so using this would not cause food scarcity.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

I conclude that due to its renewability and (almost) carbon neutrality, bio-methane is the superior fuel and must play a role in fuel eventually as supplies of natural gas are limited and are running out. So bio-methane must be used despite its requirements for space.

Results Plus: Examiner Comments

A level 3 answer with lots of advantages and disadvantages of using bio-methane rather that natural gas as a source of energy.

Q19. No Examiner's Report available for this question

Q20.

This was very well-answered by the majority of candidates. Most were able to recall the correct formulae for the reactants and products, with fewer gaining the balancing mark.
A common error often related to not writing the formula for oxygen correctly, e.g. 'O' as opposed to 'O_2', on the reactants side. Also, examiners noted that marks were lost due to careless use of lower and upper case letters for symbols or not correctly using subscripted numbers in formulae, e.g. the formula for carbon dioxide frequently shown incorrectly as 'Co2' or 'Co_2' as opposed to CO_2.

(c) Write the balanced equation for the combustion of methane, CH_4, in oxygen to form carbon dioxide and water.

(3)

$CH_4 + 2O \rightarrow Co_2 + H_2O$

Results Plus: Examiner Comments

A typical response which did not score, containing commonly seen errors. The formula for oxygen is incorrectly shown on the Left Hand Side. The Right Hand Side is incorrect since the symbol for the oxygen atom in the formula for carbon dioxide has been shown incorrectly as lower case letter. The balancing is incorrect since it is consequential of the correct formulae.

Results Plus: Examiner Tip

Be careful when writing out formulae, e.g. for carbon dioxide, CO_2 but not Co_2.

(c) Write the balanced equation for the combustion of methane, CH_4, in oxygen to form carbon dioxide and water.

(3)

$CH_4 + 4O \longrightarrow CO_2 + 2H_2O$

Results Plus: Examiner Comments

This response scored 1 mark only. The products are correctly written on the Right hand Side, however, the formulae for oxygen on the Left hand Side is incorrect, since it has been shown as 'O' and not 'O_2'. The balancing mark is not scored, since this mark is consequential of the correct formulae having been shown.

Q21. No Examiner's Report available for this question

Q22. No Examiner's Report available for this question

Q23. No Examiner's Report available for this question

Q24. No Examiner's Report available for this question

Q25. No Examiner's Report available for this question

Q26. No Examiner's Report available for this question

Q27.

Nomenclature of simple organic compounds not well understood, with very few stating but-1-ene, and few being able to draw its structure. The majority did identify water, but some just missed out the name at the bottom and others gave incorrect structures for water, e.g. H_2-O.

Q28. No Examiner's Report available for this question

Q29. No Examiner's Report available for this question

Q30.

(i)

This question was very poorly answered on the whole, with a significant majority of responses not scoring the 1 mark available.

Very few responses correctly drew in four electrons between the two carbon atoms in the diagram presented.

The majority of responses were often left blank. The vast majority of candidates drew a double bond as two lines and did not add in electrons. It would appear that candidates were unfamiliar with dot and cross diagrams where there were no rings shown to represent the electrons shells, as demonstrated by a number of responses where candidates added them in, often incorrectly.

The structure of a molecule of ethene is shown in Figure 8.

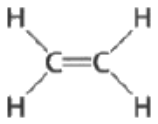


Figure 8

(i) Figure 9 shows the incomplete dot and cross diagram for a molecule of ethene.

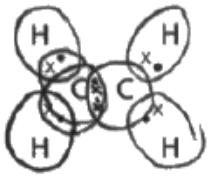


Figure 9

Complete Figure 9 to show the electrons of the C═C double bond.

Results Plus: Examiner Comments

An example of a fully correct response.

The candidate has correctly drawn in the four electrons representing the double bond between the carbon atoms. It is also worthwhile noting that shells have been added by the candidate to help clarify the bonding.

(i) Figure 9 shows the incomplete dot and cross diagram for a molecule of ethene.

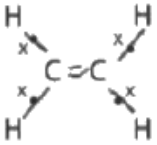


Figure 9

Complete Figure 9 to show the electrons of the C═C double bond.

(1)

Results Plus: Examiner Comments

A typical example of the many incorrect responses seen that did not score.

The candidate has simply drawn in a double bond between the carbon atoms and not followed the instructions in the question which is to show the electrons.

(ii)

This question was poorly answered on the whole, with only a fifth of responses scoring the 1 mark available.

Few candidates were able to recall the correct products, besides water, of the incomplete combustion of ethene.

The most commonly seen incorrect response was 'carbon dioxide'.

Q31. No Examiner's Report available for this question

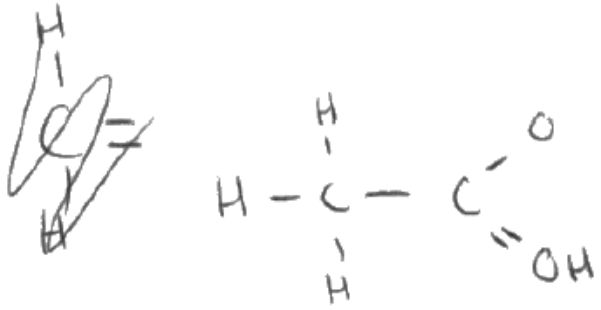
Q32.

This question was poorly answered on the whole with just over a third of responses scoring, mainly 1 mark out of the 2 marks available.

Very few candidates were able to draw the carboxylic acid group correctly. When 1 mark only was scored in a response this was often for a correct representation of a methyl group in a two carbon structure.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

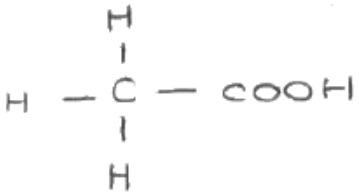
This response scored 1 mark only for the correctly drawn methyl group in the ethanoic acid molecule. However, although nearly correct, the carboxylic acid functional group has been incorrectly drawn with a double bond between the carbon and hydroxyl group, as opposed to between the carbon the oxygen atom.

Results Plus: Examiner Tip

Make sure you can draw all the covalent bonds in a carboxylic acid functional group.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

This response scored 1 mark only.

The methyl group within the ethanoic molecule is correct. However, the bonding in the carboxylic acid functional group has not been shown.

Results Plus: Examiner Tip

When drawing the structure of the carboxylic acid make sure include all the covalent bonds.

Q33.

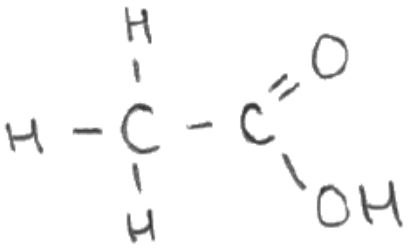
(ii)

A good proportion of candidates scored on this question with the majority scoring the full 2 marks.

In some cases, although the majority of the molecule had been drawn correctly, the inclusion of a double bond between the two carbons meant that a maximum of 1 mark could be scored.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)

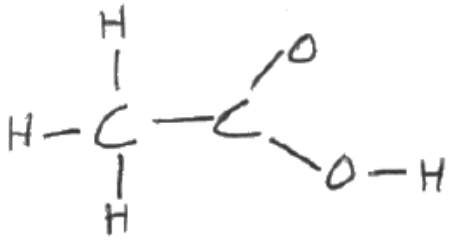


Results Plus: Examiner Comments

Although the OH on the carboxylic acid has not been fully displayed, full credit was still awarded.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

Those that did not score full credit, often lost marks as they did not draw the correct functional group for the carboxylic acid group.

Q34. No Examiner's Report available for this question

Q35.

This question was very well answered on the whole with the vast majority of responses scoring

at least 2 of the 3 marks available.

Most candidates correctly completed the table, drawing the repeating unit, drawing the monomer and naming the polymer, for each of the addition polymers in the table respectively.

The most commonly scored mark in the responses seen was invariably for drawing the correct monomer for poly(chloroethene).

It was noted that in many responses that did not score all the marks, candidates often left spaces blank.

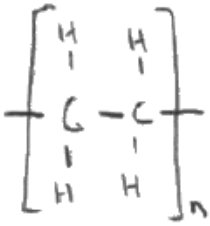
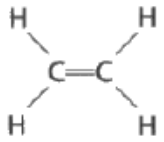
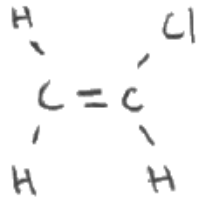
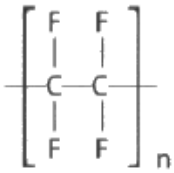
Commonly seen errors in many responses included: missing out the letter 'n' following the square brackets in the repeating unit for poly(ethene); missing out the word 'tetra' from the name of the polymer.

Polymer molecules can be made by joining together large numbers of small molecules called monomers.

Figure 5 shows the names and structures of some polymers and the monomers used to make them.

Complete the table using the information given.

(3)

name of polymer	structure of polymer molecule	name of monomer	structure of monomer molecule
poly(ethene)		ethene	
poly(chloroethene)		chloroethene	
Poly(fluoroethene)		tetrafluoroethene	

Results Plus: Examiner Comments

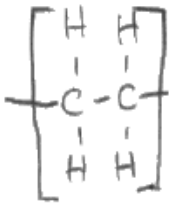
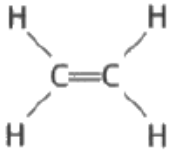
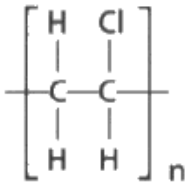
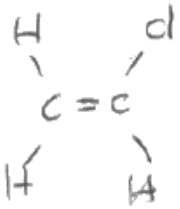
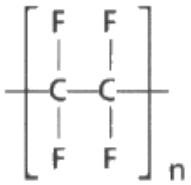
This response scored 2 marks for the correctly drawn structures of the poly(ethene) repeating unit and the chloroethene molecule.

Although very close to the correct name, the 'tetra' has been omitted from the name of the last polymer in the table, so this did not score the final mark.

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Results Plus: Examiner Tip

Remember, when naming polymers, the convention is to write the word 'poly' with the name of the monomer in brackets immediately afterwards. Also, remember to look at the pattern for the other polymers named in the table.

name of polymer	structure of polymer molecule	name of monomer	structure of monomer molecule
poly(ethene)		ethene	
poly(chloroethene)		chloroethene	
poly(tetrafluoroethene)		tetrafluoroethene	

Results Plus: Examiner Comments

This response scored 2 marks for the correctly drawn structure of the chloroethene molecule and the correctly named polymer.

Although the poly(ethene) repeating unit is very close to the correct structure, the 'n' has been omitted, so this did not score the final mark.

Results Plus: Examiner Tip

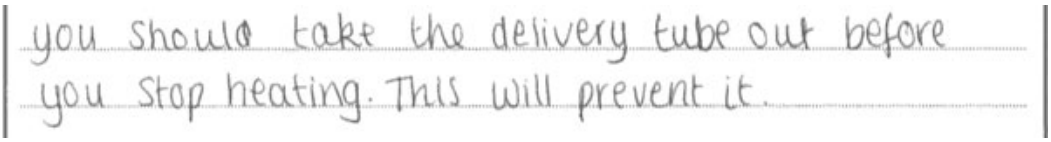
When asked to draw the structure of a repeating unit for a particular addition polymer, make

sure you include the 'n' outside the brackets.

Q36.

a

It was clear that many candidates had not performed this experiment as very few could state how they could successfully prevent suck-back occurring. Many candidates thought that removing the test tube as soon as it was full, altering the angle of the delivery tube or replacing the delivery tube with a longer version would prevent the suck-back.



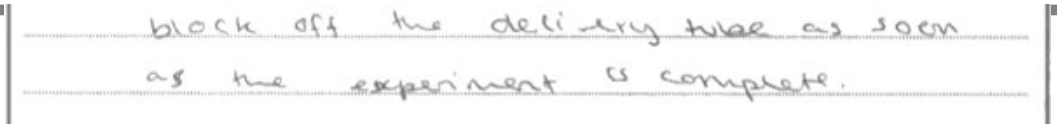
Results Plus: Examiner Comments

A good answer, which was rarely seen.



Results Plus: Examiner Comments

Many candidates did not know what to do and so guessed.



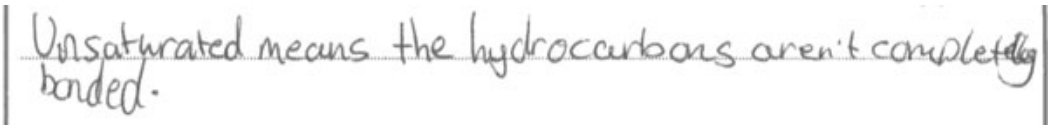
Results Plus: Examiner Comments

Again, here the candidate has attempted to think of a solution but sadly unsuccessfully.

c

The majority of candidates could correctly identify what is meant by the term unsaturated. Many

candidates are still using the term 'spare bonds', which is insufficient to gain credit.



Results Plus: Examiner Comments

Not completely bonded in sufficient to gain credit.



Results Plus: Examiner Comments

Fine for one mark.



Results Plus: Examiner Comments

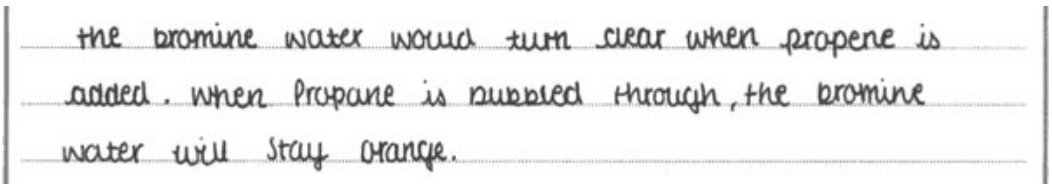
Spare bonds is not an acceptable alternative to double bonds, sadly many candidates responded using this term only and did not get the mark.

Results Plus: Examiner Tip

When stating what is meant by specific terms, ensure that correct scientific terminology is used rather than terms used to help teach or remember concepts.

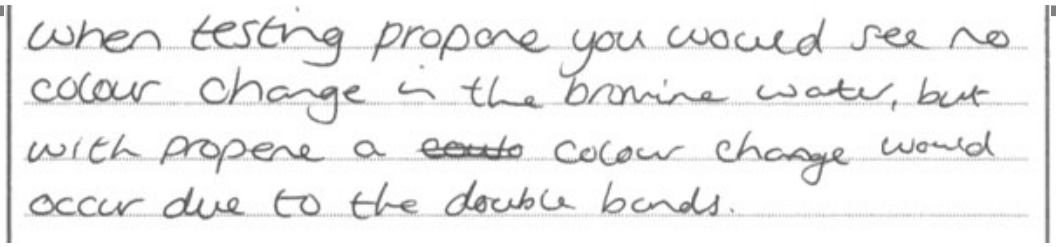
d

Many candidates scored well on this question, however some candidates lost marks due to their poor examination technique. It is important in questions like this when you are distinguishing between two tests that detail is given. For example candidates that state the one goes colourless and one changes colour, will not gain any marks as they are not making it clear which does what and are therefore are not answering the question.



Results Plus: Examiner Comments

This candidate scores two marks for the colour of bromine water and the fact that it remains orange when mixed with propane. Clear is not the same as colourless so the candidate has not scored the third marking point for what would be seen when bromine water is mixed with propene.

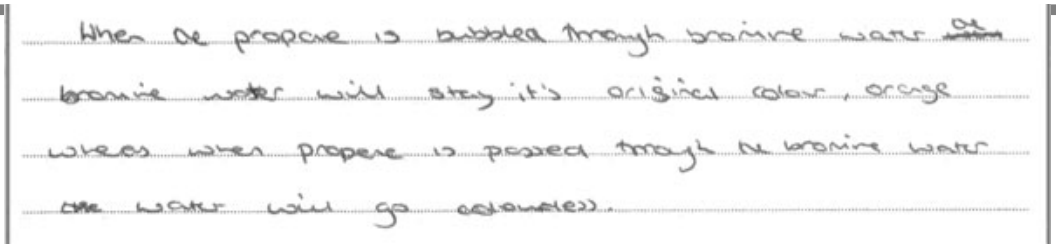


Results Plus: Examiner Comments

This response gains no marks, it does not state what colour the bromine water was seen to be at the beginning of the experiment nor does it state which colours either of the samples would go when mixed with the bromine water.

Results Plus: Examiner Tip

When asked for what is **seen**ensure that the answer states what is **seen.**Answers that relate to what reactions are happening such as the double bonds break will not answer the question and will therefore not gain credit.



Results Plus: Examiner Comments

A good answer scoring all three marks.

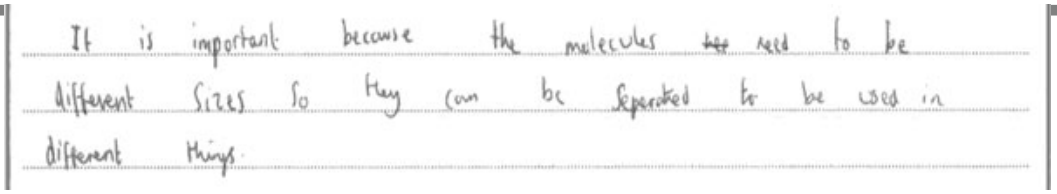
e

Candidates performed well in this question, many were able to state that there is a shortage of short chain fractions and that the process helps meet the demand.

Cracking is important because cracking can break down less useful long hydro carbon chain molecule to into a more useful small hydrocarbon chain molecule. also which has more demand.

Results Plus: Examiner Comments

A good answer which scores full marks.



Results Plus: Examiner Comments

Not enough detail in any of this to be able to give any credit.

Q37.

Candidates performed well in this question with a large proportion of candidates scoring the full 3 marks available for deducing the molecular formula of the hydrocarbon.

A different hydrocarbon has a relative formula mass of 84.
It has an empirical formula of CH_2. = 14

Deduce the molecular formula of this hydrocarbon.

84 ÷ 14 = 6

You must show your working.

(relative atomic masses : H=1, C=12)

(3)

$CH_2 \times 6 = C_6H_{12}$ $\quad \frac{84}{14} = 6$

$(12+(2\times1))$

$CH_2 = 14$

molecular formula = C_6H_{12}

Results Plus: Examiner Comments

A number of different approaches to deducing the formula were used that gained the correct answer, all of which gained full marks.

$(1 \times 2) + (12 \times 1) = 14$ - RAM of CH_4

$\div 14$ (14 : 84 → 1 : 6) $\div 14$

$2 \times 6 = 12$

therefore, using the 1:6 ratio, the molecular formula is:

CH_{12}

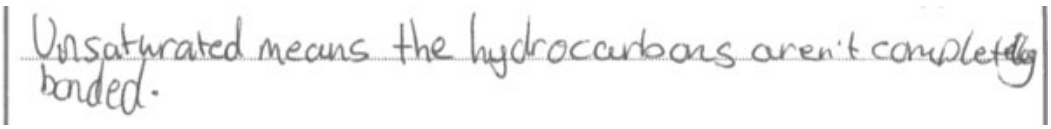
molecular formula = CH_{12}

Results Plus: Examiner Comments

In this example, the candidate has calculated the correct ratio but then incorrectly converted this into the molecular formula and therefore lost the last mark scoring just 2 of the 3 marks.

Q38.

The majority of candidates could correctly identify what is meant by the term unsaturated. Many candidates are still using the term 'spare bonds', which is insufficient to gain credit.



Results Plus: Examiner Comments

Not completely bonded in sufficient to gain credit.



Results Plus: Examiner Comments

Fine for one mark.



Results Plus: Examiner Comments

Spare bonds is not an acceptable alternative to double bonds, sadly many candidates responded using this term only and did not get the mark.

Results Plus: Examiner Tip

When stating what is meant by specific terms, ensure that correct scientific terminology is used rather than terms used to help teach or remember concepts.

Q39.

(ii)

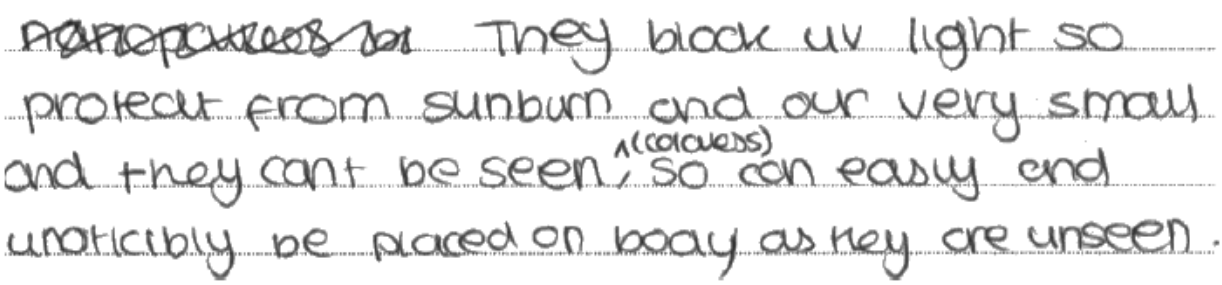
A good proportion of candidates scored in this question, with most gaining 1 mark. Candidates were asked to describe a reason, in most cases, candidates scored just 1 mark as they started to describe two reasons and did not give linked detail for either. Fewer were able to give a complete description of a reason why.

Those that did score both marks often showed a clear understanding of the context and the reason that nanoparticles of titanium(IV)oxide are used in some screens. In some cases, candidates were not specific enough with their answers and just stated that sunlight or light is absorbed rather than the UV light from the sun. This did not score. References to the titanium being insoluble in water and therefore resistant to water were ignored.

(ii) **Nanoparticles of titanium(IV) oxide are used in some sunscreens.**

Describe a reason why nanoparticles of titanium(IV) oxide are used in some sunscreens.

(2)



Results Plus: Examiner Comments

In this example, the candidate scored 2 marks. They state that the nanoparticles block UV which therefore prevents sunburn, this alone would score 2 marks. They go on to give a second 2 mark answer, that the nanoparticles are very small and therefore cannot be seen. Just one of these descriptions would have been sufficient to gain the marks.

Describe a reason why nanoparticles of titanium(IV) oxide are used in some sunscreens.

(2)



Results Plus: Examiner Comments

In this example the candidate starts the description that the nanoparticles absorb UV rays but does not complete this by stating that this prevents sunburn.

(iii)

The second question about nanoparticles, was again well attempted with a good proportion

scoring. The majority gained 1 mark and only the best candidates gained 2 marks for a complete explanation.

(iii) Some people are concerned that there is a risk when sunscreens containing nanoparticles are used.

Explain a possible risk associated with using nanoparticles in sunscreens.

(2)

Because they are so small they may be absorbed into the skin and because the tecnology is so new scientists don't really know the consequences of this which is why its concerning.

Results Plus: Examiner Comments

Where candidates did score full marks, it was often for recognising that nanotechnology is new and so therefore we don't yet know the consequences, such as in this answer. Another common fully correct answer was that the nanoparticles might pass into the body and could change or catalyse reactions in the body.

Explain a possible risk associated with using nanoparticles in sunscreens.

(2)

could result in irritations and allergic reactions.

Results Plus: Examiner Comments

Where candidates did not score, it was often as their answers were vague, for example that it might harm the body or cause health problems. In some cases candidates stated that the nanoparticles may cause allergic reaction, this was not accepted and gained no marks.

Q40. No Examiner's Report available for this question

Q41. No Examiner's Report available for this question

Q42. No Examiner's Report available for this question

Q43.

(i) Polymer formation from monomers is generally well understood, although some candidates lack the appropriate literacy skills in explaining the process. Better candidates produced good diagrams.

Q44.

(i) While most candidates mentioned yeast, the idea of warming the mixture to a limited extent was less well stated. Answers such as 'heat the mixture' were rejected unless a specified temperature or suitable range was given, whilst 'warm' was accepted.

(ii) A majority of candidates realised that fractional distillation was required; very few were able to describe the location of the fractionating column. Weaker candidates suggested all manner of remedies such as pre-boiling the dilute ethanol or putting an ice pack around the condenser or redirecting the end of the condenser, and so on.

Q45. No Examiner's Report available for this question

Q46.

The most common score on this question was 0. Candidates found it hard to describe how it could be shown the potassium and sodium ions were present in the sample.

Although it had been stated that a flame test had already been carried out on the sample, many candidates then described how to carry out the flame test.

Of those that knew that a flame photometer should be used, only around half of those then knew how this would show that the two ions were present.

A sample of potassium carbonate is contaminated with a small amount of sodium carbonate.
When a flame test is carried out on the sample, a bright yellow flame is seen.

Describe how you could show that potassium and sodium ions are present in this sample.
(2)

Dip a sterilised wire loop into the sample and angle slightly on the bunsenburner to create a coloured flame. If potassium ions are present, it becomes a lilac flame. If sodium ions are present, it produces a yellow flame.

Results Plus: Examiner Comments

Although it had been stated that a flame test had already been carried out on the sample, many candidates then described how to carry out the flame test. This gained no credit.

You could use flame photometry to determine whether potassium and sodium ions are present.

Results Plus: Examiner Comments

In this example, the candidate understood that a flame photometer should be used, but does not describe how this would show that the potassium and sodium ions were present.

Results Plus: Examiner Tip

When describing tests, ensure that you always give the manner to test for a substance and then how you would know that the ion in question is present.

I would use flame photometry to identify these ions using the range of light wavelengths produced and comparing ~~thos~~ them with the wavelengths produced by different ions including Sodium and potassium.

Results Plus: Examiner Comments

A good answer that gained both marks.

Q47.

(i)

This question was not well answered on the whole, with approximately half the candidates scoring any of the 3 marks available.

Considering that this is based around a Core practical, most candidates struggled to score marks.

Some responses clearly described the remaining steps of the method needed to determine the mass of ethanol to raise the temperature of the water by 30°C. However, it was evident that many candidates had failed to read the question properly since many answered by stating 'stop heating the water once it had reached 30°C', as opposed to a temperature **increase** of 30°C. Many candidates confused the mass of the burner with the mass of ethanol.

(i) The apparatus in Figure 16 can be used to investigate the temperature rise produced in a known mass of water when a sample of ethanol is burned.

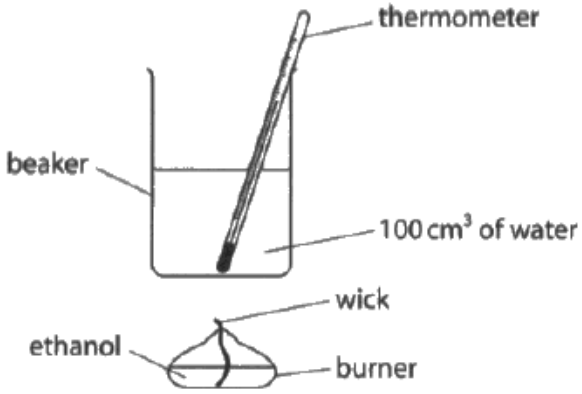


Figure 16

The first steps of the method are

1. put 100 cm^3 of water into a beaker
2. determine the mass of the burner containing ethanol
3. measure the initial temperature of the water
4. place the burner under the beaker of water
5. light the wick

Describe the remaining steps of the method that are needed to determine the mass of ethanol required to raise the temperature of the water by 30 °C.

(3)

Start a stop watch and measure and record the temperature at intervals. Once the temperature has risen to 30°C, determine the mass of the burner containing ethanol by weighing the burner. Then subtract the initial weight by the ending weight to get how much ethanol was used. This answer is how much ethanol is required to raise the temperature to 30°C.

Results Plus: Examiner Comments

This example is typical of a response scoring 2 out of the 3 marks available.

The candidate has scored 2 marks for mentioning that the burner containing the ethanol should be (re-)weighed and that the difference the in initial and final masses should be calculated. A third marking point is not scored since the response incorrectly mentions a rise to 30 °C as opposed to a rise by 30 °C.

(ii)

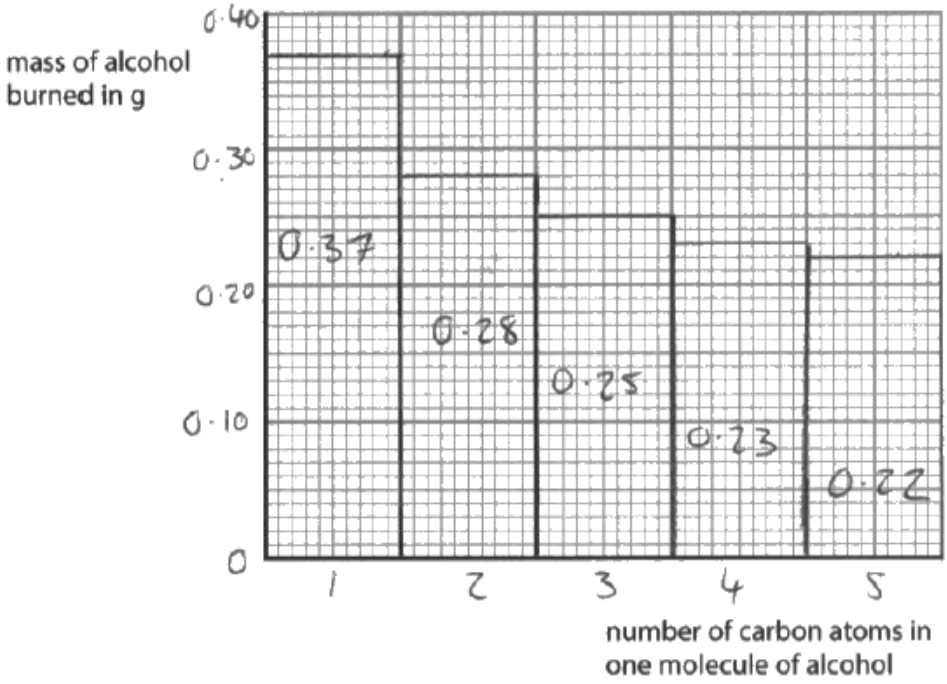
This question was generally well answered, with most responses gaining at least 2 out of the 3 marks available. A large number of responses included bar charts rather than line graphs and were able to score 2 marks. Commonly seen errors included: the y axis not covering enough of the graph paper and confusion in the scale, namely instead of 0.05, 0.1, 0.15 etc, many responses substituted 0.05 with 0.5; occasionally the points were plotted correctly but no attempt had been made to join them.

(ii) In a different experiment, separate samples of the alcohols methanol, ethanol, propanol, butanol and pentanol were burned to determine the mass of each alcohol that needs to be burned to raise the temperature of 100 cm^3 water by 10 °C.

alcohol	number of carbon atoms in one molecule of alcohol	mass of alcohol burned in g
methanol	1	0.37
ethanol	2	0.28
propanol	3	0.25
butanol	4	0.23
pentanol	5	0.22

Draw a graph of the mass of each alcohol required to raise the temperature of 100 cm^3 of water by 10 °C against the number of carbon atoms in one molecule of that alcohol.

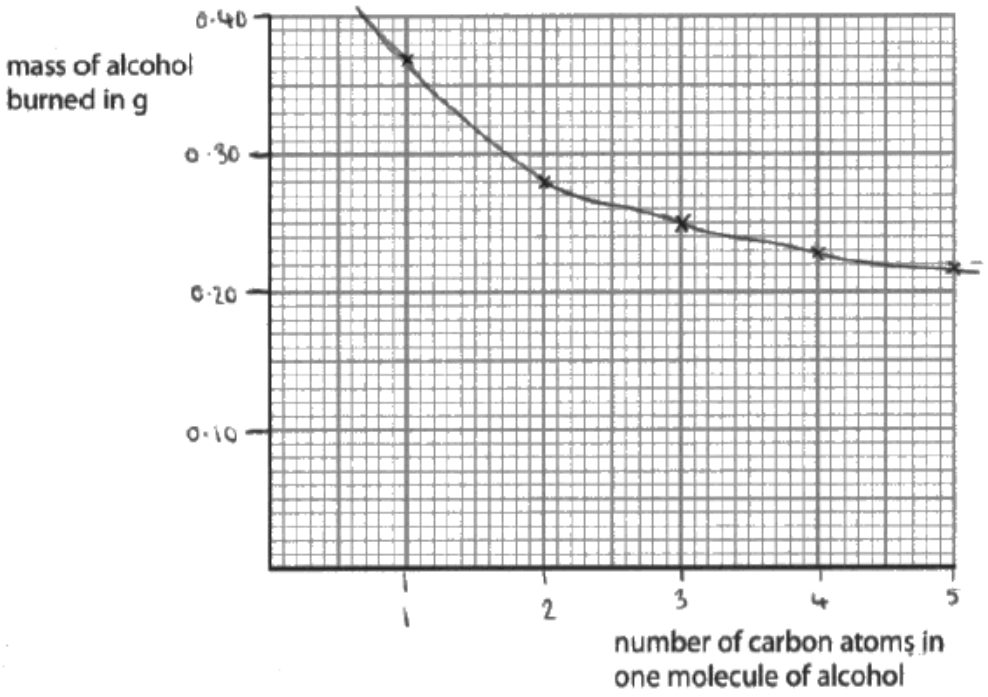
(3)



Results Plus: Examiner Comments

This response scored 2 marks.

The bar chart shown is sufficient to score 2 marks since the heights of the bars are correctly drawn and the scales are correct.



Results Plus: Examiner Comments

This response scored all 3 marks.

The scales, plotting of the points and the line of best fit are all credit worthy.

Q48.

(i)

It was pleasing to see that many candidates were familiar with this apparatus and were able to describe the remaining steps of the method needed to determine the mass of ethanol to raise the temperature of the water by 30 °C.

(i) The apparatus in Figure 3 can be used to investigate the temperature rise produced in a known mass of water when a sample of ethanol is burned.

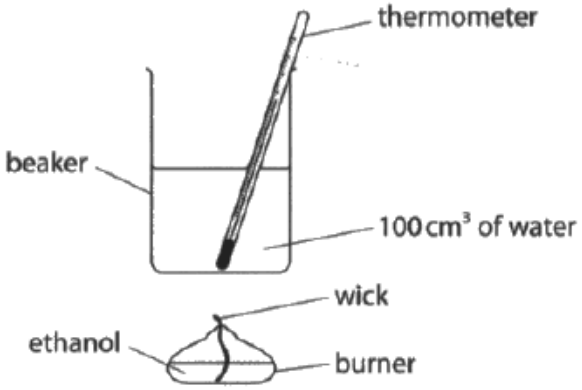


Figure 3

The first steps of the method are

1. put 100 cm³ of water into a beaker
2. determine the mass of the burner containing ethanol
3. measure the initial temperature of the water
4. place the burner under the beaker of water
5. light the wick
6. look at therm - at 30 put out flame

Describe the remaining steps of the method that are needed to determine the mass of ethanol required to raise the temperature of the water by 30 °C.

(3)

6. Keep looking at the thermometer until it reaches 30°.
7. Once it reaches 30° extinguish the flame not by blowing it out but by suffocating it.
8. Then measure the mass of the burner containing ethanol.
9. Take the new mass away from the initial mass.

Results Plus: Examiner Comments

Those that did not gain full credit often lost marks as they stated that the flame should be extinguished when the water reaches 30°C rather than when the temperature of the water had been increased by 30°C. In these cases, two marks from the last three marking points could still be credited as in this example.

(ii)

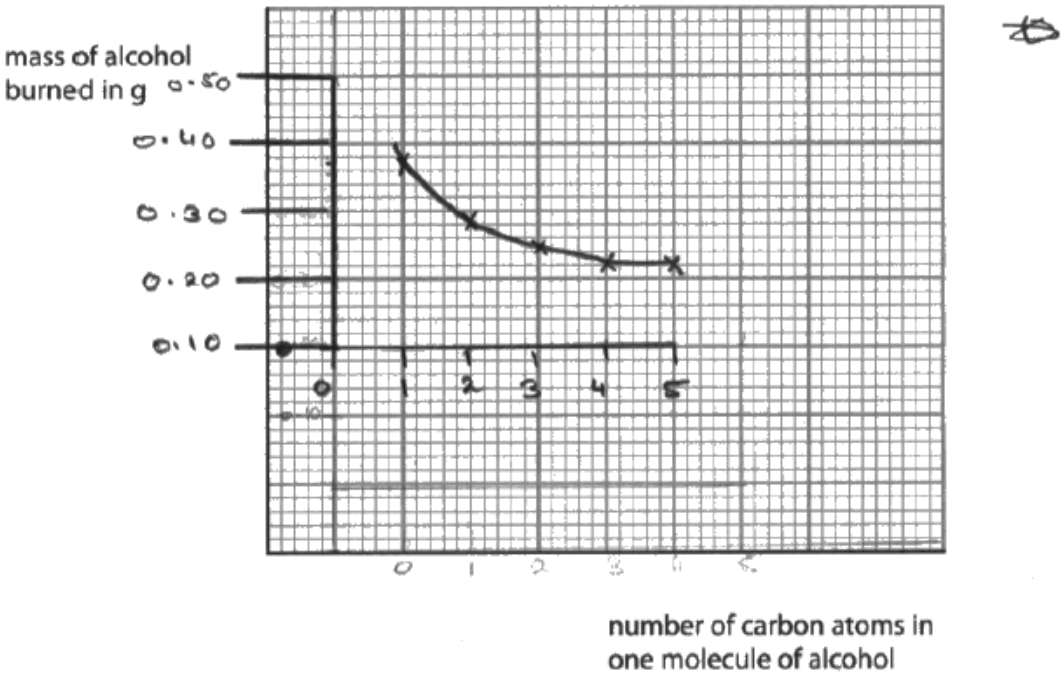
In general, this question was well answered with the majority gaining full marks, point plotting was generally very good and in the main, good lines of best fit were drawn.

(ii) In a different experiment, separate samples of the alcohols methanol, ethanol, propanol, butanol and pentanol were burned to determine the mass of each alcohol that needs to be burned to raise the temperature of 100 cm^3 water by 10 °C.

alcohol	number of carbon atoms in one molecule of alcohol	mass of alcohol burned in g
methanol	1	0.37 ✓
ethanol	2	0.28 ✓
propanol	3	0.25 ✓
butanol	4	0.23 ✓
pentanol	5	0.22

Draw a graph of the mass of each alcohol required to raise the temperature of 100 cm^3 of water by 10 °C against the number of carbon atoms in one molecule of that alcohol.

(3)



Results Plus: Examiner Comments

In some cases, candidates lost marks as they drew a non-linear scale or drew a scale that did not take up at least half of the edge of the grid.

Q49.

There were several really good answers to this 6-mark question. Those that were in the middle

ground had good detail of two of the three ion identification tests but lacked relevant equations for the reactions involved. Those at the bottom end of the range generally knew little of the ion identification tests as indicated on the specification judging by the often random attempts of a chemical reaction such as 'filter the solution and evapourate it with a bunsen burner' (***sic***). There were several candidates who left this blank.

Q50.

This extended open-response question was very poorly answered with the majority of responses not scoring. Of those responses which scored, invariably they scored only a Level 1 answer.

Clearly, this area of the specification, 'qualitative tests for cations', is one which caused great difficultly for candidates, despite this being a Core practical and questions having been set regularly in this and the previous specifications.

Many candidates were unable to recall the tests for metal ions, let alone the results of the tests. The majority of responses which scored, did so by naming the flame test and a correct result of this test for a particular metal ion. Very few candidates mentioned or described the use of the precipitation test with sodium hydroxide solution.

Examiners noted that when the flame test was used, this was often poorly described.

The main misconceptions arose from candidates: simply describing the tests and results for anions in the specification, not relevant to the question or describing the reactions and observations for the reactions of the alkali metals with water, again not relevant to the question.

* A white solid is known to be a chloride in which the metal ion is sodium, potassium, calcium or aluminium.

A chemist was told to carry out a test for each metal ion that could be present in this white solid.

Describe tests to show the presence of each of these metal ions.

(6)

To carry out a flame test, first the wire loop should be sterelized in dilute hydrochloric acid and rinsed in distilled water for accurate results and to ensure no previous substance will be detected. Then dip a loop in the metal sample and hold in the blue flame of a bunsen burner. If the white solid is held in the flame and it goes yellow, Sodium is present. If the flame goes lilac potassium is present. If the flame turns orange-red, the solid is calcium chloride.

Likewise, the chemist could add a drop of sodium hydroxide to the metal ion to form a coloured precipitate. If the precipitate goes white then colourless, it is aluminium but if the precipitate stays white then it is calcium. For mixtures of ions in a compound, flame photometry could also be used.

To make sure the solid is a chloride, dilute nitric acid should be added to silver nitrate to form a white precipitate.

Results Plus: Examiner Comments

This response was awarded Level 3–5 marks.

Both tests have been described with results of each test which put this in to Level 3.

The flame test is described in detail and with correct results for flame colours. The precipitation test is described in some detail with correct results but the need to dissolve the solids has not been mentioned.

Results Plus: Examiner Tip

When describing the precipitation test for metals ions in unknown solids using sodium hydroxide solution, remember to include a step in which the solids are dissolved in water before testing.

To find presence of sodium we can use the flame test and we will see a yellow colour.

To find presence of potassium we can use the flame test and we will see a green colour

To find the presence of calcium we can use the flame test and we will see an orange red colour.

To find aluminium we can use the flame test and we will see a brown ~~colour~~ blue colour.

Results Plus: Examiner Comments

This response was awarded Level 1–2 marks.

The response correctly states the use of a flame test to identify the metal ion in the solids. Two of the flame colours are correct, namely yellow for sodium and orange-red for calcium.

Since the flame test has not been described this limited the response to Level 1.

Results Plus: Examiner Tip

Learn the steps needed to carry out the flame test on a solid or solution.

In order to fully understand the contents of the solid when looking for ions you do the ion flame test.

Using a bunsen burner, you'd use a bunsen burner on a blue flame (easier for colour identification) and using a sanitised wire loop (first sanitise in flame then in HCl.). Place a bit of the solid onto the wire loop. Place in flame. You'll be able to identify which of these ions are present in the solid if there are any.

Sodium → If positive, this ion will burn to make a yellow flame (this is why we have blue bunsen flames).

Potassium → If positive you'll see lilac flame.

Calcium → Orange - Red if positive.

If there's nothing it is Aluminium and it's because Aluminium will not show a colour if burnt. Instead use a solution to test for it.

For aluminium you must use nitric acid and silver nitrate.

Results Plus: Examiner Comments

This response was awarded Level 2–4 marks.

The flame test has been described in some detail and there is at least one correct result of the flame test.

flame test:

- take the metal loop and dip it in hydrochloric acid to clean it.
- dip the loop into ~~a~~ one of the metal ions
- ~~put~~ make sure the bunsen burner is on the blue flame.
- ~~dip~~ put loop into the bunsen burner and observe the colour
- record the result and put the loop back into the acid so its clean for the next metal ion.
- repeat steps.

Results Plus: Examiner Comments

This response was awarded Level 2–3 marks.

The procedure for carrying out the flame test has been carried out in some detail. However, there are no results given in the response, so this limited the overall score to 3 marks.

Results Plus: Examiner Tip

Make sure you are able to recall the flame colours for the metal ions in the specification.

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
	A description including two points from CLEAN • clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• moisten splint • put splint into solid • hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1 if yellow flame, max 1	**(2)**

Q2.

	Answer	Acceptable answers	Mark
(i)	C orange-red		**(1)**
(ii)	A description including two points from CLEAN • clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• moisten splint • put splint into solid • hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1	**(2)**

Q3.

	Answer	Acceptable answers	Mark
(i)	**C** C_2H_6		**(1)**

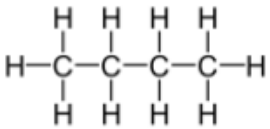
(ii)	**C** propene		**(1)**

Q4.

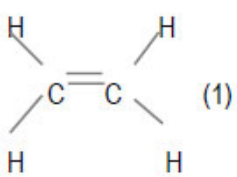
	Answer	**Acceptable answers**	**Mark**
(i)	A carbonate ion CO_3^{2-}		**(1)**
(ii)	A description including warm / heat / boil (1) {**gas/ammonia**} turns (damp red/pink) litmus blue / (damp red/pink) litmus turns blue when held above (the mixture)(1)	maximum (1) if additional reagents added ignore any ppt allow pungent smell / smell of {ammonia/wet nappies} /alkaline **gas** /effect of ammonia on other named indicators /dense white fumes with conc hydrochloric acid ignore litmus turns blue in ammonium ions/sodium hydroxide/mixture do not allow gas/ammonia if blue litmus turns red/pink	**(2)**

Q5.

Question Number	Answer	Acceptable answers	Mark
(i)	An explanation including any two of the following • same general formula (1) • have similar/same chemical reactions/properties (1) • both saturated/(both only) have single bonds / (both) have no double bonds (1)	C_nH_{2n+2} = 2 marks allow both hydrocarbons / both contain hydrogen and carbon (only) allow both end in -ane allow (molecular) formulae differ by CH_2	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	fully correct (displayed) formula of butane (2)  M1 four carbon atoms joined by single bonds (1) M2 rest of molecule correct (1)	M2 dependent on M1 If methylpropane drawn fully correctly 1 mark	**(2)**

Q6.

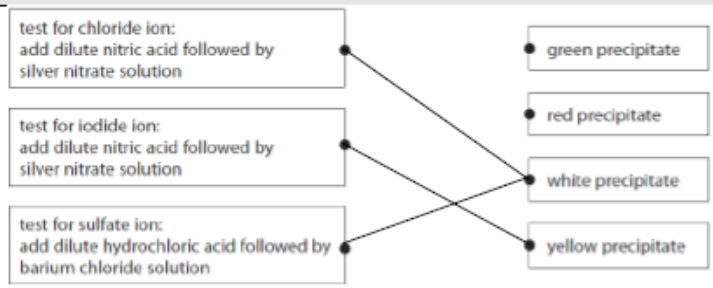
	Answer	Acceptable answers	Mark
(a)	 (1) Propene (1)	Allow $CH_2=CH_2$ Allow prope(e)n(e) only	**(2)**
(b)(i)	(molecule contains a) **double** bond	multiple bond(s)	**(1)**

		ignore spare bonds	
(b)(ii)	(colour change) from orange (1) to colourless (1)	red/yellow/brown decolorised ignore clear/ discoloured	**(2)**
(c)	**1st mark** long {molecules/ hydrocarbon / alkane/ chain} **or** break down/ decompose/ split (1) **2nd mark** into smaller {molecules / alkane / alkene / hydrocarbon/ chain} **or** more useful product		**(2)**
(d)(i)	**D**polymerisation		**(1)**
(d)(ii)	An explanation linking **two** of the following • poly(ethene) does not rot/biodegrade (1) • remains for many years in landfill/ fills up land(fill) (1) • (may) harm animals / landfill unsightly (1)		**(2)**

Q7.

Question number	Answer	Mark
(i)	An explanation linking one of the following pairs • the test only detects that ion (1) • so no confusion with other ions (1) OR • if same result is given by more than one ion (1) • do not know which ion is present (1)	(2)

Question number	Answer	Additional guidance	Mark
(ii)	carbon dioxide	allow CO_2 ignore CO^2 / CO2 / Co_2	(1)

Question number	Answer	Additional guidance	Mark
(iii)	 (3)	chloride ion – white precipitate (1) iodide ion – yellow precipitate (1) sulfate ion – white precipitate (1) 1 mark for each line If more one line connects a left hand box to those on the right, do not award that mark	(3)

Q8.

Question Number	Answer	Additional guidance	Mark
	improve sensitivity / accuracy / speed (of tests)	ignore clearer/better/precise/efficient/ reliable/valid results	(1) AO 1 1

Q9.

	Answer	Acceptable answers	Mark
(i)	36 ±1 (°C)		(1)
(ii)	increases /OWTTE		(1) grad

Q10.

Question number	Answer	Mark
(i)	**C** yes yes	**(1)**

Question number	Answer	Mark
(ii)	**D** changes from orange to colourless	**(1)**

Q11.

	Answer	Acceptable answers	Mark
	A description including: • add (dilute) (hydrochloric) acid (1) • gas/carbon dioxide (passed into/tested) with limewater (1) • limewater goes milky / cloudy / white ppt (1)	correct formulae heat/thermally decompose bubbled through limewater dependent on use of limewater	**(3)**

Q12.

	Answer	Acceptable answers	Mark
(a)	sodium carbonate + calcium nitrate → sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	ignore solution / state symbols ignore incorrect attempts at balanced equation ignore mixtures of words and formulae	**(2)**
(b)(i)	C orange-red		**(1)**
(b)(ii)	A description including two points from CLEAN	• moisten splint • put splint into solid	**(2)**

	• clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1	
(c)(i)	40/44 (1) (= 0.909) (any fraction) x 100 (1) (= 90.9 / 90.91 / 91(%))	correct answer (2) Ignore 90(%)	**(2)**
(c)(ii)	reaction is incomplete / not hot enough / not heated for long enough / use of impure calcium carbonate	ignore {gas escaping / not all collected / incorrect measurement}	**(1)**
(d)	D have high melting points		**(1)**

Q13.

Question number	Answer	Additional guidance	Mark
	18 as final answer with or without working scores 3 100 - 96.5 = 3.5 **(1)** 500 x 3.5/100 (=17.5) **(1)** = 18 (tonnes to 2 s.f.) **(1)**	480 as final answer scores 2 482.5 / 483 as final answer scores 1 answer with working using 96.5 and 500 and rounded correctly to 2 s.f. scores 1	**(3)**

Q14.

Question number	Answer	Additional guidance	Mark
	(2 × 12) + (5 × 1) + 16 + 1 (1) = 46 (1)	Award full marks for correct numerical answer without working.	**(2)**

Q15.

Question number	Answer	Additional guidance	Mark
	18 as final answer with or without working scores 3 100 - 96.5 = 3.5 **(1)** 500 x 3.5/100 (=17.5) **(1)** **=** 18 (tonnes to 2 s.f.) **(1)**	480 as final answer scores 2 482.5 / 483 as final answer scores 1 answer with working using 96.5 and 500 and rounded correctly to 2 s.f. scores 1	**(3)**

Q16.

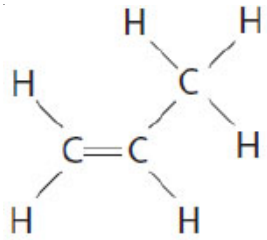
Question number	Answer	Mark
	moles of sucrose = $\frac{\text{moles of ethanol}}{4}$ (1) (= $\frac{26.9}{4 \times 46}$ = 0.146) mass of sucrose = $\frac{\text{moles of ethanol}}{4}$ x 342 (1) (= $\frac{26.9 \times 342}{4 \times 46}$ = 49.999 g) allow 50 g for 2 marks	**(2)** **AO2**

Q17.

Question number	Answer	Additional guidance	Mark
	MP1 : calculation 24 600 x 42 (1) (=1 033 200) **MP2 : answer to 3 sig figs** = 1 030 000 / 1.03 x 10^6 (1) (to 3 sig figs)	without working: 1 030 000 – 2 marks 1 033 200 – 1 mark allow 24600/42 = 586 (1)	**(2)**

Q18.

	Answer	Acceptable answers	Mark
(a)	C – CH_3CH_3		
(b)		carbon skeleton correct including double bond (1)	(2)

		rest of molecule correct (1) allow CH_3	
(c)	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ • reactant formulae (1) • product formulae (1) • balancing of correct formulae (1)	accept multiples reject incorrect use of cases and non-subscripts	(3)

		Indicative Content	
QWC	***(d)**	advantages • renewable / sustainable • more plants can be grown • crops use up carbon dioxide and produce oxyg growing /photosynthesising • carbon neutral because the carbon produced c combustion is used when growing the plants • does not use up crude oil/non-renewable resou disadvantages • crops grown for bio-fuels use up land • land could otherwise be used to provide home farmland available for growing food crops • lots of crops required to provide a small amou bio-methane • bad season reduces availability • carbon emissions due to transport and produc qualified	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. using bio-methane conserves fossil fuels and uses up carbon dioxide when plants are grown • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. growing plants to produce biomethane is sustainable and conserves fossil fuels but uses up lots of farm land which could be used to grow plants for food • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• detailed description e.g growing plants remove carbon dioxide from the air during photosynthesis and conserves fossil fuels but lots of crops are required to make biomethane and this uses up farm land which could otherwise be used to grow crops for food • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q19.

Question number	Answer	Mark
	D does not dissolve in water **A**, **B** and **C** are not factually correct	**(1)** **AO2**

Q20.

Question Number	Answer	Acceptable answers	Mark
	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (3) LHS (1) RHS (1) balancing of correct formulae (1)	allow correct multiples allow reactants on LHS and products on RHS in either order ignore state symbols allow = for →	**(3)**

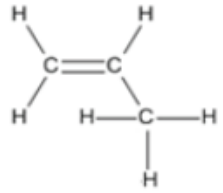
Q21.

Question number	Answer	Mark
	An explanation that combines identification via a judgement (maximum 2 marks) to reach a conclusion via justification/reasoning, which must be linked to the judgement (maximum 2 marks): • it is lighter/has a lower density/than steel (1) • so it is easier/more comfortable to wear (1) OR • it is stronger (1) • so it is less likely to be penetrated (1) OR • it is more flexible (1) • so it is easier/more comfortable to wear (1) OR • does not (corrode/rust) (1) • so it will last longer (1)	**(4)**

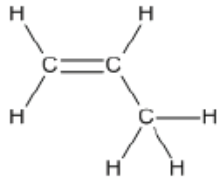
Q22.

Question number	Answer	Mark
	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$	(1)

Q23.

Question number	Answer	Additional guidance	Mark
	• molecular formula – C_5H_{10} (1) • structure (1) 		(2)

Q24.

Question number	Answer	Mark
	• Molecular formula – C_2H_4 (1) • Structure (1) 	(2)

Q25.

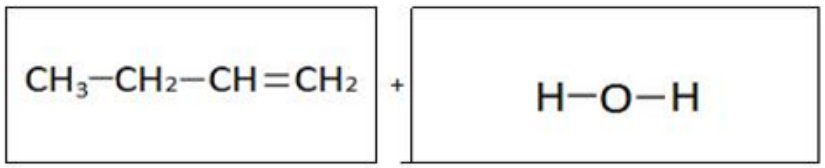
Question number	Answer	Additional guidance	Mark
(i)	(copper sulfate(aq) + sodium hydroxide(aq) →) copper hydroxide(s) + sodium sulfate(aq) • sodium sulfate identified as a product (1) • (sodium sulfate)(aq) **and** copper hydroxide(s) both state symbols matched to the correct product (1)	allow Na_2SO_4 allow copper(II) hydroxide/ $Cu(OH)_2$	**(2)**

Question number	Answer	Mark
(ii)	white precipitate/ppt/solid	**(1)**

Q26.

Question number	Answer	Mark
	$(Fe^{3+} + 3OH^-) \rightarrow Fe(OH)_3$	**(1)**

Q27.

Question number	Answer	Mark
	 but-1-ene + water structure of but-1-ene (1) name of but-1-ene (1) structure or formula **and** name of water (1)	**(3)**

Q28.

Question number	Answer	Mark
	$C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + 2HCl$ HCl **(1)** 2 **(1)**	**(2)**

Q29.

Question number	Answer	Mark
	$C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + 2HCl$ • HCl (1) • 2 (1)	**(2)**

Q30.

Question number	Answer	Additional guidance	Mark
(i)	4 electrons shown between the 2 carbon atoms	electrons may be shown as dots, crosses or as a mixture	**(1)**
(ii)	carbon monoxide / carbon / soot	allow CO / C ignore carbon dioxide	**(1)**

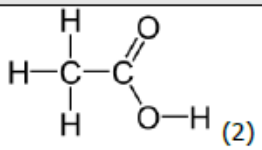
Q31.

Question number	Answer	Additional guidance	Mark
(i)	$C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$ (2) left hand side (1) right hand side (1)	correct formulae with incorrect balancing (1)	**(2)**

Question number	Answer	Mark
(ii)	**C** 4/60 x 100 **C** is the only correct answer. **A** is incorrect because there are four atoms of hydrogen in ethanoic acid **B** is incorrect because there are four atoms of hydrogen in ethanoic acid **D** is incorrect because the fraction is inverted and there are four atoms of hydrogen in ethanoic acid	(1)

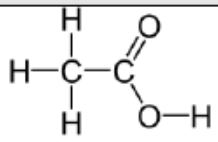
Q32.

Question number	Answer	Mark
(i)	**B** oxidised is the only correct answer **A, C** and **D** are factually incorrect	(1)

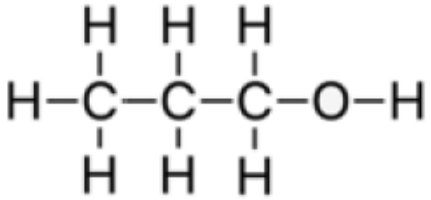
Question number	Answer	Additional guidance	Mark
(ii)	 (2) or correct carboxylic acid group (1) correct methyl group (1)	allow correct dot and cross diagram ignore incorrect bond angles allow OH for O-H reject methyl group with additional carbons max 1 mark if double bond present 2 carbons	(2)

Q33.

Question number	Answer	Mark
(i)	**B** oxidised is the only correct answer **A**, **C** and **D** are factually incorrect	**(1)**

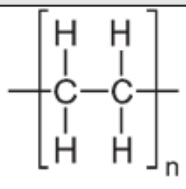
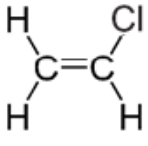
Question number	Answer	Additional guidance	Mark
(ii)	 (2) or correct carboxylic acid group (1) correct methyl group (1)	allow correct dot and cross diagram ignore incorrect bond angles allow OH for O-H reject methyl group with additional carbons max 1 mark if double bond present 2 carbons	**(2)**

Q34.

Question number	Answer	Additional guidance	Mark
(i)	 (2) OR hydroxyl group on a carbon (1) rest of molecule correct (1)	 allow OH for O-H reject any multiple bonds drawn	**(2)** **AO1**

Question number	Answer	Mark
(ii)	**C** it is oxidised **A, B and D are incorrect as this is an oxidation reaction.**	**(1)** **AO2**

Q35.

Question number	Answer	Additional guidance	Mark
	 (1)  (1) poly(tetrafluoroethene) (1)	note **n** must be present on the repeating unit allow polytetrafluoroethene ignore ptfe / Teflon	**(3)**

Q36.

	Answer	Acceptable answers	Mark
(a)	remove delivery tube from water <u>before stopping heating</u>	other words which make sequence clear use of (Bunsen) valve	(1)
(b)	B C_4H_8		(1)
(c)	contains a {double/multiple} bond	ignore "spare bonds" ignore reference to number of hydrogen atoms attached.	(1)
(d)	A description to include • bromine water is orange (1) • propane: (remains) orange / no colour change (1) • propene: becomes colourless /decolourises (1)	 red / yellow / brown any combination of these ignore clear /discolours	(3)
(e)	An explanation linking any**two** of • shorter chain molecules are more useful ORA (1) • demand for shorter chain molecules ORA (1)	 reject long chain molecules are useless named fraction/use/fuel	(2)

	• meets demand • reduces the excess of longer chain molecules (1) • (cracking) produces alkenes (1) • alkenes used to make polymers (1)	named fraction /use/fuel	

Q37.

Question number	Answer	Additional guidance	Mark
	C_6H_{12} with or without working gains 3 marks relative mass $CH_2 = 12 + (2x1)$ (1) (=14) CH_2 units in hydrocarbon = $\frac{84}{14}$ (1) (=6) molecular formula is C_6H_{12} (1)	allow ECF	**(3)**

Q38.

	Answer	Acceptable answers	Mark
	contains a {double/multiple} bond	ignore "spare bonds" ignore reference to number of hydrogen atoms attached.	(1)

Q39.

Question number	Answer	Mark
(i)	**C** 1×10^{-7} metres (correct 100 nanometers) is the only correct answer. **A** is not correct because it is 100 000 nanometers **B** is not correct because it is 10 000 nanometers **D** is not correct because it is 1 nanometer	**(1)**

Question number	Answer		Mark
(ii)	A description to include the following points can {absorb/block} **UV** light from the skin (1) therefore can prevent sunburn (1) OR particles are very small (1) (therefore) appear invisible / cannot be seen on the skin (1)	allow reflects **UV** light ignore sunlight allow can prevent {skin/cell} damage / protects skin /can help prevent skin cancer allow is not white on the skin ignore insoluble in water so water resistant	**(2)**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking two from do not know the risks fully / long term risks not yet known (1) because they have not been used for a long enough time / are new technology / no long term research (1) might pass into the body / through cell membranes / enter skin / enter the bloodstream (1) could {change / catalyse} reactions in body (1)	allow named change / damage to named organ ignore harm the skin/ body/ causes rashes /illness ignore nanoparticles could be inhaled allow any plausible risk of sunscreen (1) with linked explanation (1)	**(2)**

Q40.

Question number	Answer	Additional guidance	Mark
	An answer that provides a description by making reference to: • test gas with moist (red) litmus paper (1) • turns blue (1)	Allow universal indicator paper/pH paper (1) and yellow to blue/purple (1).	**(2)**

Q41.

Question number	Answer	Mark
(i)	0.39 with or without working scores 1 mark 152.62 – 152.23 (= 0.39) (1)	**(1)** **AO2**

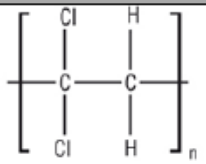
Question number	Indicative content	Mark
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • measure 100 cm^3 of water into a beaker. • place the beaker above the burner • place draft shields around the equipment • weigh the (alcohol) burner containing the alcohol • record this mass and the name of the alcohol. • place a thermometer in the water • record the initial temperature of the water • place a lid on beaker • light the wick. • heat the water so the temperature rises by 20°C. • extinguish the flame. • re-weigh the (alcohol) burner • subtract final mass from initial mass of burner and alcohol/ calculate the mass of alcohol used. • repeat with the next alcohol • using same volume of water • keep the height of the beaker the same	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Heat the water by 20°C and then subtract the final mass from the initial mass of the burner and alcohol
Level 2	3–4	Measure 100 cm^3 of water into a conical flask, allow the alcohol to heat the water so the temperature rises by about 20°C. re-weigh the spirit burner and cap then calculate the mass of alcohol used.
Level 3	5–6	Measure 100 cm^3 of water into a conical flask/beaker. Weigh the burner and cap containing the alcohol. Record the initial temperature of the water in the flask. Allow the alcohol to heat the water so the temperature rises by about 20°C. Re-weigh the spirit burner and cap, subtract final mass from initial mass of burner and alcohol.

Question number	Answer	Mark
(iii)	0.02 with or without working scores 2 marks $\frac{0.36}{20}$ = (0.018) (1) 0.02 (1)	(2) AO2

Q42.

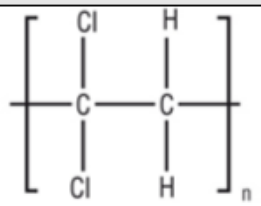
Question number	Answer	Additional Guidance	Mark
(i)	A description to include any two from • double bond (in monomer) breaks (1) • {monomers/ molecules} link together (1) • to form a (long) chain (1)	diagrams can score MP1, 2 or 3 ignore mention of addition or condensation	(2)

Question number	Answer	Mark
(ii)	 **B** **B** is the only correct answer. **A** is not correct as it is poly(1,2-dichloroethene) **C** is not correct as it has a double bond **D** is not correct as it is poly(1,1,2-trichloroethene)	(1)

Question number	Answer	Mark
(iii)	**B** only the dichloroethene and bromine water goes colourless **A** is incorrect because the alkene decolourises bromine water **C** is incorrect because the polymer does not decolourise bromine water but the alkene does **D** is not correct because the polymer does not decolourise bromine water	(1)

Q43.

Question number	Answer	Additional guidance	Mark
(i)	A description to include any two from • double bond (in monomer) {breaks/ opens up} **(1)** • {monomers/ molecules} {link/ join} together **(1)** • to form a (long) chain **(1)**	diagrams can score MP1, 2 or 3 ignore mention of addition or condensation	**(2)**

Question number	Answer	Mark
(ii)	 **B** is the only correct answer. **A** is not correct as it is poly(1,2-dichloroethene) **C** is not correct as it has a double bond **D** is not correct as it is poly(1,1,2-trichloroethene)	**(1)**

Question number	Answer	Mark
(iii)	**B** only the dichloroethene and bromine water goes colourless is the only correct answer **A** is incorrect because the alkene decolourises bromine water **C** is incorrect because the polymer does not decolourise bromine water but the alkene does **D** is not correct because the polymer does not decolourise bromine water	**(1)**

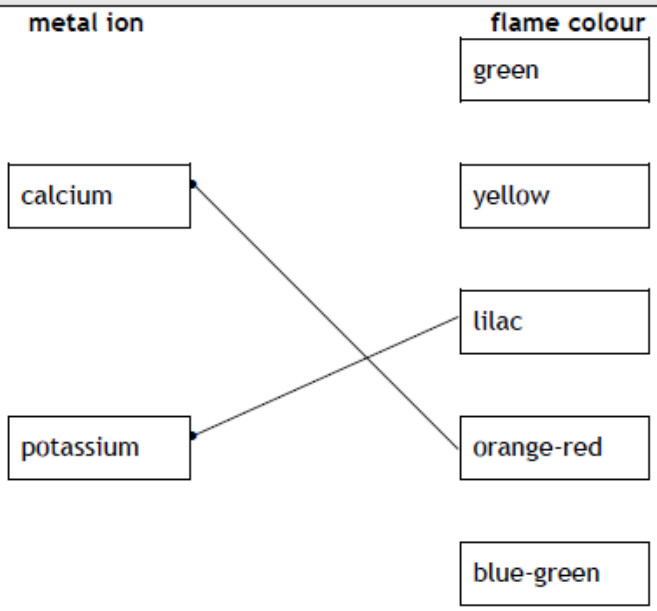
Q44.

Question number	Answer	Additional guidance	Mark
(i)	• add yeast **(1)** • warm **(1)**	accept zymase / enzymes accept any sensible method of warming eg waterbath reject boiling allow 'heat' only if temperature range within 20-45℃ specified	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	A description to include • add fractional distillation column/fractionating column (1) • in neck of flask/between flask and condenser (1)	allow use fractional distillation for MP1	**(2)**

Q45.

Question number	Answer	Additional guidance	Mark
(i)	A description including • put (clean) wire into solid (1) • hold (wire) in (Bunsen) flame (1)	 put (damp) splint into solid (1) hold splint in (Bunsen) flame (1) ignore: hold over flame reject use of yellow flame	(2)

Question number	Answer	Mark
(ii)	 Each line 1 mark Do not award mark if more than one line join the left hand boxes with those on the right	(2)

Q46.

Question number	Answer	Additional guidance	Mark
	A description to include **flame** photometer (1) two (sets of) emissions / OWTTE (1)	 allow flame emission spectroscopy / spectroscope ignore flame test allow compare emission to reference samples	(2)

Q47.

Question number	Answer	Additional guidance	Mark
(i)	A description to include • heat water to increase temperature by 30°C (1) **AND** any two from • extinguish flame (1) • (re-)determine mass of burner containing ethanol (1) • subtract final from initial mass / calculate the change in mass (1)	ignore references to timing allow watch thermometer until the temperature increases 30°C / wait for temperature to rise 30°C allow put a cap on the burner (to extinguish flame) allow '(re-)weigh the burner'	(3)

Question number	Answer	Additional guidance	Mark
(ii)	vertical axis with linear scale that uses more than half of the edge of the grid (1) all points correctly plotted to +/- ½ small square (1) single line of best fit drawn (1)	allow axis not starting at 0 allow points joined by straight lines / dot to dot ignore the line after points reject tramlines correct bar chart can gain MP1 and MP2	(3)

Q48.

Question number	Answer	Additional guidance	Mark
(i)	A description to include • heat water to increase temperature by 30°C (1) **AND** any two from • extinguish flame (1) • (re-)determine mass of burner containing ethanol (1) • subtract final from initial mass / calculate the change in mass (1)	ignore references to timing allow watch thermometer until the temperature increases 30°C / wait for temperature to rise 30°C allow put a cap on the burner (to extinguish flame) allow '(re-)weigh the burner'	**(3)**
(ii)	vertical axis with linear scale that uses more than half of the edge of the grid (1) all points correctly plotted to +/- ½ small square (1) single line of best fit drawn (1)	allow axis not starting at 0 allow points joined by straight lines / dot to dot ignore the line after points reject tramlines correct bar chart can gain MP1 and MP2	**(3)**

Q49.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. • ions present – NH_4^+, Fe^{2+}, SO_4^{2-} • dissolve solid in (distilled / deionised) water • add drops of sodium hydroxide solution • green / grey-green / dirty green • precipitate shows Fe^{2+} ion • precipitate is iron(II) hydroxide • $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ • warm mixture of salt solution and sodium hydroxide solution • hold damp (red litmus / universal / pH indicator) paper **above** mixture • indicator paper turns (blue / purple) • test shows ammonia gas formed • ammonia gas comes from NH_4^+ ions present • $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$ • to second portion of salt solution add drops of dilute hydrochloric acid • add drops of barium chloride solution (or lead nitrate solution) • white • precipitate forms • precipitate is barium sulfate (or lead sulfate) • Ba^{2+}(or Pb^{2+}) $+ SO_4^{2-} \rightarrow$ Ba(or Pb)SO_4	**(6)** **AO1** **AO2**

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance • names an ion present in the compound or • attempts test to identify an ion	Possible candidate responses • Ion present in compound NH_4^+ / Fe^{2+} / SO_4^{2-} • Adds compound to water (to make a solution) • Adds sodium hydroxide solution to solution of compound • Adds barium chloride solution to solution of compound
Level 2	3–4	Additional guidance • names at least two ions present And • describes at least one test to identify one of those ions – with positive result	Possible candidate responses • Adds sodium hydroxide solution to solution of compound - green ppt shows Fe^{2+} ion present or • adds dilute hydrochloric acid and barium chloride solution to solution of compound - white ppt shows SO_4^{2-} ion present or • adds sodium hydroxide solution to solution of compound and warms gently - pungent gas given which turns damp universal indicator purple shows presence of NH_4^+
Level 3	5–6	Additional guidance • Identifies all 3 ions And • Describes at least two tests for those ions – with positive results And • Suitable equations for at least two tests of ions	Possible candidate responses • adds sodium hydroxide solution to solution of compound - green ppt shows Fe^{2+} ion present • $Fe^{2+} + 2\ OH^- \rightarrow Fe(OH)_2$ • adds dilute hydrochloric acid and barium chloride solution to solution of compound - white ppt shows SO_4^{2-} ion present • $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ • adds sodium hydroxide solution to solution of compound and warms gently - pungent gas given which turns damp universal indicator purple shows presence of NH_4^+ ions in compound • $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q50.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • sodium, potassium and calcium ions detected by flame test • clean flame test wire with hydrochloric acid • dip wire into solid • hold wire in flame • if flame is yellow – sodium • if flame is lilac – potassium • if flame is orange-red – calcium • if no flame colour – could be aluminium • calcium and aluminium ions detected using sodium hydroxide solution • dissolve white solid in water • add drops of sodium hydroxide solution • white ppt shows calcium or aluminium ions • no ppt shows sodium or potassium ions • add more drops sodium hydroxide solution • if white ppt dissolves to form colourless solution • is aluminium ions • if white ppt does not dissolve • is calcium ions	**(6)**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)