PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 0: FORMULAE, EQUATIONS AND HAZARDS (PACK 1)

SCORE	PERCENTAGE
/42	%

STEMUP

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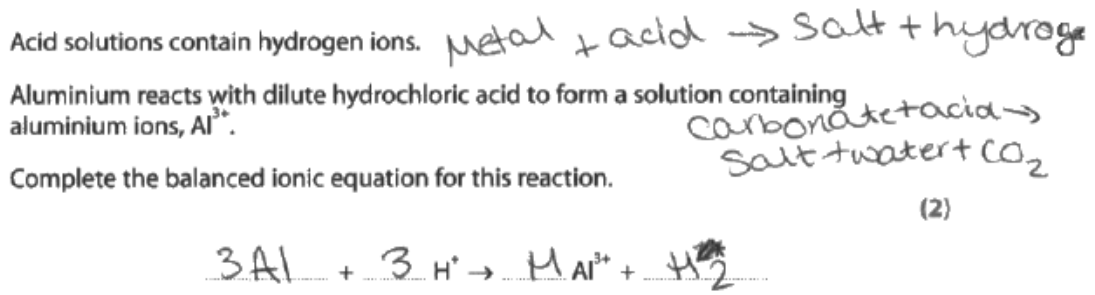
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Q2.

This question was poorly answered. Only a few candidates managed to write in formulae of Al and H_2, and even fewer balance the ionic equation correctly. Probably only the most able candidates scored the two marks here. Some candidates included the chloride ion somehow and overlooked the first sentence of the question or had Al^{3+} on both sides.


Acid solutions contain hydrogen ions. metal + acid → salt + hydrog

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}.

carbonate + acid → salt + water + CO_2

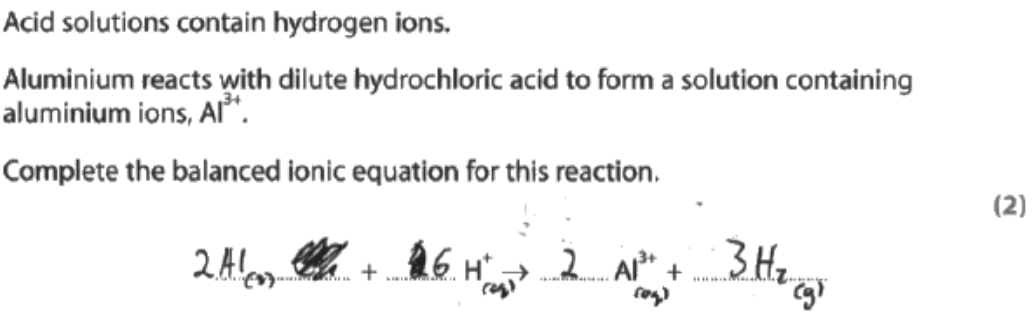
Complete the balanced ionic equation for this reaction.

(2)

$3Al + 3H^+ \rightarrow Al^{3+} + H_2$

Results Plus: Examiner Comments

Al and H_2 are in the correct places and these score the first mark. Balancing was incorrect and so the second mark was not scored.


Acid solutions contain hydrogen ions.

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}.

Complete the balanced ionic equation for this reaction.

(2)

$2Al_{(s)} + 6H^+_{(aq)} \rightarrow 2Al^{3+}_{(aq)} + 3H_{2(g)}$

Results Plus: Examiner Comments

Correct formulae and balancing, so both marks were awarded.
State symbols were ignored - even if incorrect.
2 marks for this answer

Results Plus: Examiner Tip

State symbols are not needed unless asked for.

Q3. No Examiner's Report available for this question

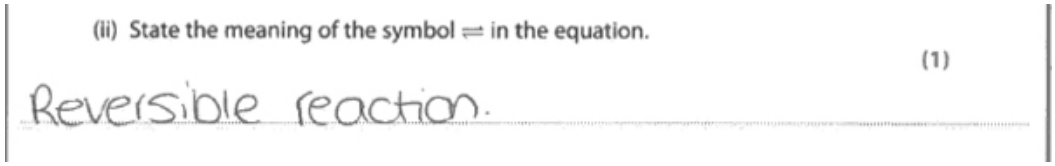
Q4.

(b) (i)

Most candidates gained credit for their answers, scoring the 1 mark available for simply stating 'gas'.

(b) (ii)

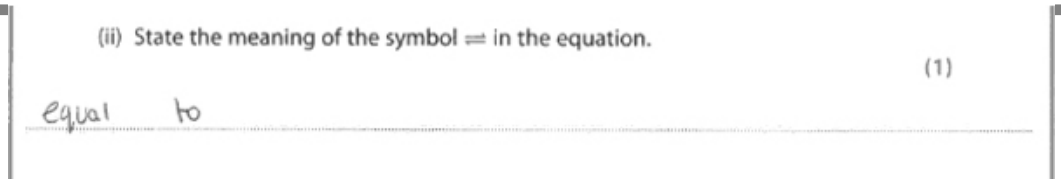
Most candidates gained credit for their answers.


(ii) State the meaning of the symbol ⇌ in the equation. (1)

Reversible reaction.

Results Plus: Examiner Comments

This response was the most commonly seen correct answer for the 1 mark available.


(ii) State the meaning of the symbol ⇌ in the equation. (1)

equal to

Results Plus: Examiner Comments

A typical incorrect answer, where the reversible sign was confused with simply an equal sign, so does not score.

(c)

As expected, most candidates gained credit for showing both the correct reactants and products.

Occasionally, extra incorrect products, namely 'carbon dioxide' or 'water' were given, so only 1 mark was scored.

Unfortunately, spelling errors were all too common, especially when the compounds were given in the question.

(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

ammonia + sulfuric acid → ammonium sulfate

Results Plus: Examiner Comments

Both the correct reactants and products have been given, so this response was awarded the 2 marks available.

(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

Ammonia + Sulfuric acid -> ammonium sulfate + water

Results Plus: Examiner Comments

A typical 1 mark response for showing the correct reactants only. The right hand side is incorrect since 'water' has also been added.

(d)

This question was well answered, with the majority of candidates clearly understanding the role of a fertiliser, to score the 1 mark available.

The most common correct answers referred to increasing the rate of plant growth or the addition of nutrients / mineral salts to the soil.

Where some candidates failed to score, the main misconception was to confuse fertilisers with pesticides or herbicides.

A typically seen correct response for 1 mark.

(d) Ammonium sulfate is used as a fertiliser.

State why farmers use fertilisers on their fields.

(1)

Farmers use fertilisers on their fields to speed up the growing rate of there crops and plants.

Results Plus: Examiner Comments

A typical correct response referring to 'speed up rate of growth', so this was awarded 1 mark.

(d) Ammonium sulfate is used as a fertiliser.

State why farmers use fertilisers on their fields.

(1)

To keep away insects so damage isn't caused to crops.

Results Plus: Examiner Comments

A common misconception, namely to confuse insecticides and fertilisers, so this response did not score.

(e) (i)

Many candidates were unable to recall 'burette', and simply confused a pipette with a burette.

Of those candidates who gained credit for this item, invariably the word was spelled phonetically, this was in most cases sufficient to gain the 1 mark available.

(e) (ii)

Few candidates gained the mark for this question.

Where correct answers were seen, credit was invariably for 'indicator' alone, or 'methyl orange' or 'phenolphthalein' (or a phonetic spelling which was more or less correct).

The most common incorrect answers referred to 'Universal Indicator'. It needs to be stressed to centres that Universal Indicator solution is an inappropriate indicator for titrations.

(ii) State what is added to the sulfuric acid to show when it has been neutralised by the ammonia solution.

(1)

Methyl Orange.

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

A typical 1 mark response for a correctly named indicator, namely 'methyl orange'.

(ii) State what is added to the sulfuric acid to show when it has been neutralised by the ammonia solution.

(1)

universal indicator.

Results Plus: Examiner Comments

A very commonly seen incorrect response. 'Universal indicator' does not score.

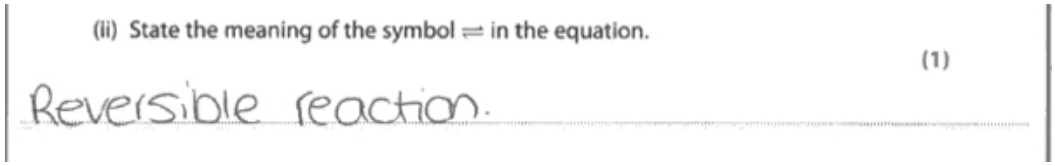
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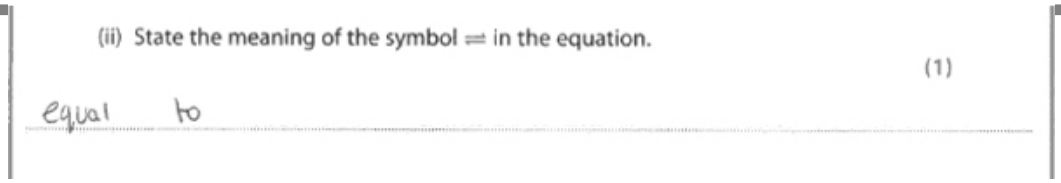
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Results Plus: Examiner Comments

This response was the most commonly seen correct answer for the 1 mark available.


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Write the word equation for this reaction.

(2)

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Results Plus: Examiner Comments

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Write the word equation for this reaction.

(2)

Ammonia + Sulfuric acid -> ammonium sulfate + water

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A typical 1 mark response for showing the correct reactants only. The right hand side is incorrect since 'water' has also been added.

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The most common incorrect answers referred to 'Universal Indicator'. It needs to be stressed to centres that Universal Indicator solution is an inappropriate indicator for titrations.

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(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

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(ii) State what is added to the sulfuric acid to show when it has been neutralised by the ammonia solution.

(1)

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Results Plus: Examiner Comments

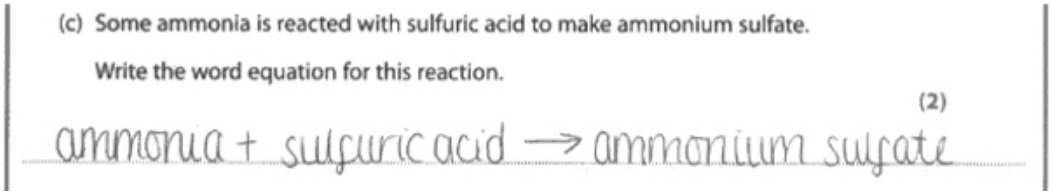
A very commonly seen incorrect response. 'Universal indicator' does not score.

Q6.

As expected, most candidates gained credit for showing both the correct reactants and products.

Occasionally, extra incorrect products, namely 'carbon dioxide' or 'water' were given, so only 1 mark was scored.

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(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

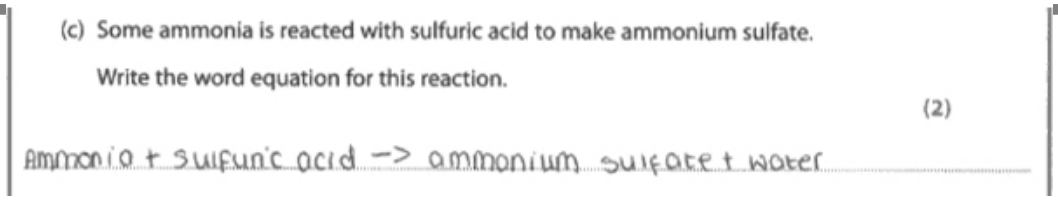
Write the word equation for this reaction.

(2)

ammonia + sulfuric acid → ammonium sulfate

Results Plus: Examiner Comments

Both the correct reactants and products have been given, so this response was awarded the 2 marks available.


(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

Ammonia + Sulfuric acid -> ammonium sulfate + water

Results Plus: Examiner Comments

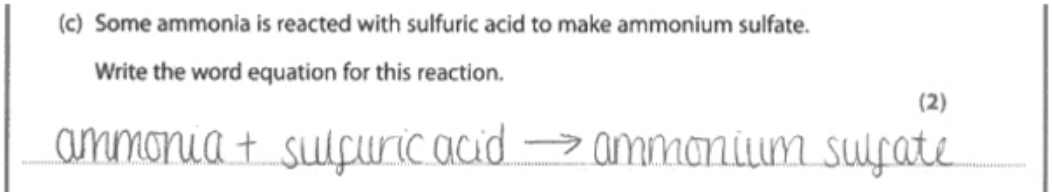
A typical 1 mark response for showing the correct reactants only. The right hand side is incorrect since 'water' has also been added.

Q7.

As expected, most candidates gained credit for showing both the correct reactants and products.

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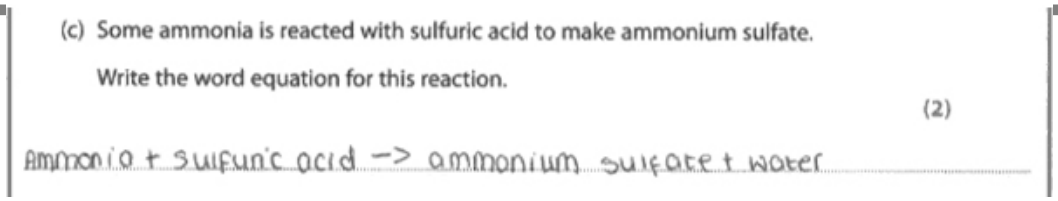
Write the word equation for this reaction.

(2)

ammonia + sulfuric acid → ammonium sulfate

Results Plus: Examiner Comments

Both the correct reactants and products have been given, so this response was awarded the 2 marks available.


(c) Some ammonia is reacted with sulfuric acid to make ammonium sulfate.

Write the word equation for this reaction.

(2)

Ammonia + Sulfuric acid -> ammonium sulfate + water

Results Plus: Examiner Comments

A typical 1 mark response for showing the correct reactants only. The right hand side is incorrect since 'water' has also been added.

Q8. No Examiner's Report available for this question

Q9.

(ii)

This question was very well answered on the whole with the majority of responses scoring at least 1 of the 2 marks available.

Most commonly correct responses referred to keeping the 'amount or volume of acid' the same and keeping the 'concentration of acid' the same. Often incorrect references to time were made which was ignored by the examiners.

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 how much metal we but in the reactivity.

2 and the time.

Results Plus: Examiner Comments

A typical example of response which did not score.

The amount of metal has been mentioned but, while true, this is repeating the stem of the question, so did not score. The time is ignored.

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 how much of hydrochloric acid is used

2 And the concentration of the hydrochloric acid.

Results Plus: Examiner Comments

A typical example of a fully correct answer.

Keeping the amount and concentration of the acid are the two variables that should be kept the same.

(iii)

This question was well answered on the whole with most responses scoring the 1 mark available.

The majority of correct responses referred to 'copper not reacting' to score the mark.

Often in those responses which did not score, answers incorrectly referred to copper being a 'transition metal' or 'not having enough electrons', showing little understanding of the reactivity series of metals.

(iv)

This question was very well answered on the whole with most responses scoring at least 1 of the 2 marks available.

Most candidates were able to recall the correct state symbols for the two products in the given word equation. Although, lower case symbols are expected, the use of upper case symbols was credited.

Q10.

(a) This proved to be a good discriminator. Some weaker candidates did not attempt the question. Of those that did, many used the formulae which had been given in the question but some then didn't balance the equation correctly. Other candidates were far too inclined to change the formulae from the ones stated in the question, often by incorrect use of subscripts in the product such as stating H_2Cl_2

(d) Hydrogen chloride, HCl, can be formed by the reaction of hydrogen, H_2, with chlorine, Cl_2.

Write the balanced equation for this reaction.

(2)

$H_2 + Cl_2 \rightarrow 4HCl$

Results Plus: Examiner Comments

This was awarded 1 mark for the correct formulae but did not gain the second mark as it was incorrectly balanced.

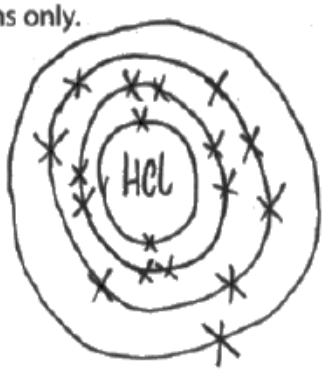
(b) Candidates generally scored 2 marks or no marks on this question indicating they either knew it well or not at all. Many did not attempt the question. Of those that did, many answers saw candidates trying to combine the two elements into one single, combined structure labelled HCl. Many still drew inner shells despite being told not to in the question but were still able to score both marks. Some thought the bonding was ionic and drew diagrams indicating electron transfer from hydrogen to chlorine. However it was pleasing to see some very well drawn fully correct answers.

(e) The electronic configuration of hydrogen is 1.
The electronic configuration of chlorine is 2.8.7.

Draw a dot and cross diagram to show the arrangement of electrons in a molecule of hydrogen chloride, HCl.

Show outer electrons only.

(2)



(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

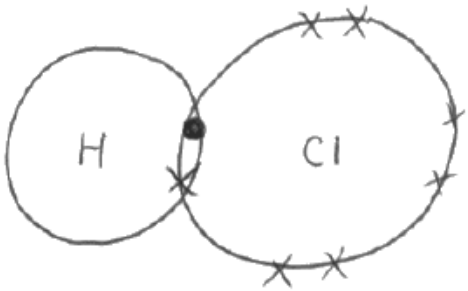
This type of answer was surprisingly common. The two atoms have been combined into one and labelled as one structure HCl.

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(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

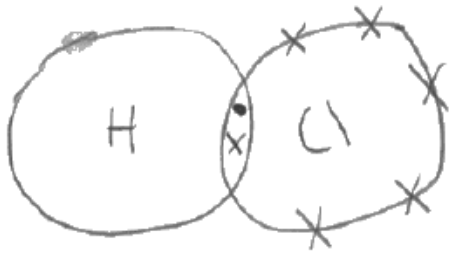
A well drawn fully correct answer.

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Draw a dot and cross diagram to show the arrangement of electrons in a molecule of hydrogen chloride, HCl.

Show outer electrons only.

(2)



(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This answer gained one mark for the shared pair of electrons but unfortunately has the incorrect number of electrons in the outer shell of chlorine.

Q11.

(a) This proved to be a good discriminator. Some weaker candidates did not attempt the question. Of those that did, many used the formulae which had been given in the question but some then didn't balance the equation correctly. Other candidates were far too inclined to change the formulae from the ones stated in the question, often by incorrect use of subscripts in the product such as stating H_2Cl_2

(d) Hydrogen chloride, HCl, can be formed by the reaction of hydrogen, H_2, with chlorine, Cl_2.

Write the balanced equation for this reaction.

(2)

$H_2 + Cl_2 \rightarrow 4HCl$

Results Plus: Examiner Comments

This was awarded 1 mark for the correct formulae but did not gain the second mark as it was incorrectly balanced.

(b) Candidates generally scored 2 marks or no marks on this question indicating they either

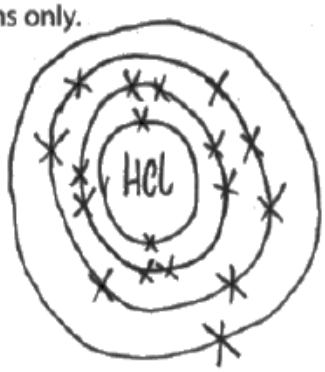
knew it well or not at all. Many did not attempt the question. Of those that did, many answers saw candidates trying to combine the two elements into one single, combined structure labelled HCl. Many still drew inner shells despite being told not to in the question but were still able to score both marks. Some thought the bonding was ionic and drew diagrams indicating electron transfer from hydrogen to chlorine. However it was pleasing to see some very well drawn fully correct answers.

(e) The electronic configuration of hydrogen is 1.
The electronic configuration of chlorine is 2.8.7.

Draw a dot and cross diagram to show the arrangement of electrons in a molecule of hydrogen chloride, HCl.

Show outer electrons only.

(2)



(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

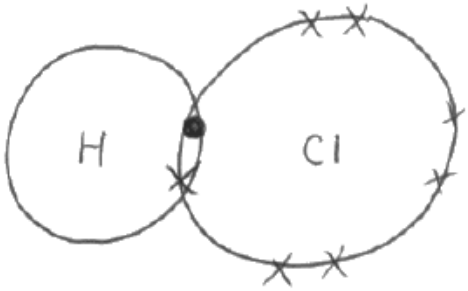
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Show outer electrons only.

(2)



(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

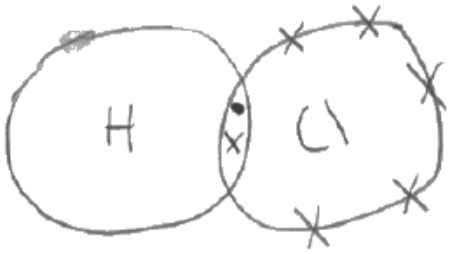
A well drawn fully correct answer.

(e) The electronic configuration of hydrogen is 1.
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Draw a dot and cross diagram to show the arrangement of electrons in a molecule of hydrogen chloride, HCl.

Show outer electrons only.

(2)



(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This answer gained one mark for the shared pair of electrons but unfortunately has the incorrect number of electrons in the outer shell of chlorine.

Q12. No Examiner's Report available for this question

Q13.

Many candidates scored the mark for correctly balancing the equation. However a large proportion showed a lack of understanding of a balanced equation as they added random numbers, letters or formulae in the spaces.

Balance the equation for the reaction.

(1)

$2 H_2 + O_2 \rightarrow 2 H_2O$

Results Plus: Examiner Comments

This correct answer obtained the mark.

Q14. No Examiner's Report available for this question

Q15. No Examiner's Report available for this question

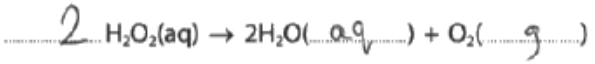
Q16.

It was pleasing to see that most were able to score 1 mark for balancing the equation.

Candidates found it much more difficult to add the state symbols to the equation with many losing this mark. The most common error was to use aq for water rather than l.

Some wrote the complete word for the state of the substance rather than using the symbol. A few seemed not to have encountered state symbols and added the names or symbols of other elements into the brackets.

Complete the balanced equation for the reaction and fill in the two missing state symbols.
(2)



Results Plus: Examiner Comments

This was a common error.

Complete the balanced equation for the reaction and fill in the two missing state symbols.
(2)



Results Plus: Examiner Comments

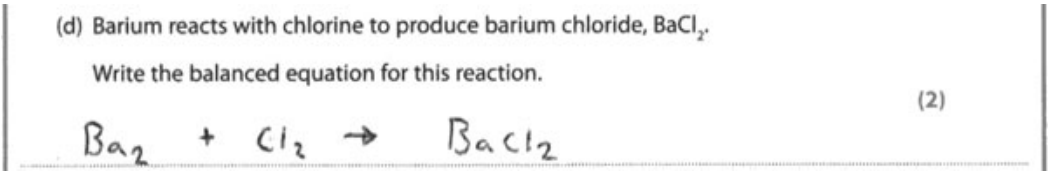
Where dotted lines are given, it is very likely that a repsonse will be required.

Q17.

Several candidates were able to interpret the information correctly and produce a correctly balanced equation. The commonest error was found to be that chlorine was not recognised as a diatomic molecule so giving 2Cl on left hand side; the resultant equation scored one mark. Balanced equations of this type will be tested on the F-tier paper where a simple ratio exists between the reactants and or products. The weaker candidates attempted a word equation, which did not score. Other errors included incorrect symbols such as 'BA', 'ba' and 'CL', but they were not present in significant numbers.

Other errors found included incorrect balancing which limited them to 1 mark. Other ways in which a mark could be scored and were seen included '$2Ba + 2Cl \rightarrow 2BaCl_2$ ',

'$Ba^{2+} + Cl^- \rightarrow BaCl_2$'. Some correctly gave $BaCl_2$ or $Ba + Cl_2$ but didn't draw an arrow to show where in the equation these appeared and so could not be credited.


(d) Barium reacts with chlorine to produce barium chloride, $BaCl_2$.

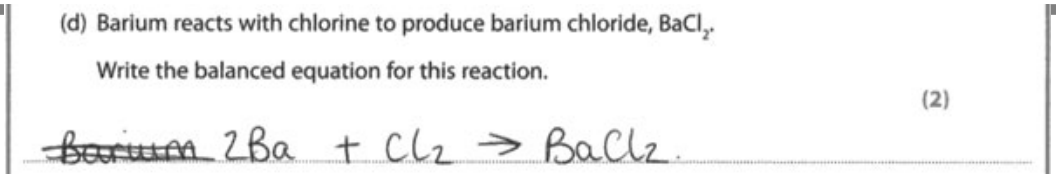
Write the balanced equation for this reaction.

(2)

$Ba_2 + Cl_2 \rightarrow BaCl_2$

Results Plus: Examiner Comments

The Ba_2 did not score, so 1 mark was given for the correct right hand side of the equation.


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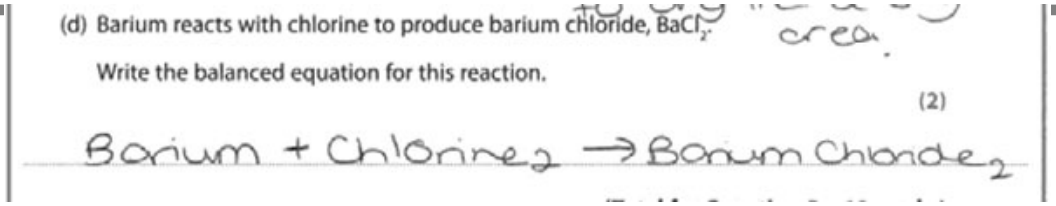
Write the balanced equation for this reaction.

(2)

~~Barium~~ $2Ba + Cl_2 \rightarrow BaCl_2$.

Results Plus: Examiner Comments

Correct formulae on both sides of the equation was spoilt by incorrect balancing of the equation. Only 1 mark was given.


(d) Barium reacts with chlorine to produce barium chloride, $BaCl_2$.

Write the balanced equation for this reaction.

(2)

Barium + Chlorine$_2$ → Barium Chloride$_2$

Results Plus: Examiner Comments

Word equations do not score when asked for balanced equations.

(d) Barium reacts with chlorine to produce barium chloride, $BaCl_2$.

Write the balanced equation for this reaction.

(2)

$Ba + 2Cl \rightarrow BaCl_2$

Results Plus: Examiner Comments

This was probably the most frequent of the errors seen. These candidates had not realised that the formula of chlorine gas is Cl_2. 1 mark was awarded.

Results Plus: Examiner Tip

Use the information given when constructing balanced equations. You will be expected to know the formulae of simple compounds you have met in the course, for example, sodium hydroxide, water etc., and you should also know the formulae of the gaseous elements such as hydrogen (H_2), oxygen (O_2) and that they all have 2 atoms in one molecule.

Spend time making sure you can balance simple equations.

Q18. No Examiner's Report available for this question

Q19. No Examiner's Report available for this question

Q20.

(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.

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The products are calcium carbonate and another salt.

Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

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

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

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$CaN_3 + NaC_3 \longrightarrow CaC_3 +$ Salt.

Results Plus: Examiner Comments

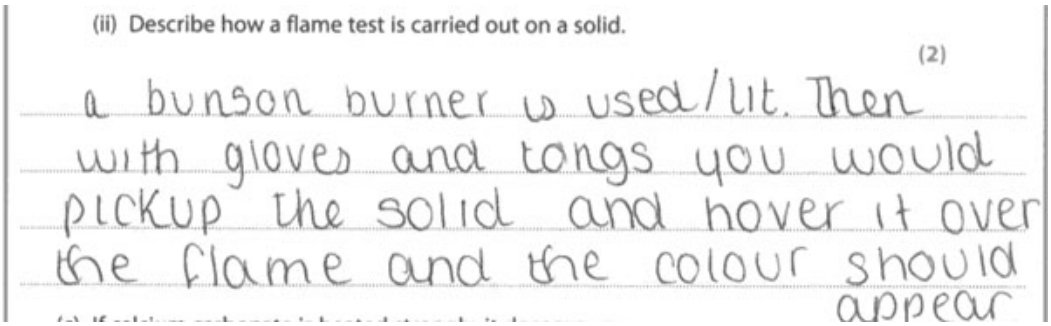
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When word equations are asked for, do not attempt to write a balanced equation using chemical formulae. Use the information in the question to help in the construction of the word equation.

(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.

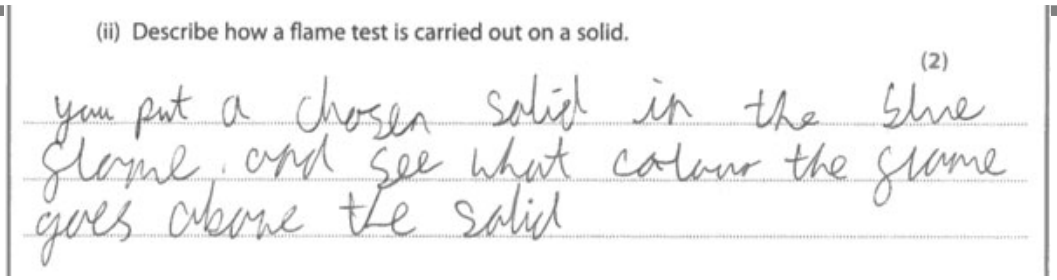

(ii) Describe how a flame test is carried out on a solid.

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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.

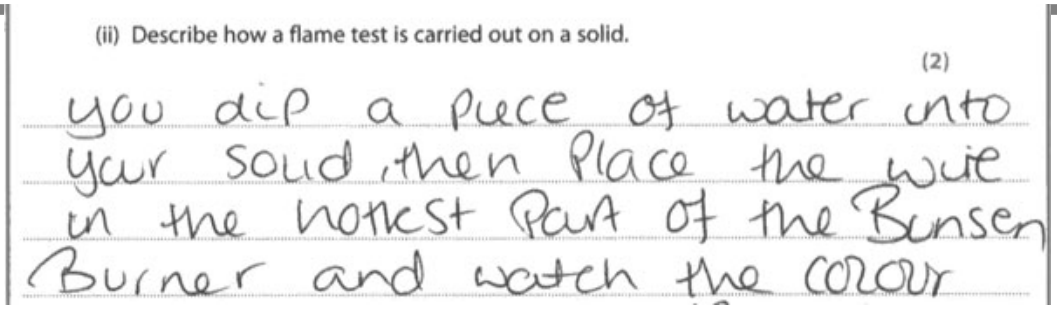

(ii) Describe how a flame test is carried out on a solid.

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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.


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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

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

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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.

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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.

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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'.

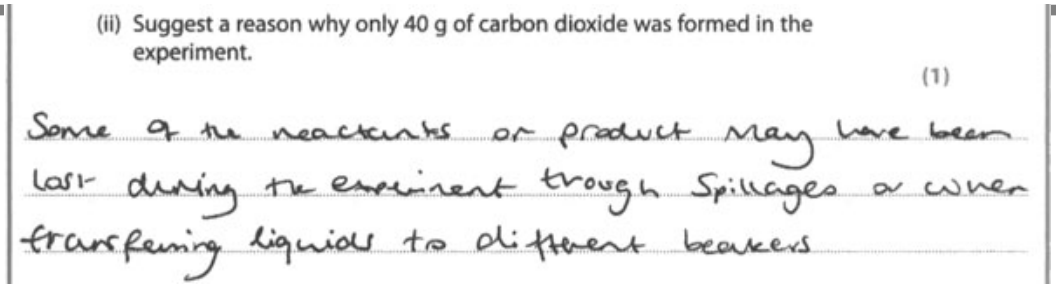
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(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.



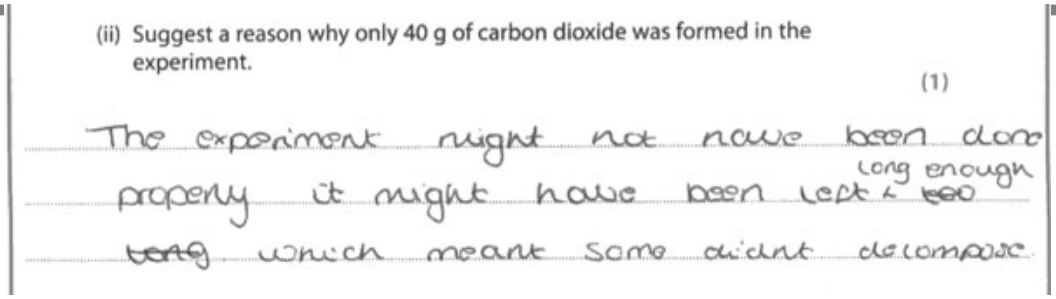
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The candidate had not thought through the process. A solid was being heated to form another solid with the loss of a gas, so loss of transferring liquids could not possibly happen in this situation. 0 marks given.



(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.

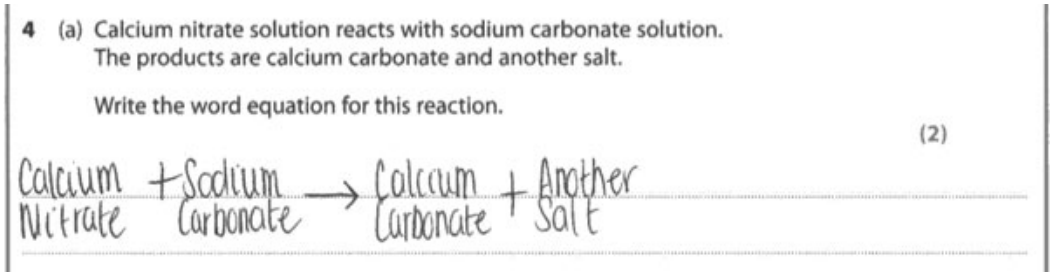
c) Other unwanted reactions - usually to make a different product.

Think about the reaction when applying these ideas.

Q21.

(a)

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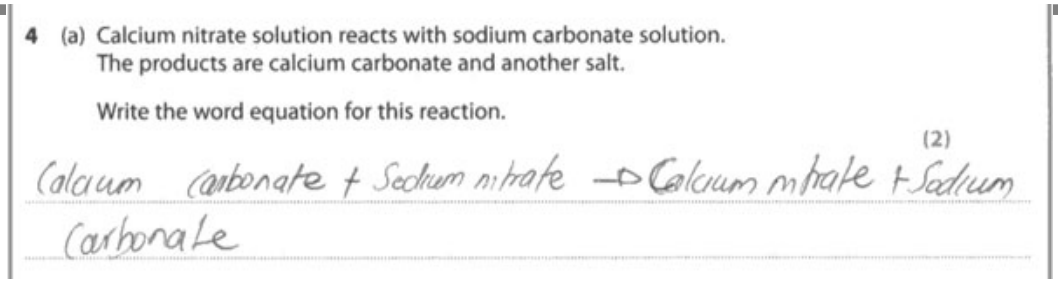
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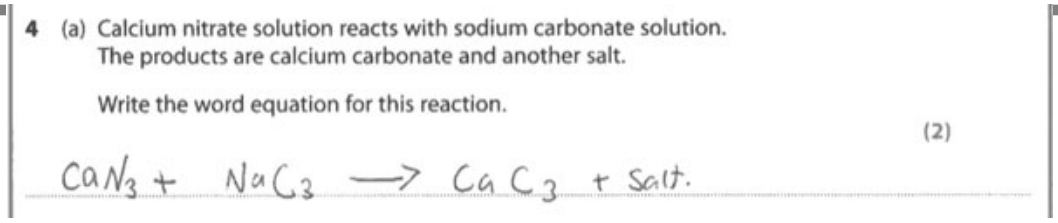
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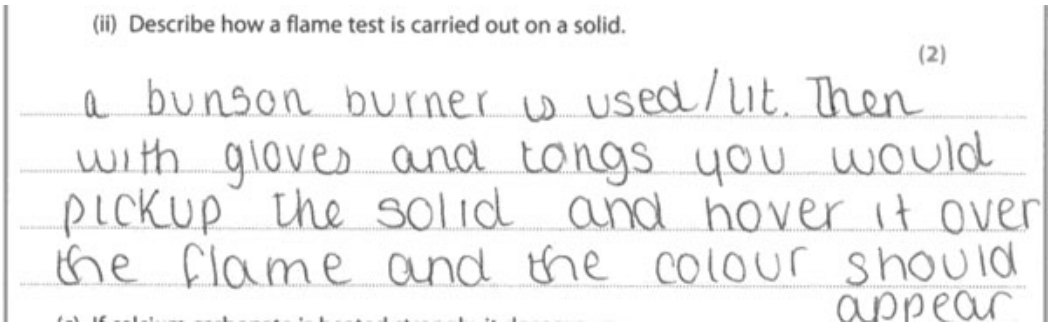
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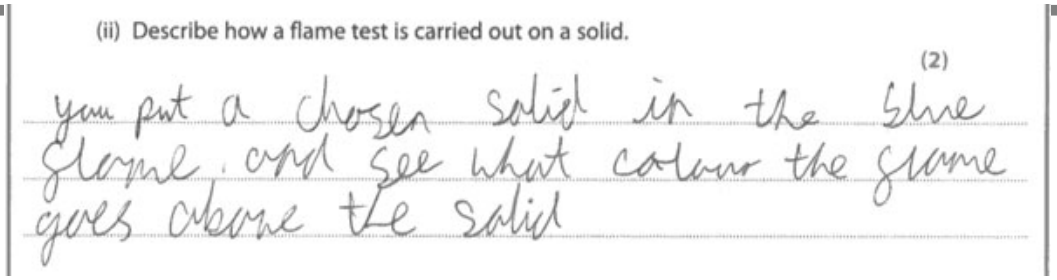

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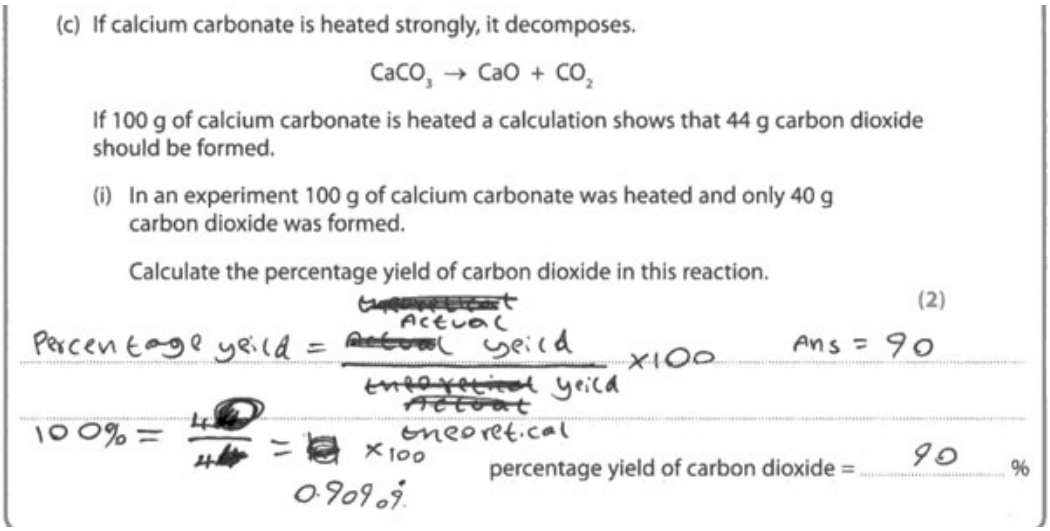
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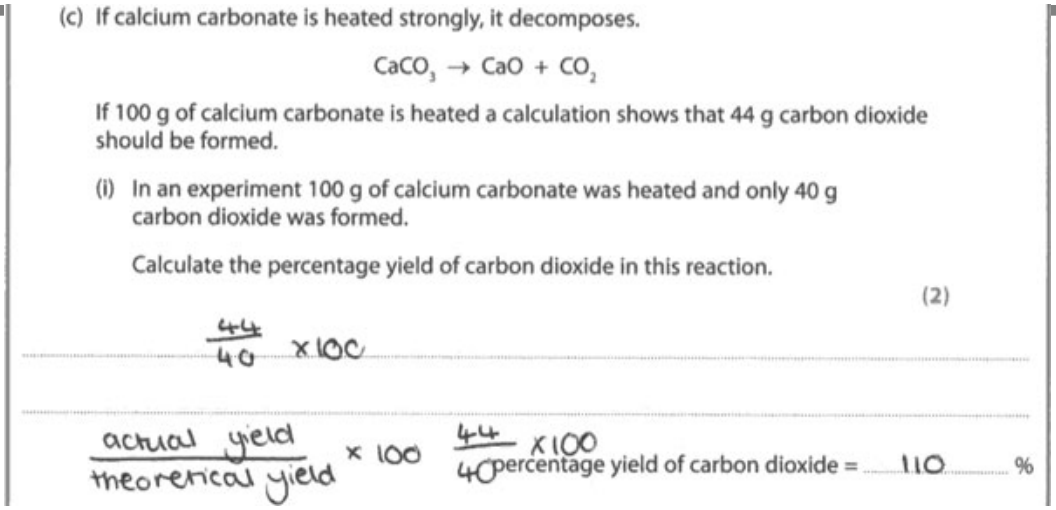
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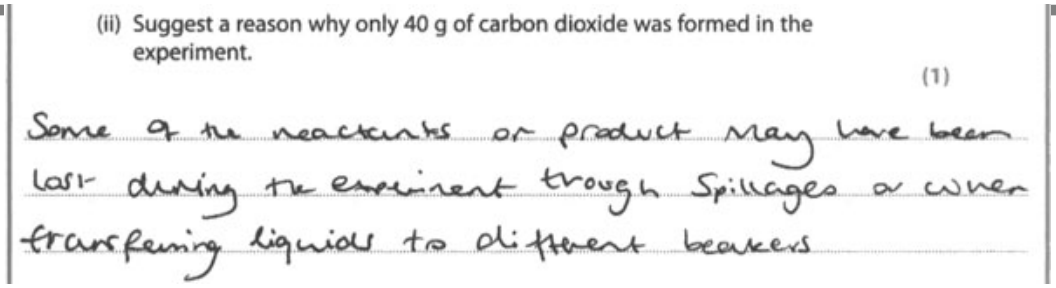
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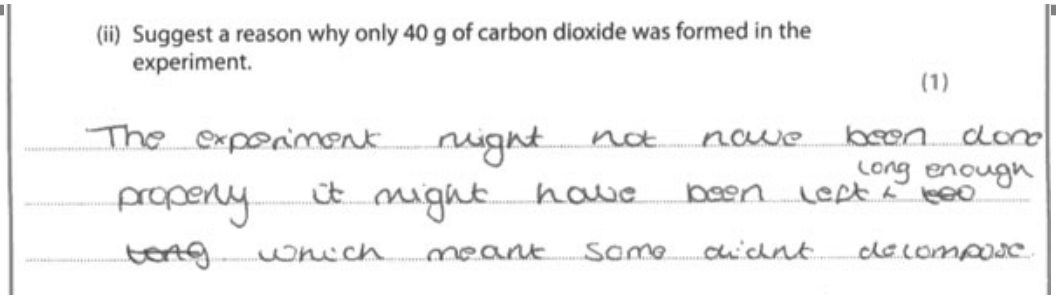
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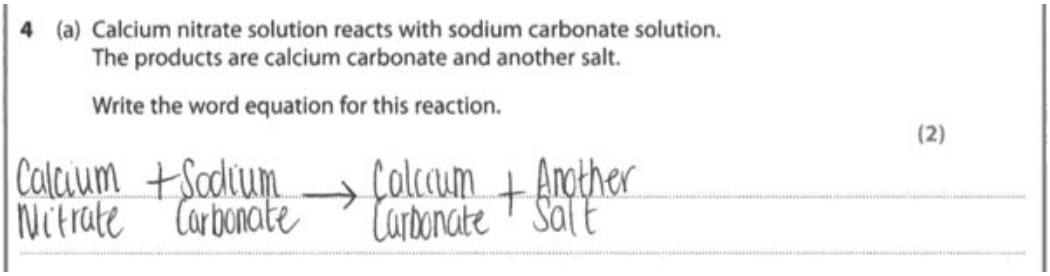
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Think about the reaction when applying these ideas.

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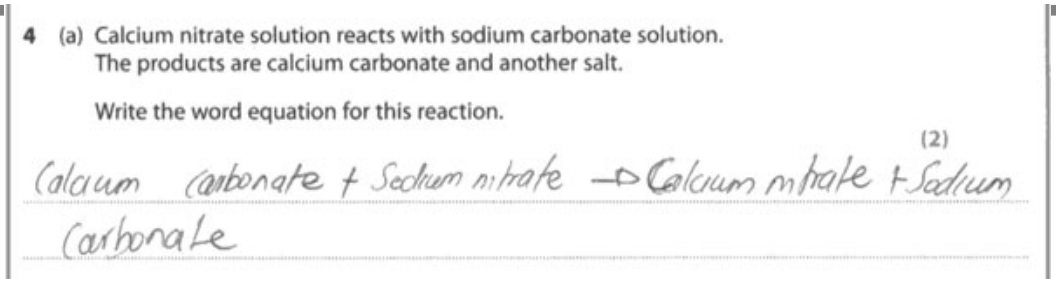
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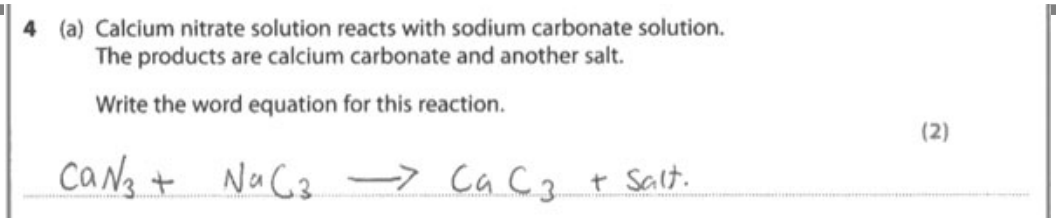
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(2)

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Results Plus: Examiner Comments

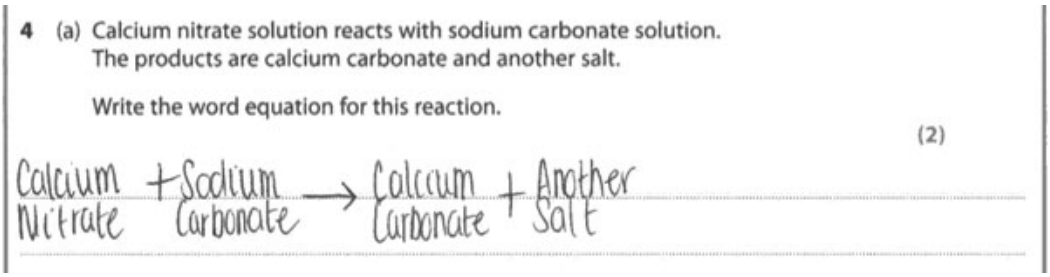
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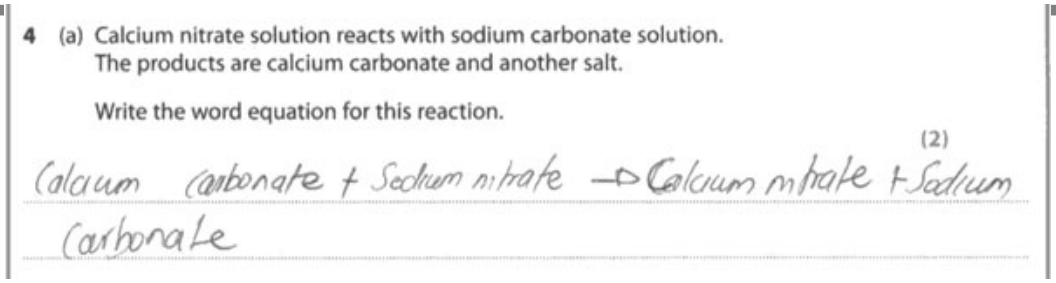
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Results Plus: Examiner Comments

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

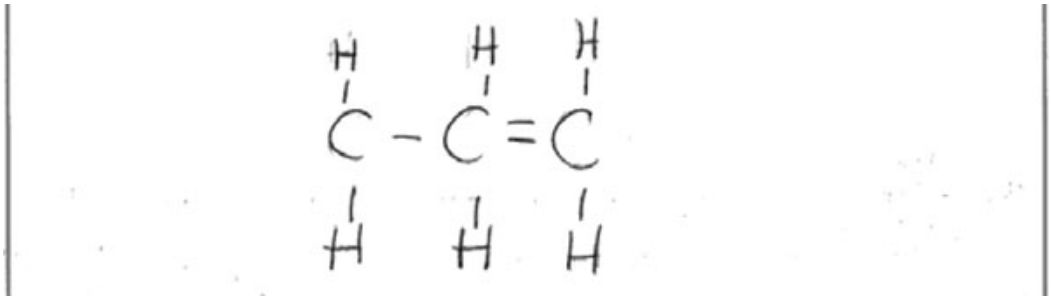
When word equations are asked for, do not attempt to write a balanced equation using chemical formulae. Use the information in the question to help in the construction of the word equation.

Q24. No Examiner's Report available for this question

Q25.

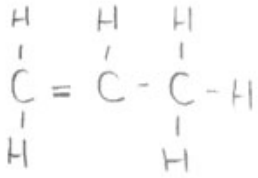
b

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.

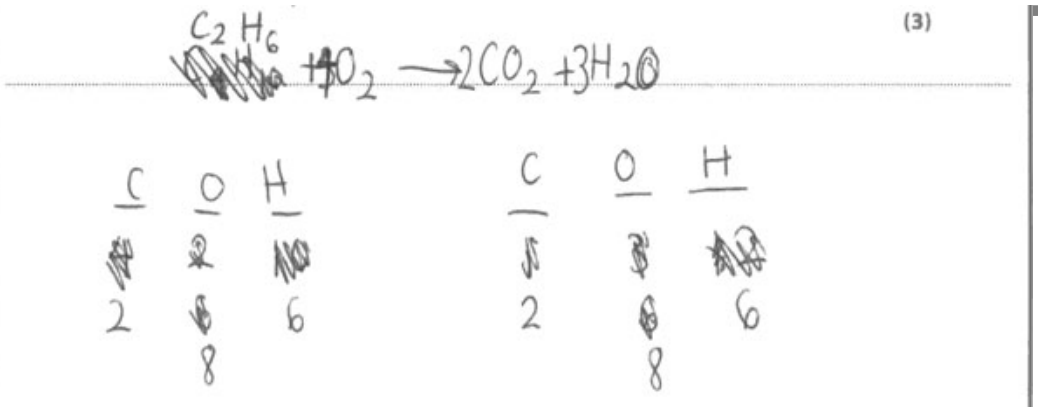
c

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

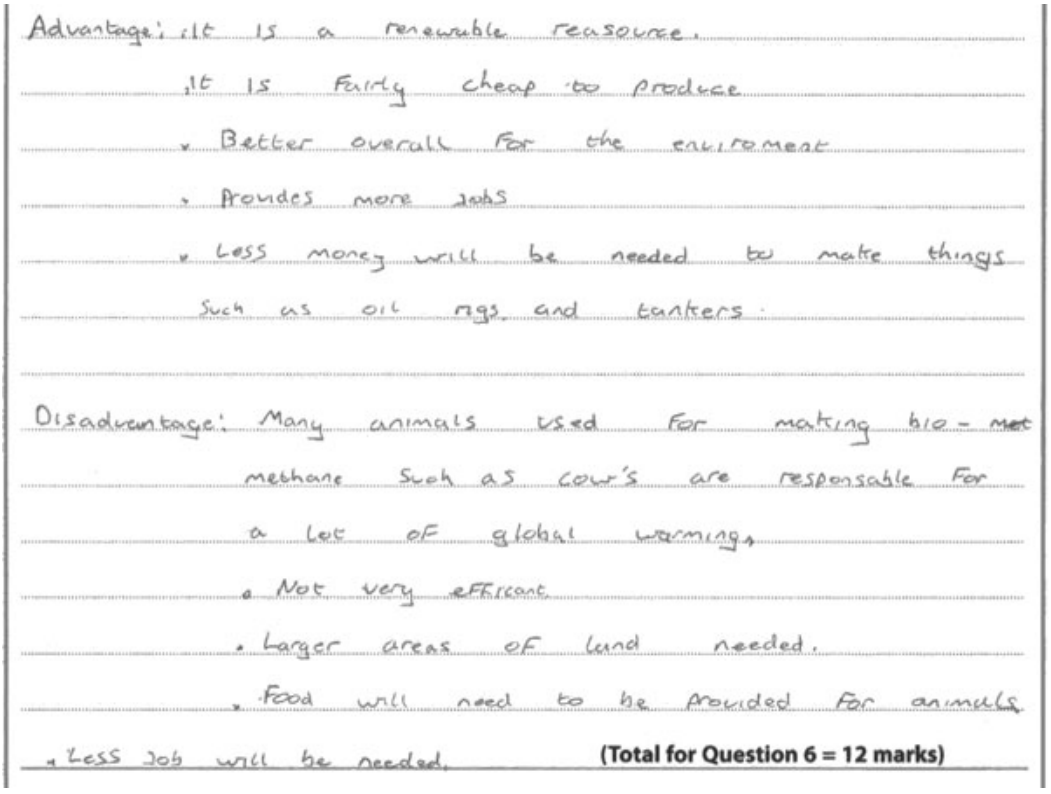
Just one mark here, for the formulae of the products.

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 reasource.
it is fairly cheap to produce
• Better overall for the enviroment
• 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 efficant
• 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 ~~CO2~~ 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 carbon dioxide in the making. 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 security.

(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.

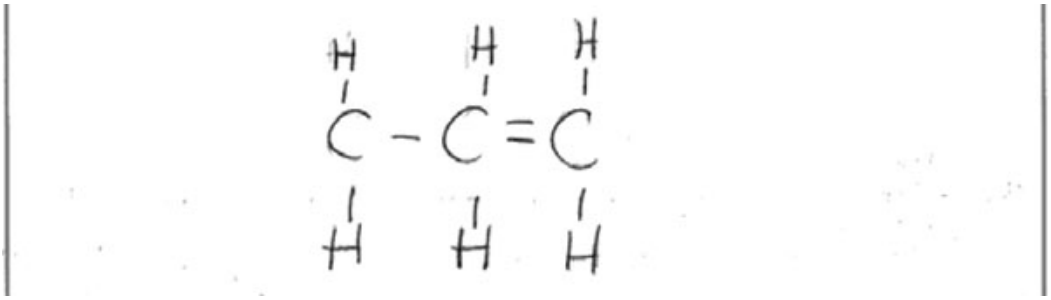
Results Plus: Examiner Comments

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

Q26.

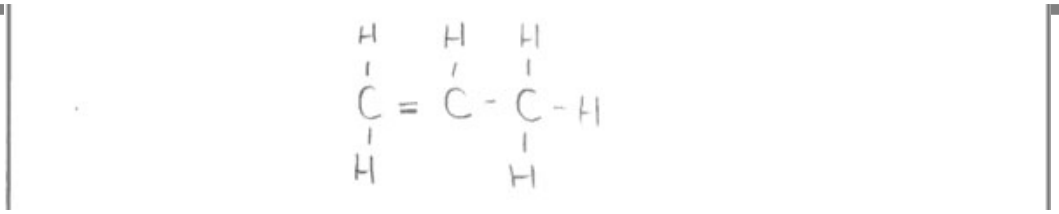
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Results Plus: Examiner Comments

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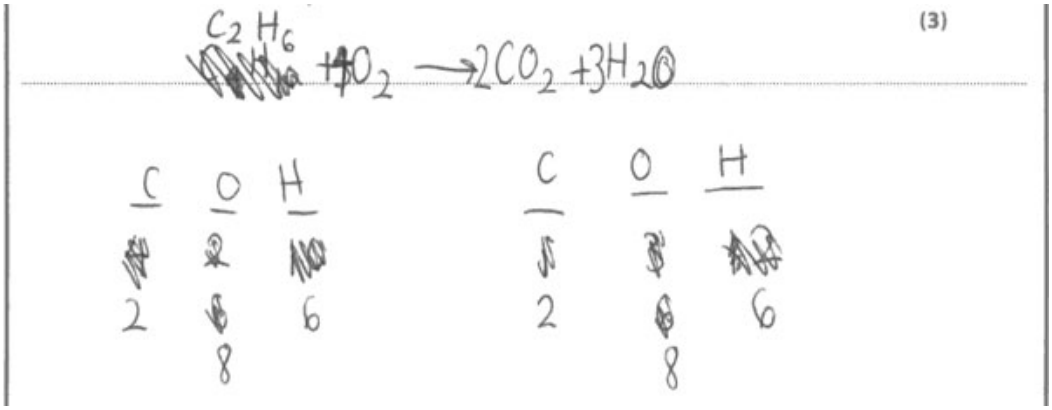
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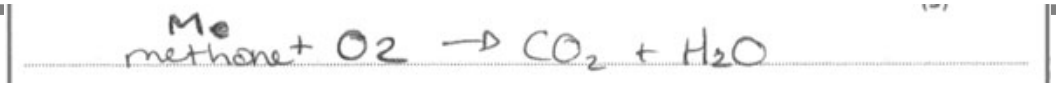
Results Plus: Examiner Comments

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

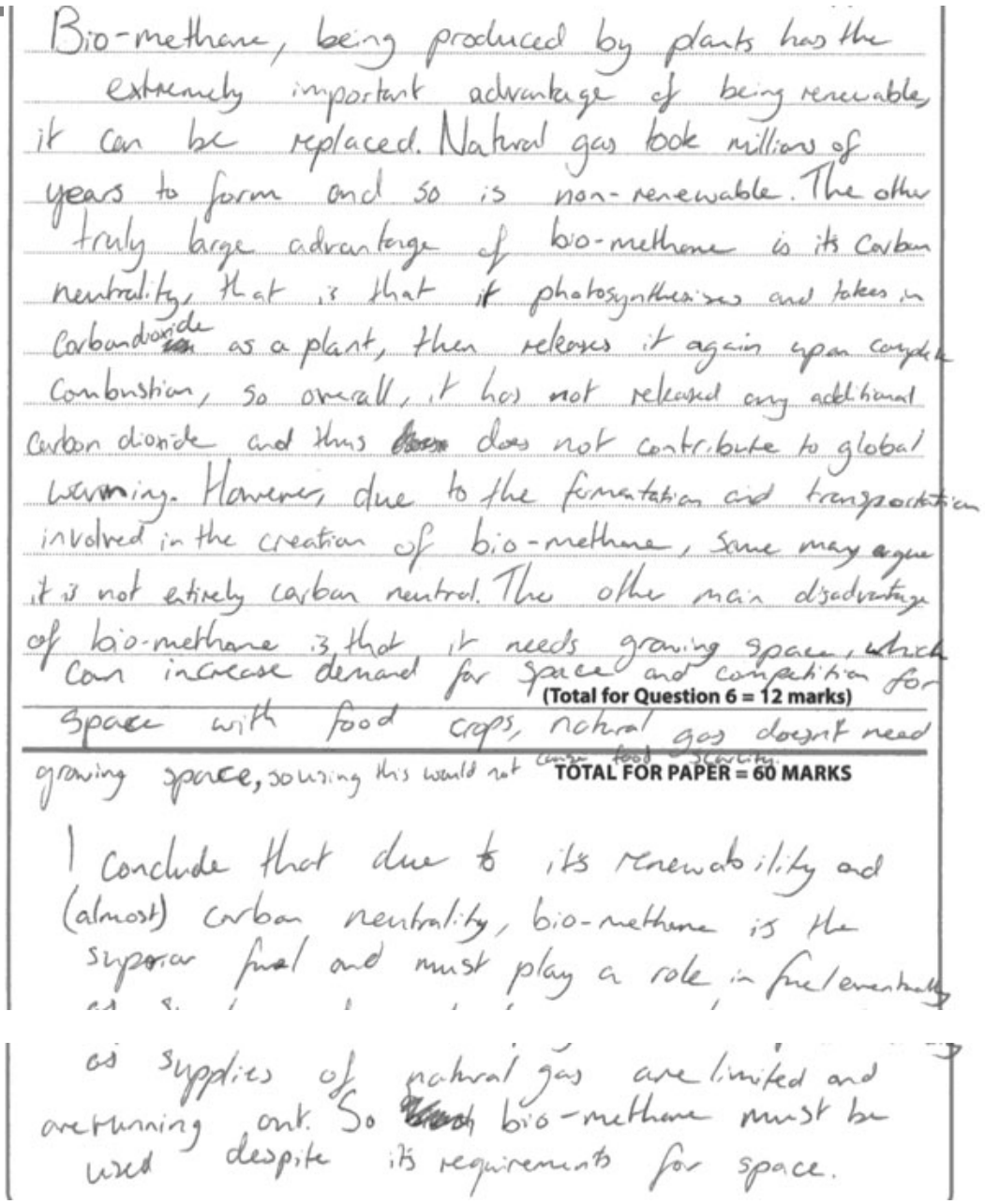
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A level 1 answer, whilst some ideas are creditworthy, such as the space for growing crops is taken up, much of the answer has incorrect or irrelevant ideas.



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.

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

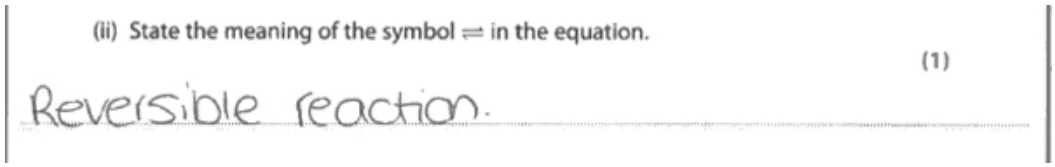
Q27.

(i)

Most candidates gained credit for their answers, scoring the 1 mark available for simply stating 'gas'.

(ii)

Most candidates gained credit for their answers.

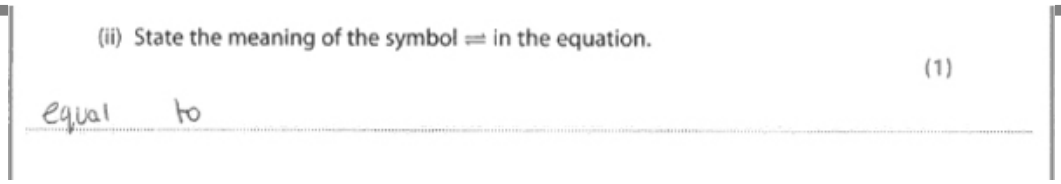

(ii) State the meaning of the symbol ⇌ in the equation.

(1)

Reversible reaction.

Results Plus: Examiner Comments

This response was the most commonly seen correct answer for the 1 mark available.


(ii) State the meaning of the symbol ⇌ in the equation.

(1)

equal to

Results Plus: Examiner Comments

A typical incorrect answer, where the reversible sign was confused with simply an equal sign, so does not score.

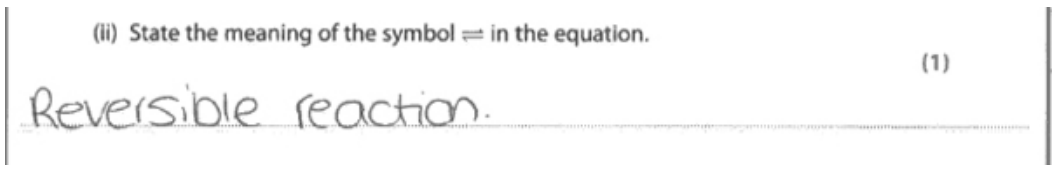
Q28.

(i)

Most candidates gained credit for their answers, scoring the 1 mark available for simply stating 'gas'.

(ii)

Most candidates gained credit for their answers.


(ii) State the meaning of the symbol ⇌ in the equation.

(1)

Reversible reaction.

Results Plus: Examiner Comments

This response was the most commonly seen correct answer for the 1 mark available.

(ii) State the meaning of the symbol ⇌ in the equation.

(1)

equal to

Results Plus: Examiner Comments

A typical incorrect answer, where the reversible sign was confused with simply an equal sign, so does not score.

Q29. No Examiner's Report available for this question

Q30. No Examiner's Report available for this question

Q31.

(i)

Candidates found balancing the equation difficult, although some gained 1 mark, a smaller number gaining the full two marks available. In some cases, candidates inserted the symbols of elements instead of using numbers to balance the equation.

When burnt completely in air, butene forms carbon dioxide and water.

(i) Balance the equation for this reaction by putting numbers in the spaces provided.

(2)

$C_4H_8 + 6O_2 \rightarrow$ 4 CO_2 + 4 H_2O

Results Plus: Examiner Comments

The correct answer that scored both marks.

(ii)

There were a large amount of blank responses on this question, of those that attempted the question a large proportion could not name lime water – alternatives given included limestone, lime juice, lemon juice or just water.

In general, those that could give limewater as the liquid got both marks by saying it went cloudy/milky.

(ii) Describe the test to show that a gas is carbon dioxide.

(2)

You get a test tube with the gas in then hold your thumb over the end of it so they can not escape then get a lint splint and put it over the opening and it will make a squeky POP if its present.

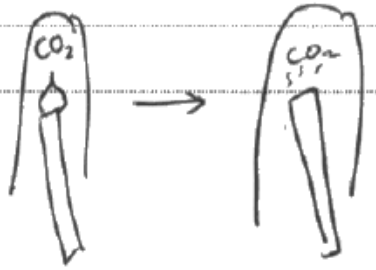
Results Plus: Examiner Comments

A large percentage of candidates gave the test for hydrogen rather than the test for carbon dioxide. Other tests included glowing splint relighting, using litmus paper, all of which gained no credit.

(ii) Describe the test to show that a gas is carbon dioxide.

(2)

lit splint into test tube with carbon Dioxide, splint should go out.



Results Plus: Examiner Comments

Many candidates stated that carbon dioxide would extinguish a lit splint.

Results Plus: Examiner Tip

It should be noted that extinguishing a lit splint is not an acceptable answer (whilst true this will also happen for a number of other gases and thus does not prove the prescence of carbon dioxide).

(ii) Describe the test to show that a gas is carbon dioxide.

(2)

To test for carbon dioxide with lime water and if the lime water begins to bubble this shows that carbon dioxide is present.

Results Plus: Examiner Comments

In some cases, the candidate knew the method but did not give the positive result of the test so gained just 1 mark.

(ii) Describe the test to show that a gas is carbon dioxide.

(2)

using lime water testing for it to go cloudy

Results Plus: Examiner Comments

A correct answer that gained both marks.

Q32.

(i)

Candidates appeared to understand what was meant by the term state symbol, however they did not use the information in the table to inform their answer but simply gave the states of the substances at room temperature.

Hydrogen burns in air at a temperature well above 100 °C to form water.

(i) The boiling points of hydrogen and water are shown in Figure 15.

	boiling point in °C
hydrogen	−253
water	100

Figure 15

Use this information to add the missing state symbols to the equation for the reaction taking place as the hydrogen burns.

(2)

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

Results Plus: Examiner Comments

A correct answer that scored both marks.

Hydrogen burns in air at a temperature well above 100 °C to form water.

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	boiling point in °C
hydrogen	−253
water	100

Figure 15

Use this information to add the missing state symbols to the equation for the reaction taking place as the hydrogen burns.

(2)

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

Results Plus: Examiner Comments

For hydrogen this was sufficient and 'g' gained a mark. However for the water those that gave 'l' did not score the mark because in this reaction water would be formed as a gas.

Results Plus: Examiner Tip

Candidates should be taught to use the information in the stem to inform their answer.

Hydrogen burns in air at a temperature well above 100 °C to form water.

(i) The boiling points of hydrogen and water are shown in Figure 15.

	boiling point in °C
hydrogen	−253
water	100

Figure 15

Use this information to add the missing state symbols to the equation for the reaction taking place as the hydrogen burns.

(2)

$2H_2(\text{2}) + O_2(g) \rightarrow 2H_2O(\text{2})$

Results Plus: Examiner Comments

In some cases, it was clear that candidates were not familar with state symbols are tried adding numbers to balance the equation rather than adding state symbols.

(ii)

Candidates found it quite difficult to put into words why the atom economy of the reaction is 100%, many simply stated that the equation is balanced or the same on both sides, whilst this is true, it is not what shows that the atom economy is 100%. Few refered to the useful product.

Where candidates scored the mark, it was usually for saying that there were no waste products.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

Everything is used up nothing is left

Results Plus: Examiner Comments

Everything is used up did not gain credit.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

It is balanced.

Results Plus: Examiner Comments

A common answer that did not score was that the equation was balanced.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

there are no excess products of the reaction, all of the reactants made 1 product.

Results Plus: Examiner Comments

This answer gained 1 mark.

Q33.

(i)

Less than a quarter of the candidates scored both marks here. The first state symbol was given correctly by the overwhelming majority, but only about a fifth of the candidates had understood the implication of the first line of the question and had not realised the water formed would be in the gas state. Some candidates showed no knowledge of state symbols.

(ii)

Many candidates assumed that a balanced equation results in 100% atom economy, but just over a half had the idea of one product being formed so no waste.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

The equation is balanced perfectly

Results Plus: Examiner Comments

Examiners reported seeing this misconception frequently and by this and similar answers. This did not score the mark.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

Because atom economy = $\frac{\text{desired product mr}}{\text{all products mr}} \times 100 = \frac{36}{36} \times 100 = 100\%$

Results Plus: Examiner Comments

The mathematical expression alone did not score, but with the correct data included as here, scored the mark.

(ii) The atom economy for the reaction in (i) is 100%.

State how the equation shows that the atom economy is 100%.

(1)

The reactants equal the entire wanted product.

Results Plus: Examiner Comments

This was an unusual way of expressing that the reactants went to form just one product. This scored the mark.

Q34.

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.

Q35.

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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

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Q36. No Examiner's Report available for this question

Q37.

(i) This question had a wide range of scores from 0 – 3, even across the small number of entries and indicates that most candidates can come up with some formulae and state symbols. The most common reason for candidates receiving 2 marks instead of 3 was due to many candidates still not having the correct formula for chlorine as Cl_2. There were also a number of responses

giving the state symbol for water as (aq).

Q38. No Examiner's Report available for this question

Q39. No Examiner's Report available for this question

Q40. No Examiner's Report available for this question

Q41. No Examiner's Report available for this question

Q42.

This question started, in question (i) with a balanced equation for candidates to complete. Many were able to score with a good proportion gaining both marks available, where candidates lost a mark, it was often as they could not recall the formula for sulfuric acid. In part (ii) the vast majority of candidates were able to calculate the relative formula mass of copper carbonate to score both marks available.

Q43. No Examiner's Report available for this question

Q44.

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.

Q45. No Examiner's Report available for this question

Q46. No Examiner's Report available for this question

Q47.

Most gave a correct answer for the formula of the product as NO_2 with many scoring the second mark to balance the equation. Writing balanced equations is a skill that candidates should practice along with knowing the formulae of the common substances listed in the specification as well as using names clues to write the formula.

Q48. No Examiner's Report available for this question

Q49.

The vast majority of candidates balanced the equation, although not all got the correct state symbols – even though the question stated that potassium fluoride was a solid.

Q50. No Examiner's Report available for this question

Q51.

It appeared that many candidates had not been taught state symbols. Very few were able to write the state symbols for each product in the reaction given. Some candidates scored 1 mark for correctly writing the state symbol for the sodium sulfate. The majority apparently guessed and either wrote formula, numbers or wrote solid and liquid in the spaces.

$$CuSO_4(aq) + 2NaOH(aq) \rightarrow Cu(OH)_2(\quad) + Na_2SO_4(\quad)$$

In the spaces, write the state symbol of each product.

Results Plus: Examiner Comments

A common mistake was to write the aqueous state symbol for the copper hydroxide precipitate as well as the sodium sulfate solution. This candidate scored 1 mark for giving the correct state symbol for the sodium sulfate solution.

Q52.

It was obvious that candidates struggled to produce ionic and half equations and many responses here were either left blank or filled with words or state symbols. Very few candidates scored both marking points although some responses were awarded a mark for including electrons on the left-hand side of the equation.

Q53.

Well answered overall with only a few blank responses. There were a few responses showing the formula of aluminium phosphate with the ion charges.

Q54.

The '2' was straightforward but the charge on the magnesium ion was much less well done, candidates apparently not knowing that charges must be balanced on both sides of an equation.

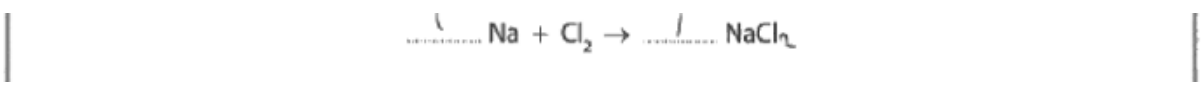
Q55. No Examiner's Report available for this question

Q56. No Examiner's Report available for this question

Q57.

(a)(i)

The majority of candidates were able to balance the equation. A common error was to put 2 in front of Na and 4 in front of NaCl. It was surprising to see some candidates using negative numbers in the equation. A few candidates put formulae or state symbols on the dotted lines instead of balancing numbers. Some candidates changed the formulae to balance the equation.



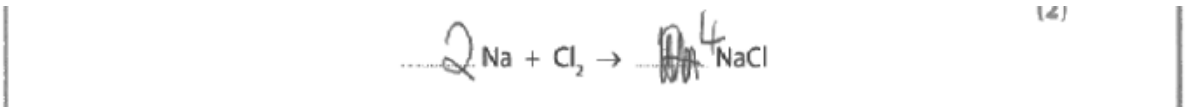
Results Plus: Examiner Comments

This candidate has changed the formula of sodium chloride to $NaCl_2$. If you are given an equation to balance, the formulae will always be correct and you need to balance the equation by putting

numbers in front of the formulae in the spaces provided. This answer did not score any marks.

Results Plus: Examiner Tip

Do not change any formulae you are given in a question to balance an equation.

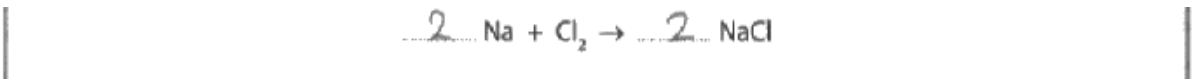


Results Plus: Examiner Comments

This candidate has the first balancing number correct, so scores 1 mark.

Results Plus: Examiner Tip

Count up the number of atoms on the left side of the equation first. There are 2 sodium atoms and 2 chlorine atoms. The number of atoms on the right of the equation must be the same as on the left. The equation is balanced by writing a 2 in front of NaCl.



Results Plus: Examiner Comments

This is an example of a correct answer that scored 2 marks.

(a)(ii)

Many candidates were able to calculate the percentage yield. Some candidates divided 4.0 by 2.5 then multiplied by 100 to get a yield of 160%. They should realise that the yield cannot be higher than 100%. Candidates should show their working for calculations so that they have the opportunity to gain a consequential error mark if they have the final answer wrong.

(ii) In an experiment to make sodium chloride, the yield is 2.5 g.
The theoretical yield of sodium chloride for this experiment is 4.0 g.

Calculate the percentage yield of sodium chloride in this experiment.

$\frac{TY}{AY} \times 100 =$

(2)

$\frac{4.0}{2.5} \times 100 = 160$

percentage yield = 160 %

Results Plus: Examiner Comments

This answer is incorrect, but it scored 1 mark for some correct working. The first step is wrong as the candidate should have divided 2.5 by 4.0. The candidate has then shown their fraction multiplied by 100 to obtain the percentage and they score a consequential mark.

Results Plus: Examiner Tip

Always show your working for calculations.

$\frac{1}{} Na + Cl_2 \rightarrow \frac{1}{} NaCl$

Results Plus: Examiner Comments

This is an incorrect answer and it scored no marks. If some working had been shown, it might have scored 1 mark for correct working, even if the final answer is wrong.

Results Plus: Examiner Tip

Show your working for all calculations.

2.5 ÷ 4 = 5/8 × 100 = 62.5

percentage yield = 62.5 %

Results Plus: Examiner Comments

This is a very good answer, showing the correct working and answer. This scored 2 marks.

(a)(iv)

The majority of candidates could work out the relative formula mass for sodium chloride. Some candidates multiplied the relative atomic masses and a few subtracted or divided them.

(iv) Calculate the relative formula mass of sodium chloride, NaCl.
(relative atomic masses: Na = 23, Cl = 35.5)
46 + 35.5 = 81.5
23+ 23 + 35.5 = 81.5 (1)

relative formula mass = 81.5

Results Plus: Examiner Comments

This candidate has assumed the formula for sodium chloride is Na_2Cl as they have added the relative atomic mass of two sodium atoms to one chlorine atom. This did not score the mark.

Results Plus: Examiner Tip

Use the formula given in the question. NaCl contains one sodium and one chlorine atom.

23+35.5 = 58.5

relative formula mass = 58.5

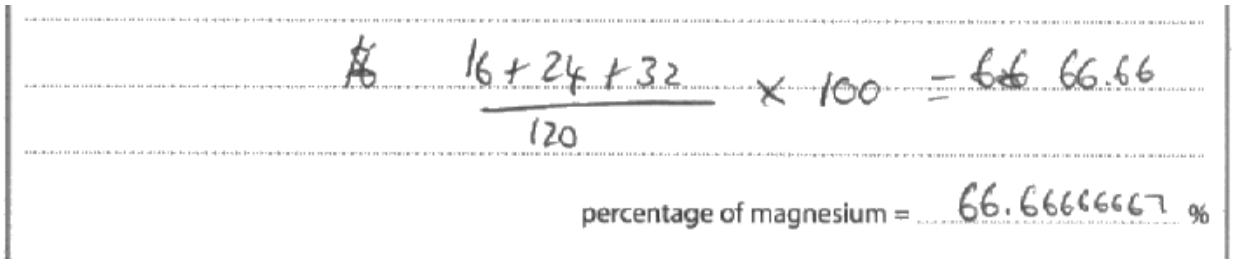
Results Plus: Examiner Comments

This is an example of a correct answer, with the working shown. This scores 1 mark.

(b)

Many candidates were able to calculate the percentage of magnesium in magnesium sulfate.

Some candidates tried to calculate the relative formula mass for magnesium sulfate and got a different answer to the value given in the question.

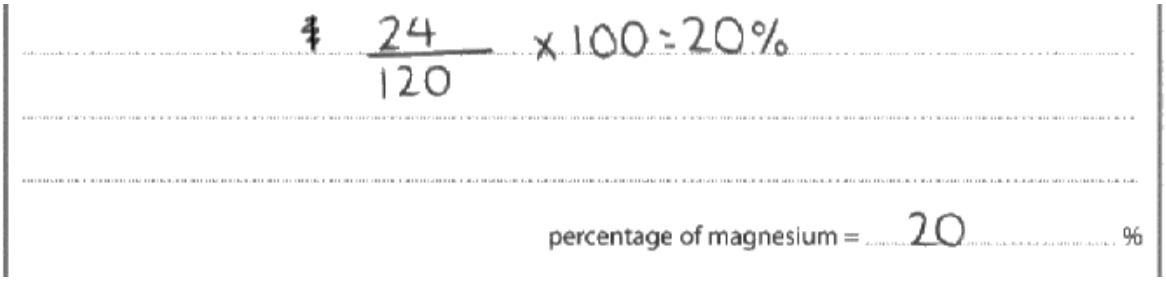


Results Plus: Examiner Comments

This candidate has got the first step of the calculation wrong as they should have just divided the mass of magnesium (24) by 120. However, they have then multiplied their fraction by 100, so they score 1 mark.

Results Plus: Examiner Tip

Show your working in calculations.



Results Plus: Examiner Comments

This candidate has given correct working and has the correct answer so was awarded 2 marks.

(c)(i)

Very few candidates understood the term 'empirical formula', so they were unable to score a

mark for this question. A common incorrect answer was CH_8.



Results Plus: Examiner Comments

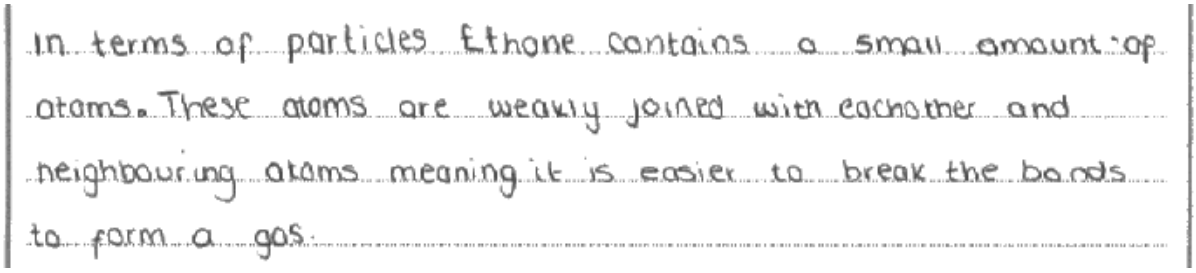
This candidate has correctly worked out that the simplest ratio of carbon to hydrogen is 1:3, but they did not score a mark as the question asked for the empirical formula.

The empirical formula shows the simplest whole number ratio of atoms in the formula. The correct empirical formula for ethane is CH_3.

(c)(ii)

This question was designed to be answered correctly by the candidates working at the top end of the grade range for this paper and it achieved that aim. The concept of weak intermolecular forces between molecules was only given by the more able candidates. Many candidates wrote about the weak bonds between the atoms but a large number did not refer to bonds at all and wrote about few particles that are far apart in a gas.

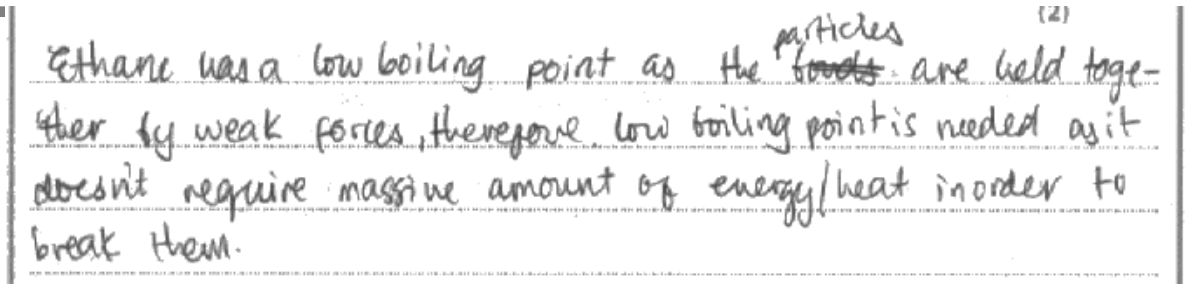
Examiners were surprised to see some candidates writing about hydrogen bonds. There are no hydrogen bonds between ethane molecules and we would not expect candidates to know about specific intermolecular forces at GCSE.


In terms of particles Ethane contains a small amount of atoms. These atoms are weakly joined with eachother and neighbouring atoms meaning it is easier to break the bonds to form a gas.

Results Plus: Examiner Comments

This answer did not score a mark as it referred to the bonds between atoms being weak.

The bonds between atoms are strong but the forces between molecules are weak.


Ethane has a low boiling point as the ~~bonds~~ particles are held together by weak forces, therefore low boiling point is needed as it doesn't require massive amount of energy/heat in order to break them. (2)

Results Plus: Examiner Comments

This is an excellent answer that scored 2 marks.

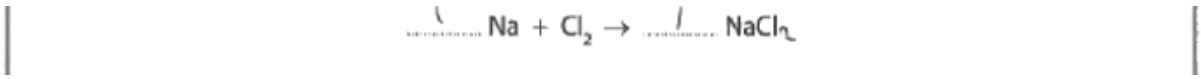
Results Plus: Examiner Tip

Try to remember that the covalent bonds that hold the atoms together in molecules are strong. There are just weak forces between the molecules.

Q58.

(a)(i)

The majority of candidates were able to balance the equation. A common error was to put 2 in front of Na and 4 in front of NaCl. It was surprising to see some candidates using negative numbers in the equation. A few candidates put formulae or state symbols on the dotted lines instead of balancing numbers. Some candidates changed the formulae to balance the equation.

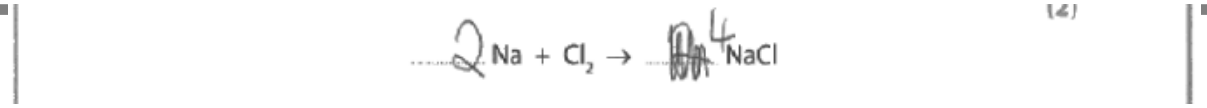


Results Plus: Examiner Comments

This candidate has changed the formula of sodium chloride to $NaCl_2$. If you are given an equation to balance, the formulae will always be correct and you need to balance the equation by putting numbers in front of the formulae in the spaces provided. This answer did not score any marks.

Results Plus: Examiner Tip

Do not change any formulae you are given in a question to balance an equation.



Results Plus: Examiner Comments

This candidate has the first balancing number correct, so scores 1 mark.

Results Plus: Examiner Tip

Count up the number of atoms on the left side of the equation first. There are 2 sodium atoms and 2 chlorine atoms. The number of atoms on the right of the equation must be the same as on the left. The equation is balanced by writing a 2 in front of NaCl.

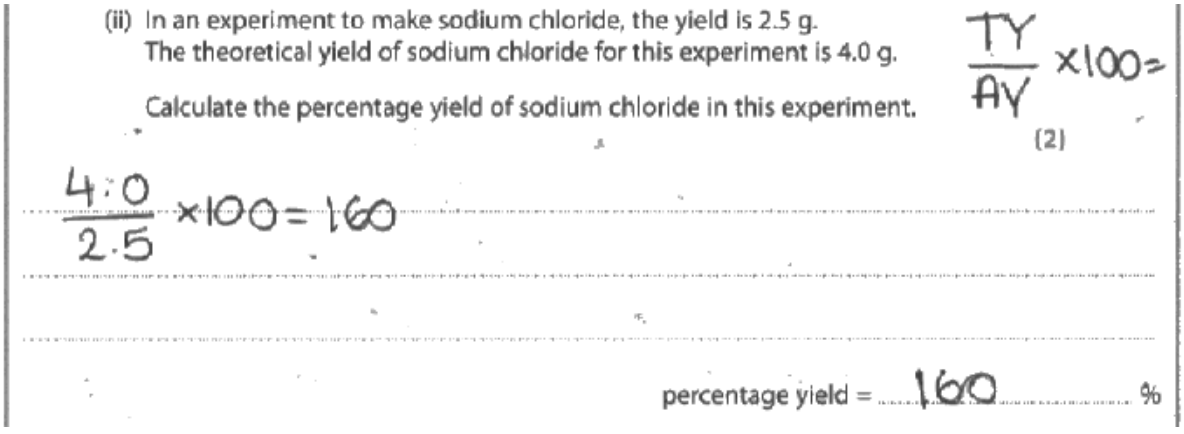
2 Na + Cl_2 → 2 NaCl

Results Plus: Examiner Comments

This is an example of a correct answer that scored 2 marks.

(a)(ii)

Many candidates were able to calculate the percentage yield. Some candidates divided 4.0 by 2.5 then multiplied by 100 to get a yield of 160%. They should realise that the yield cannot be higher than 100%. Candidates should show their working for calculations so that they have the opportunity to gain a consequential error mark if they have the final answer wrong.


(ii) In an experiment to make sodium chloride, the yield is 2.5 g.
The theoretical yield of sodium chloride for this experiment is 4.0 g.

Calculate the percentage yield of sodium chloride in this experiment.

(2)

TY / AY ×100=

4·0 / 2·5 ×100=160

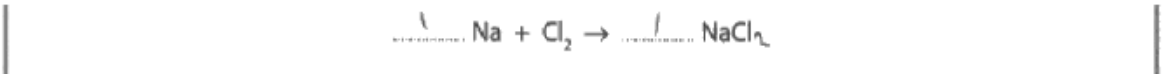
percentage yield = 160 %

Results Plus: Examiner Comments

This answer is incorrect, but it scored 1 mark for some correct working. The first step is wrong as the candidate should have divided 2.5 by 4.0. The candidate has then shown their fraction multiplied by 100 to obtain the percentage and they score a consequential mark.

Results Plus: Examiner Tip

Always show your working for calculations.

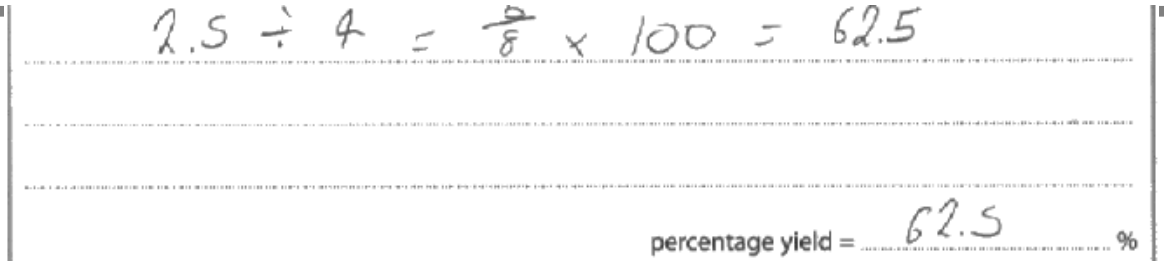


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This is an incorrect answer and it scored no marks. If some working had been shown, it might have scored 1 mark for correct working, even if the final answer is wrong.

Results Plus: Examiner Tip

Show your working for all calculations.



Results Plus: Examiner Comments

This is a very good answer, showing the correct working and answer. This scored 2 marks.

(a)(iv)

The majority of candidates could work out the relative formula mass for sodium chloride. Some candidates multiplied the relative atomic masses and a few subtracted or divided them.

(iv) Calculate the relative formula mass of sodium chloride, NaCl.
(relative atomic masses: Na = 23, Cl = 35.5)

46 + 35.5 = 81.5

23 + 23 + 35.5 = 81.5 (1)

relative formula mass = 81.5

Results Plus: Examiner Comments

This candidate has assumed the formula for sodium chloride is Na_2Cl as they have added the relative atomic mass of two sodium atoms to one chlorine atom. This did not score the mark.

Results Plus: Examiner Tip

Use the formula given in the question. NaCl contains one sodium and one chlorine atom.

23 + 35.5 = 58.5

relative formula mass = 58.5

Results Plus: Examiner Comments

This is an example of a correct answer, with the working shown. This scores 1 mark.

(b)

Many candidates were able to calculate the percentage of magnesium in magnesium sulfate.

Some candidates tried to calculate the relative formula mass for magnesium sulfate and got a different answer to the value given in the question.

$\frac{16 + 24 + 32}{120} \times 100 = 66.66$

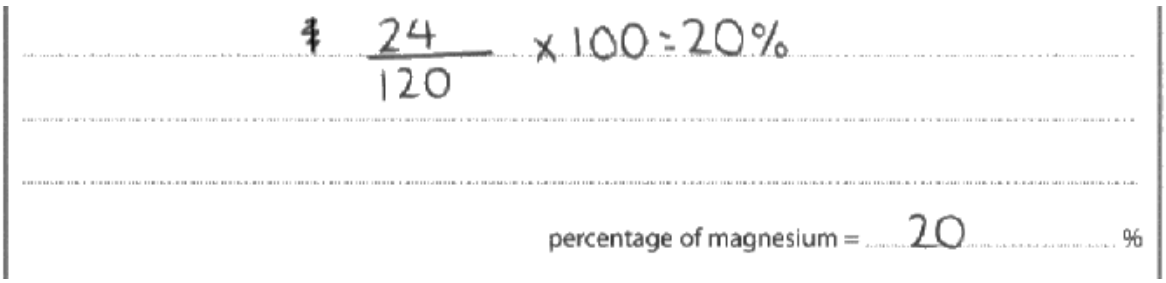
percentage of magnesium = 66.66666667 %

Results Plus: Examiner Comments

This candidate has got the first step of the calculation wrong as they should have just divided the mass of magnesium (24) by 120. However, they have then multiplied their fraction by 100, so they score 1 mark.

Results Plus: Examiner Tip

Show your working in calculations.



Results Plus: Examiner Comments

This candidate has given correct working and has the correct answer so was awarded 2 marks.

(c)(i)

Very few candidates understood the term 'empirical formula', so they were unable to score a mark for this question. A common incorrect answer was CH_8.



Results Plus: Examiner Comments

This candidate has correctly worked out that the simplest ratio of carbon to hydrogen is 1:3, but they did not score a mark as the question asked for the empirical formula.

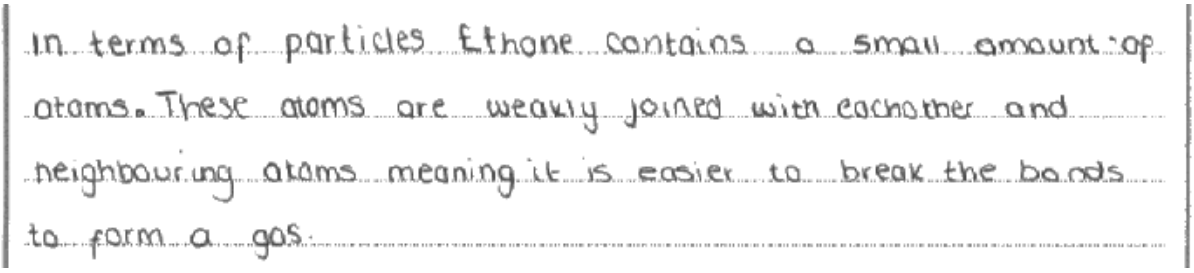
The empirical formula shows the simplest whole number ratio of atoms in the formula. The correct empirical formula for ethane is CH_3.

(c)(ii)

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forces between molecules was only given by the more able candidates. Many candidates wrote about the weak bonds between the atoms but a large number did not refer to bonds at all and wrote about few particles that are far apart in a gas.

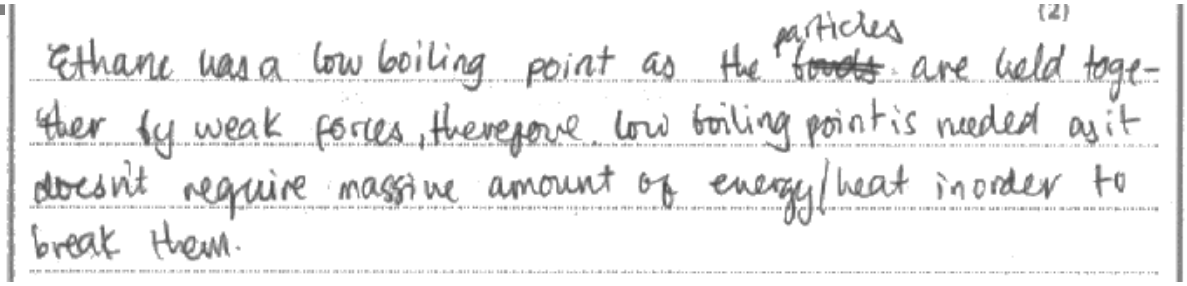
Examiners were surprised to see some candidates writing about hydrogen bonds. There are no hydrogen bonds between ethane molecules and we would not expect candidates to know about specific intermolecular forces at GCSE.


In terms of particles Ethane contains a small amount of atoms. These atoms are weakly joined with eachother and neighbouring atoms meaning it is easier to break the bonds to form a gas.

Results Plus: Examiner Comments

This answer did not score a mark as it referred to the bonds between atoms being weak.

The bonds between atoms are strong but the forces between molecules are weak.


Ethane has a low boiling point as the ~~bonds~~ particles are held together by weak forces, therefore low boiling point is needed as it doesn't require massive amount of energy/heat inorder to break them. (2)

Results Plus: Examiner Comments

This is an excellent answer that scored 2 marks.

Results Plus: Examiner Tip

Try to remember that the covalent bonds that hold the atoms together in molecules are strong. There are just weak forces between the molecules.

Q59.

(i)

Generally well answered on the whole, with the majority of the candidates identifying 'fuel oil' as the fraction that was most likely to be cracked. Nearly all the incorrect responses, indicating a misunderstanding of the question, referred to petrol.

(ii)

Most candidates were able to score 2 of the 3 marks available.

The endothermic reaction profile was known only to about half the candidates. Most candidates managed to label the positions of reactants and products correctly. Only a small number could show the activation energy correctly on an endothermic reaction profile to score all the marks available.

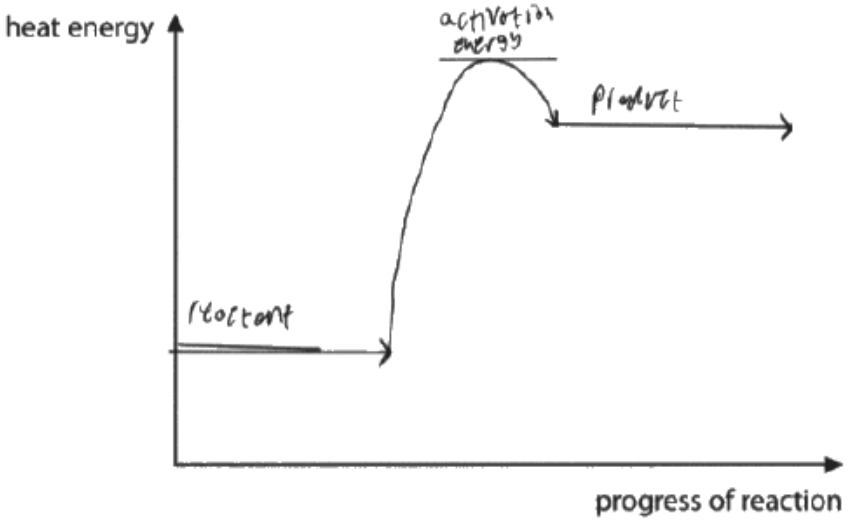
Consequential marking was in place for those who drew an exothermic reaction profile.

Incorrect diagrams included random straight lines starting from the origin, others drew a line similar to that produced from a rates of reaction curve and a few candidates drew curves to show what happened to the amount reactant and to the amount of product formed during a reaction.

(ii) In a cracking reaction, reactants are heated to form products.
This reaction is endothermic.

On the axes provided, draw the reaction profile of this reaction.
Label the energy of the reactants, the energy of the products and the activation energy of the reaction.

(3)



Results Plus: Examiner Comments

This response scored 2 of the 3 marks available.

A profile has been drawn for an endothermic reaction, with the relative positions of the reactants and products labelled and shown correctly. However, the activation energy is not labelled correctly, so limiting this response to 2 marks.

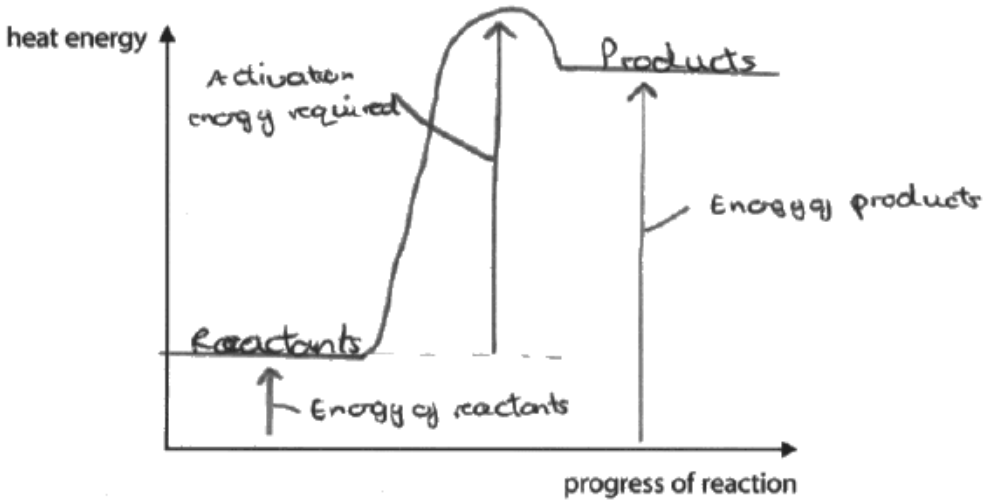
Results Plus: Examiner Tip

Make sure that not only can you draw the reaction profiles for both endothermic and exothermic reactions that you can label the activation energy on the profiles for both these types of reaction.

(ii) In a cracking reaction, reactants are heated to form products.
This reaction is endothermic.

On the axes provided, draw the reaction profile of this reaction.
Label the energy of the reactants, the energy of the products and the activation energy of the reaction.

(3)



Results Plus: Examiner Comments

An example of a fully correct response which scored 3 marks.

A profile has been drawn for an endothermic reaction, with the correct relative positions of the reactants and products labelled, with the activation energy also labelled correctly.

(iii)

Most candidates were able to work out the formula of the single product needed to balance the equation for the cracking of dodecane by writing C_6H_{14}. A common incorrect response seen here was to give $2C_3H_7$ as the answer, despite the question stating that the formula of a single molecule was needed to balance the equation.

Q60. No Examiner's Report available for this question

Mark Scheme

Q1.

Question Number	Answer	Mark
(i)	hydrochloric acid	**(1)**

Question Number	Answer	Mark
(ii)	**C** pink-red	**(1)**

Q2.

Question Number	Answer	Additional guidance	Mark
	$2Al + 6H^+ \rightarrow 2Al^{3+} + 3H_2$ (2)	Al and H_2 (1) balancing of correct species (1) allow multiples	**(2)** AO 2 1

Q3.

Question number	Answer	Additional guidance	Mark
(i)	as the number of carbon atoms in the molecule increases, the boiling point increases (1)	accept reverse argument	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	relative formula mass = (3 X 12) + (8 X 1) (1) = 44	Award mark if correct answer given with no working	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	propane + oxygen → carbon dioxide + water LHS (1) RHS (1)	ignore air allow reactants on LHS and products on RHS in either order allow $C_3H_8 + 5\,O_2 \rightarrow 3CO_2 + 4H_2O$ (2) incorrect balancing of correct species max 1 mark ignore state symbols even if incorrect allow = for →	(2)

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): **EITHER** carbon monoxide/CO formed (1) toxic/poisonous/restricts the amount of oxygen carried (by the blood) (1) **OR** carbon/smoke/soot formed (1) damages lungs/chokes people/breathing difficulties /makes things dirty (1)	 ignore carbon dioxide ignore dangerous/harmful allow the second mark if an incorrect gas is given *e.g.* methane allow second mark if 'gas' stated, but no name is given allow less energy released ignore dangerous/harmful allow blocks fuel jets allow less energy released	(2)

Q4.

	Answer	Acceptable answers	Mark
(a)	A – air		(1)
(b)(i)	gas	ignore g alone	(1)
(b)(ii)	reaction is reversible / reaction goes both ways	reaction is in /reaches equilibrium	(1)
(c)	ammonia + sulfuric acid → ammonium sulfate (2) left hand side (1) right hand side (1)	Allow = for →	(2)
(d)	improve crop yields / promote plant		(1)

	growth	crops grow faster adds essential elements / OWTTE	
(e)(i)	burette		**(1)**
(e)(ii)	indicator / any named acid-base indicator	ignore Universal indicator	**(1)**

Q5.

	Answer	**Acceptable answers**	**Mark**
(a)	A – air		**(1)**
(b)(i)	gas	ignore g alone	**(1)**
(b)(ii)	reaction is reversible / reaction goes both ways	reaction is in /reaches equilibrium	**(1)**
(c)	ammonia + sulfuric acid → ammonium sulfate (2) left hand side (1) right hand side (1)	Allow = for →	**(2)**
(d)	improve crop yields / promote plant growth	crops grow faster adds essential elements / OWTTE	**(1)**
(e)(i)	burette		**(1)**
(e)(ii)	indicator / any named acid-base indicator	ignore Universal indicator	**(1)**

Q6.

	Answer	**Acceptable answers**	**Mark**
	ammonia + sulfuric acid → ammonium sulfate (2) left hand side (1) right hand side (1)	Allow = for →	**(2)**

Q7.

	Answer	**Acceptable answers**	**Mark**
	ammonia + sulfuric acid → ammonium sulfate (2) left hand side (1)	Allow = for →	**(2)**

	right hand side (1)		

Q8.

Question number	Answer	Mark
(a)	any **one** precaution from: • wear gloves to prevent contact with skin/safety (1) • spectacles to prevent contact with eyes (1)	**(1)**

Question number	Answer	Additional guidance	Mark
(b)	1000 cm^3 contain $\frac{4.3 \times 1000}{250}$ (1) 1 dm^3 contains 17.1 ($g\,dm^{-3}$) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
(c)	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ • correct formulae (1) • balancing (1)	Do not award 2 if incorrect balancing added.	**(2)**

Question number	Answer	Mark
(d)	• {titration 1/27 cm^3} should not be used because burette readings {not precise/not accurate/not read to 2 d.p.} (1) • {titration 4/25.80 cm^3} should not be used because volume of used (25.80 cm^3) not concordant with other two (1)	**(2)**

Q9.

Question number	Answer	Mark
(i)	A a balance The only correct answer is A. B is incorrect because a pipette is used to measure out a volume of liquid and is not used to find the mass of a metal. C is incorrect because a stopwatch is used to measure time and is not used to find the mass of a metal. D is incorrect because a thermometer is used to measure temperature and is not used to find the mass of a metal.	(1)

Question number	Answer	Additional guidance	Mark
(ii)	Any two from the following • (same) volume of acid (1) • (same) concentration of acid (1) • (same) size of metal (pieces) (1) • (same) temperature (1)	 allow amount / mass of acid allow strength / pH allow surface area ignore references to time	(2)
(iii)	copper is {not reacting / no reaction / unreactive / low in reactivity series / not reactive enough}	allow less reactive (than hydrogen) ignore inert (alone)	(1)
(iv)	$MgCl_2$ (aq) (1) H_2 (g) (1) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$	allow AQ allow G	(2)

Q10.

Question Number	Answer	Acceptable answers	Mark
(a)	$H_2 + Cl_2 \rightarrow 2HCl$ M1 correct formulae on LHS and RHS **(1)** M2 correctly balanced **(1)**	In M1 do not allow incorrect use of upper/lower case/subscripts but M2 can be awarded for correct balancing dependent on M1 being awarded (but note special case above) accept multiples	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	M1 shared pair of electrons between one H and one Cl **(1)** M2 remaining outer electrons correct **(1)**	Accept all permutations of dots and crosses for electrons If any indication of ionic bonding including charges 0/2 symbols not required ignore incorrect symbols eg C/CL M2 dependent on M1 electrons do not need to be in pairs ignore inner shells electrons can be on/in ring or no ring	**(2)**

Q11.

Question Number	Answer	Acceptable answers	Mark
(a)	$H_2 + Cl_2 \rightarrow 2HCl$ M1 correct formulae on LHS and RHS **(1)** M2 correctly balanced **(1)**	In M1 do not allow incorrect use of upper/lower case/subscripts but M2 can be awarded for correct balancing dependent on M1 being awarded (but note special case above) accept multiples	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	M1 shared pair of electrons between one H and one Cl **(1)** M2 remaining outer electrons correct **(1)**	Accept all permutations of dots and crosses for electrons If any indication of ionic bonding including charges 0/2 symbols not required ignore incorrect symbols eg C/CL M2 dependent on M1 electrons do not need to be in pairs ignore inner shells electrons can be on/in ring or no ring	**(2)**

Q12.

Question number	Answer	Mark
	$2Fe_2O_3$ + **3** C → **4** Fe + **3** CO_2	**(1)**

Q13.

Question number	Answer	Additional guidance	Mark
	$2H_2$ + O_2 → ...$2H_2O$	both numbers are required for the mark allow multiples	**(1)**

Q14.

Question number	Answer	Additional guidance	Mark
	2 Na + F_2 → 2 NaF (2) F_2 (1) 2 (1)		**(2)**

Q15.

Question number	Answer	Additional guidance	Mark
	2 Na + F_2 → 2 NaF (2) F_2 (1) 2 (1)		**(2)**

Q16.

Question Number	Answer	Additional guidance	Mark
	2H_2O_2(aq) → 2H_2O(**l**) + O_2 (**g**) (2) OR **2**H_2O_2 (1) state symbols l, g (1)	 do not allow first marking point if equation unbalanced allow capital or small letters for state symbols do not allow words for state symbols	**(2)** AO 1 1 AO 2 1

Q17.

	Answer	Acceptable answers	Mark
	Ba + Cl_2 (→) (1) → BaC_{l2} (1) reactants = 1 product = 1	max 1 for any incorrectly balanced equation	**(2)**

Q18.

Question Number	Answer	Additional guidance	Mark
(i)	calcium + oxygen → calcium oxide LHS (1) RHS (1)	ignore air allow reactants on LHS in either order allow 2Ca + O_2 → 2CaO (2) incorrect balancing of correct species max 1 mark ignore state symbols allow = for →	(2)

Question number	Answer	Additional guidance	Mark
(ii)	Ca : O 1.05/40 : 0.42/16 (1) 0.026 : 0.026 1 : 1 (1) empirical formula CaO (1)	 allow ecf formula alone scores max 1 mark	(3)

Q19.

Question Number	Answer	Additional guidance	Mark
(i)	C neutral (1)		(1)

Question Number	Answer	Mark
(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark) • to react all the (nitric) acid in the solution (1) • so that the calcium nitrate solution is pure (1)	(2)

Question Number	Answer	Mark
(iii)	$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$ (3) left hand side formulae (1) right hand side formulae (1) balancing correct formulae (1)	(3)

Q20.

	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 • 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)**
(c)(i)	40/44 (1) (= 0.909)	correct answer (2)	**(2)**

	(any fraction) x 100 (1) (= 90.9 / 90.91 / 91(%))	Ignore 90(%)	
(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)**

Q21.

	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 • 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)**
(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)**

Q22.

	Answer	**Acceptable answers**	**Mark**
	sodium carbonate + calcium nitrate →	ignore solution / state symbols ignore	**(2)**

	sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	incorrect attempts at balanced equation ignore mixtures of words and formulae	

Q23.

	Answer	**Acceptable answers**	**Mark**
	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)**

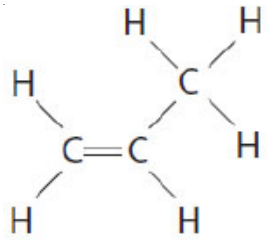
Q24.

Question Number	Answer	Mark
(i)	5 molecules of each have reacted/ 5:5 (1) 1: 1 (1)	**(2)**

Question Number	Answer	Mark
(ii)	**C** $H_2 + Cl_2 \rightarrow 2HCl$	**(1)**

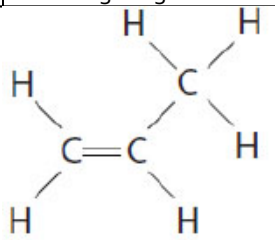
Q25.

	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	

Q26.

	Answer	Acceptable answers	Mark
(a)	C – CH_3CH_3		
(b)		carbon skeleton correct including double bond (1) rest of molecule correct (1) allow CH_3	(2)
(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	

Q27.

	Answer	**Acceptable answers**	**Mark**
(i)	gas	ignore g alone	**(1)**
(ii)	reaction is reversible / reaction goes both ways	reaction is in /reaches equilibrium	**(1)**

Q28.

	Answer	**Acceptable answers**	**Mark**
(i)	gas	ignore g alone	**(1)**
(ii)	reaction is reversible / reaction goes both ways	reaction is in /reaches equilibrium	**(1)**

Q29.

Question number	**Answer**	**Additional guidance**	**Mark**
(i)	(liquid changes from colourless to) yellow / orange/ brown / red		**(1)**

Question number	**Answer**	**Additional guidance**	**Mark**
(ii)	$Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ LHS (1) RHS (1) balancing of correct species (1)		**(3)**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • when chlorine and iodine react, their atoms gain an electron (1) • electron attracted into chlorine atom more strongly than into an iodine atom (1) • because chlorine atom is smaller / outer electrons in chlorine atom closer to the nucleus / more shielding between nucleus of iodine atom and outer electrons (1)		(2)

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • iodide ion loses an electron (1) • oxidation is loss of electrons / iodine is oxidised (1) • chlorine atom gains an electron (1) • reduction is gain of electrons / chlorine is reduced (1)	if no reference made to gain or loss of electrons, allow (1) for redox reaction involves both oxidation and reduction	(4)

Q30.

Question number	Answer	Mark
(i)	**D**  **A** is incorrect as it is the symbol for flammable substances. **B** is incorrect as it is the symbol for corrosive substances. **C** is incorrect as it is the symbol for substances that are harmful to health.	(1) **AO1**

Question number	Answer	Additional guidance	Mark
(ii)	use a fume cupboard	ignore wear PPE / masks ignore wear goggles / gloves	(1) **AO1**

Q31.

Question Number	Answer	Additional guidance	Mark
(i)	$C_4H_8 + 6O_2 \rightarrow \mathbf{4}CO_2 + \mathbf{4}H_2O$ $4CO_2$ (1) $4H_2O$ (1)		**(2)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	A description linking • (bubble gas through) limewater (1) • (limewater) turns {milky / cloudy / white precipitate} (1)	second mark dependent on first ignore lit splint goes out	**(2)** AO 1 1

Q32.

Question Number	Answer	Mark
(i)	$2H_2$ (g) + O_2 (g) → $2H_2O$ (g)	**(2)** AO 3 1a AO 3 1b

Question Number	Answer	Additional guidance	Mark
(ii)	all <u>atoms</u> in the reactants are present in the product / only one product is formed	allow no atoms are wasted (in the reaction) / no waste products / nothing is wasted allow total mass of reactants = mass of useful products allow complete calculation to show that atom economy is 100% ignore equation is balanced / same number of atoms on both sides	**(1)** AO 1 1

Q33.

Question Number	Answer	Mark
(i)	$2H_2$ (g) + O_2 (g) → $2H_2O$ (g)	**(2)** AO 3 1a AO 3 1b

Question Number	Answer	Additional guidance	Mark
(ii)	all atoms in the reactants are present in the product / only one product is formed	allow no atoms are wasted (in the reaction) / no waste products / nothing is wasted allow total mass of reactants = mass of useful products allow complete calculation to show that atom economy is 100% ignore equation is balanced / same number of atoms on both sides	**(1)** AO 1 1

Q34.

Question Number	Answer	Acceptable answers	Mark
	$CH_4 + 2O_2$ → 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)**

Q35.

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)**

Q36.

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

Q37.

Question number	Answer	Additional guidance	Mark
(i)	$Cl_2(g) + H_2O(l) \rightleftharpoons HCl(aq) + HClO(aq)$ (3)	all three formulae (only) on correct sides of equation with no incorrect balancing (2) two formulae correct regardless of any other error (1) all three state symbols (1) Do not allow incorrect symbols or non subscripts e.g. CL^2	(3) AO2

Question number	Answer	Additional guidance	Mark
(ii)	H^+	if any other ions included 0 marks	(1) AO1

Question number	Answer	Additional guidance	Mark
(iii)	neutralisation	allow exothermic reject endothermic	(1) AO1

Q38.

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)**

Q39.

Question number	Answer	Additional guidance	Mark
(i)	$Cl_2(g) + H_2O(l) \rightleftharpoons HCl(aq) + HClO(aq)$ (3)	all three formulae (only) on correct sides of equation with no incorrect balancing (2) two formulae correct regardless of any other error (1) all three state symbols (1) Do not allow incorrect symbols or non subscripts eg CL^2	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	H^+	if any other ions included 0 marks	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(iii)	neutralisation	allow exothermic reject endothermic	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
(iv)	A description including any two from: • powder disappears (1) • effervescence/ bubbles/ fizzing (1) • blue solution forms (1)	allow dissolves	**(2)** **AO2**

Q40.

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

Q41.

Question number	Answer	Additional guidance	Mark
(i)	Left : H_2SO_4 (1) Right : $CuSO_4$ (1)	reject superscript numbers reject superscript numbers incorrect balancing max 1	(2)

Question number	Answer	Mark
(ii)	63.5 + 12 + 3x16 (1) = 123.5 (1)	(2)

Question number	Answer	Mark
(iii)	**A** bubble the gas through limewater, limewater turns cloudy **The only correct answer is A** **B** is not correct because test shows only an acidic gas **C** is not correct because test shows only that the gas does not support combustion **D** is not correct because test shows only an acidic gas	(1)

Q42.

Question number	Answer	Additional guidance	Mark
(i)	Left : H_2SO_4 (1) Right : $CuSO_4$ (1)	reject superscript numbers reject superscript numbers incorrect balancing max 1	(2)

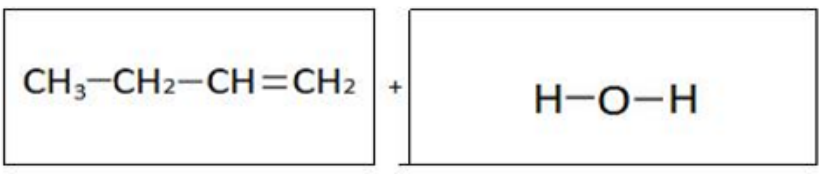
Question number	Answer	Mark
(ii)	63.5 + 12 + 3x16 (1) = 123.5 (1)	(2)

Question number	Answer	Mark
(iii)	**A** bubble the gas through limewater, limewater turns cloudy **The only correct answer is A** **B** is not correct because test shows only an acidic gas **C** is not correct because test shows only that the gas does not support combustion **D** is not correct because test shows only an acidic gas	(1)

Q43.

Question number	Answer	Additional guidance	Mark
	C_2H_4	Allow H_4C_2	(1) AO2

Q44.

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)

Q45.

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

Q46.

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

Q47.

Question number	Answer	Additional guidance	Mark
	$N_2 + 2O_2 \rightarrow 2NO_2$ (2) or NO_2 (1)	other incorrect balancing max 1	**(2)** **AO2**

Q48.

Question number	Answer	Additional guidance	Mark
	2K (s) + F_2 (g) → 2KF (s) **2 K (1)** **2 KF (1)** **s, s (1)**	ignore words	**(3)**

Q49.

Question number	Answer	Additional guidance	Mark
	$2K\ (s) + F_2\ (g) \rightarrow 2KF\ (s)$ **2K(1)** **2 KF (1)** **s, s (1)**	ignore words	**(3)**

Q50.

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)**

Q51.

Question number	Answer	Mark
	$Cu(OH)_2$ **(s) (1)** Na_2SO_4 **(aq) (1)**	**(2)**

Q52.

Question number	Answer	Additional guidance	Mark
	$O_2 + 4H^+ + 4e^{(-)} \rightarrow 2H_2O$ (2) $e^{(-)}$ (on left) (1) balancing (1)	allow equation with e^+ to score MP2 if this is only error allow equation missing electrons but with no extraneous substances to score MP2 if correctly balanced	**(2)** **AO2**

Q53.

Question number	Answer	Additional guidance	Mark
	$Al^{3+} + PO_4^{3-} \rightarrow AlPO_4$ (2) Al^{3+} (1) $AlPO_4$ (1)	allow any neutral aluminium phosphate formula based on their aluminium ion. allow $Al^{3+}PO_4^{3-}$	**(2)** **AO2**

Q54.

Question number	Indicative content	Mark
	$2\ CaCO_3 + Mg^{2+} \rightarrow CaMg(CO_3)_2 + Ca^{2+}$ 2 **(1)** Mg^{2+} **(1)**	**(2)**

Q55.

Question number	Answer	Mark
(i)	hydrogen row: 10 4 -6	(1) AO2

Question number	Answer	Additional guidance	Mark
(ii)	$N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$ (2) Formulae of nitrogen **and** hydrogen (1)	balancing mark only if formulae correct	(2) AO2

Q56.

Question number	Answer	Additional guidance	Mark
(i)	methane + oxygen (1) → water + carbon dioxide (1)	ignore symbols reject other substances on either side for that mark	(2)

Question number	Answer	Additional guidance	Mark
(ii)	limited supply of oxygen	ignore air	(1)

Q57.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**2** Na **(1)** + Cl_2 → **2** NaCl (1) Ignore + in front of the 2s	maximum 1 mark if any balancing number is added in front of Cl_2 or if any of the formulae are changed eg 4Na + $2Cl_2$ → 4NaCl or Na + 1/2 Cl_2 → NaCl score (1) do not allow negative signs in front of balancing numbers	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	2.5 / 4.0 (1) their fraction x 100 (1) (=62.5)	0.625 or 5/8 62.5/63 with {no/incorrect} working correct working with {no/wrong}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	A ionic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	23 + 35.5 (=58.5) Ignore g	58.5 with {no/incorrect} working 23 + 35.5 with {no/wrong} answer do not allow 58/59 without working	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	$\frac{24}{120}$ (1) their fraction x 100 (1) (=20%)	1/5 or 0.2 20 with {no/incorrect} working correct working with {no/wrong} answer	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	CH_3	2 CH_3 / C_1H_3 / H_3C do not allow just 1:3	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking any **two** from weak {forces/attractions} (1) between {molecules/particles/them}/ intermolecular (1) little {heat/energy} needed {to separate the molecules/overcome force(s) between molecules} (1)	maximum **1** mark if breaking bonds between atoms/breaking down {molecules/ particles}/breaking covalent bonds specific weak forces eg Van der Waals/London weak bonds do not allow covalent bonds are weak /weak bonds between atoms ignore weak hydrogen bonds weak bonds between {molecules / particles} do not allow intramolecular 'little energy is needed to break the bonds' only if it is clear that {covalent/single} bonds are not being broken	**(2)**

(Total for Question = 11 marks)

Q58.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**2** Na **(1)** + Cl_2 → **2** NaCl (1) Ignore + in front of the 2s	maximum 1 mark if any balancing number is added in front of Cl_2 or if any of the formulae are changed eg 4Na + $2Cl_2$ → 4NaCl or Na + 1/2 Cl_2 → NaCl score (1) do not allow negative signs in front of balancing numbers	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	2.5 / 4.0 (1) their fraction x 100 (1) (=62.5)	0.625 or 5/8 62.5/63 with {no/incorrect} working correct working with {no/wrong}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	A ionic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	23 + 35.5 (=58.5) Ignore g	58.5 with {no/incorrect} working 23 + 35.5 with {no/wrong} answer do not allow 58/59 without working	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	$\frac{24}{120}$ (1) their fraction x 100 (1) (=20%)	1/5 or 0.2 20 with {no/incorrect} working correct working with {no/wrong} answer	**(2)**

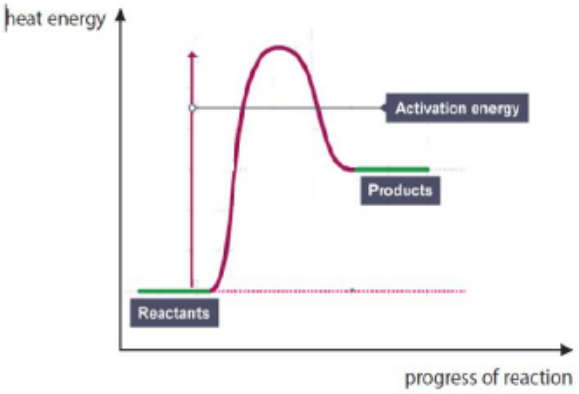
Question Number	Answer	Acceptable answers	Mark
(c)(i)	CH_3	2 CH_3 / C_1H_3 / H_3C do not allow just 1:3	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking any **two** from weak {forces/attractions} (1) between {molecules/particles/them}/ intermolecular (1) little {heat/energy} needed {to separate the molecules/overcome force(s) between molecules} (1)	maximum **1** mark if breaking bonds between atoms/breaking down {molecules/ particles}/breaking covalent bonds specific weak forces eg Van der Waals/London weak bonds do not allow covalent bonds are weak /weak bonds between atoms ignore weak hydrogen bonds weak bonds between {molecules / particles} do not allow intramolecular 'little energy is needed to break the bonds' only if it is clear that {covalent/single} bonds are not being broken	**(2)**

(Total for Question = 11 marks)

Q59.

Question Number	Answer	Mark
(i)	fuel oil	**(1)** AO 3 2a

Question Number	Answer	Additional guidance	Mark
(ii)	• reactant(s) and product(s) labelled in their correct positions (1) • activation energy labelled (1) • energy of reactants lower than energy of products (1)	example of diagram  ignore arrow heads allow unlabelled diagram of an endothermic reaction showing the basic outline shape if exothermic reaction profile shown, allow (1) for reactants and products in correct position and (1) for correct labelling of activation energy	(3) AO 1 1

Question Number	Answer	Additional guidance	Mark
(iii)	C_6H_{14}		(1) AO 2 1

Q60.

Question number	Answer	Additional guidance	Mark
(i)	measuring cylinder	allow burette or pipette	(1)

Question number	Answer	Mark
(ii)	(ammonia) + phosphoric acid → ammonium phosphate	(1)

Question number	Answer	Mark
(iii)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • first heat the solution/leave water to evaporate (1) • and then filter off/dry crystals formed (1)	(2)