PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 0: FORMULAE, EQUATIONS AND HAZARDS (PACK 2)

SCORE	PERCENTAGE
/181	%

STEMUP

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Q1.

Candidates found this question difficult, although a good proportion were able to correctly determine the formula of the iron oxide and then use it to complete the balanced equation for the reaction. Some candidates were able to find the ratio of iron to oxygen but were unable to take this any further and so scored just two marks.

Q2. No Examiner's Report available for this question

Q3.

In part (i) candidates found it hard to suggest a reason for using ammonium sulfate and solid ammonium nitrate as fertilisers with many repeating the stem of the question and stating that it would be to increase the yield. Candidates also found it hard to write the balanced equation for the reaction even though the names of all the reactants and products had been given, candidates should be familiar with the formula of common substances referred to in the specification. In (iii), many candidates were able to give a similarity or a difference, but few were able to give both to score both marks available. The most common correct answer seen was the allowable answer that both use the same reactants.

Q4. No Examiner's Report available for this question

Q5. No Examiner's Report available for this question

Q6.

(a)

The majority of candidates were able to score the 1 mark available, with references to 'improves resistance to corrosion'. The most common error was to mention 'to prevent rusting' which is clearly only specific to iron and steel. However, this was credited only if the rusting, when mentioned, was specifically linked to iron and steel. Some candidates confused 'corrosive' with 'corrosion'. Several candidates incorrectly referred to 'making the metal stronger' or 'making the metal conduct' or simply repeated the reason already given in stem of the question.

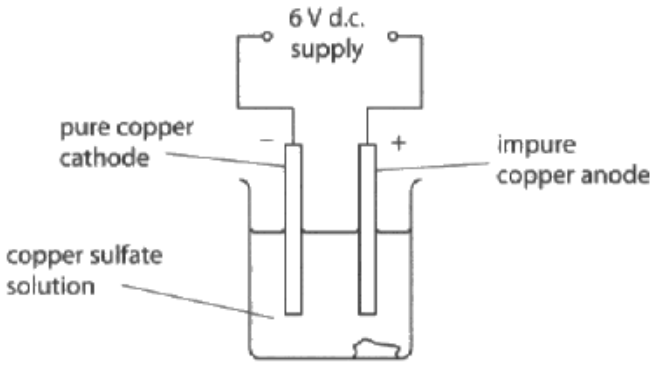
(b)

Although there were some excellent responses seen by examiners, gaining the full 3 marks available, the majority of candidates struggled with interpreting the results for the purification of copper by electrolysis in terms of atoms, ions and the redox processes occurring. Marks were

generally awarded for stating 'the movement of copper ions from the anode to the cathode' or for a correct reference to 'the difference in the changes in mass (0.2 g) being down to impurities'.

Many answers referred to the change in mass of the anode or cathode, but did not explain this, or extend this sufficiently to explain the mass difference in terms of impurities. Few responses actually made specific reference to the oxidation/atoms losing electrons or reduction/ions gaining electrons at the anode and cathode respectively. Half equations were rarely given.

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

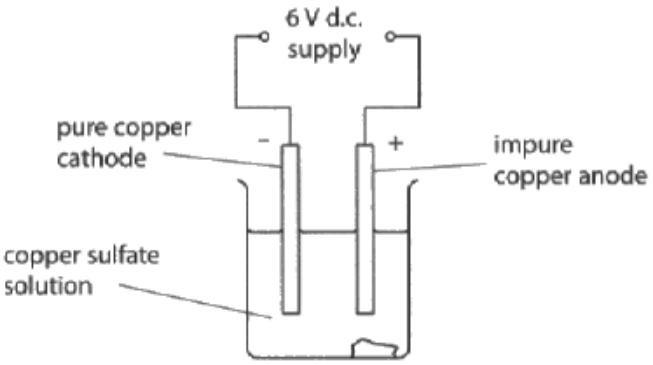
(3)

Because the copper was attracted to the cathode which increased the amount of copper in the cathode while there was a reduction in the anode as the copper migrated to the cathode leaving just the impurities.

Results Plus: Examiner Comments

In this response there is no mention of copper ions or the movement of copper ions, or copper atoms being formed. The impurities are not linked to the 0.2g difference in the mass changes. This response scored 0 marks.

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
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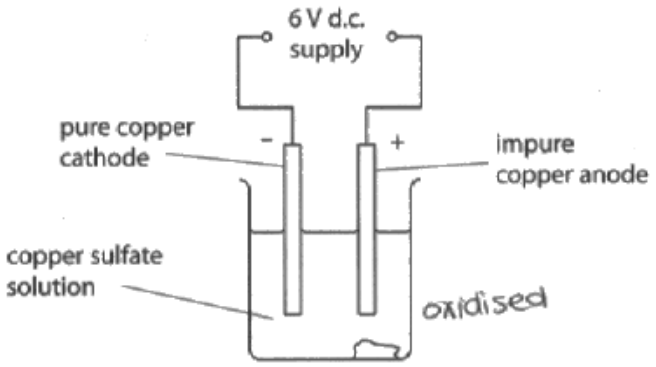
(3)

At the anode, copper atoms are oxidised meaning they lose electrons, forming Cu^{2+} ions that enter into solution. At the cathode, electrons are offered up to reacting Cu^{2+} ions forming copper atoms which sticks to the cathode. This means that the anode loses 5 g of mass because copper is stripped off, and the cathode gains 4.8 g because copper is added to it.

Results Plus: Examiner Comments

The processes occurring at the anode and cathode have been discussed in detail. There has been no further discussion of the 0.2g change in mass difference linked to impurities or any mention of movement of ions. This response scored 2 marks.

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

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Explain these results.

(3)

There was a 4.8g increase on the copper cathode because the copper ~~met~~metal was oxidised at the anode and formed Cu^{2+} ions in solution and then were ~~a~~reduced at the cathode to form solid copper atoms coating the cathode. This is why the anode decreased in mass by 5g and 0.2g of this was impurities causing a 4.8g increase in cathode mass

Results Plus: Examiner Comments

A typically seen very good response. Three marking points have been mentioned in this response. The formation of copper ions at the anode/oxidation. The reduction of copper ions at the cathode to form copper atoms. The difference in the change in mass has been correctly linked to impurities. This response scored 3 marks.

(c)

This question was very poorly answered by the majority of candidates, with very few candidates scoring the 2 marks available. In cases where 1 mark was scored, it was invariably for showing the correct species on both sides of the equation, but with incorrect balancing, typically for showing only 2 electrons, rather than 4 electrons on the Right Hand Side of the equation. The majority of answers which failed to score, reference to gaining electrons on the Left Hand Side. In some responses this reaction was confused with the oxidation half equation occurring at the

anode during the electrolysis of water.

(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

$O^{2-} \rightarrow O_2 + 2e$

Results Plus: Examiner Comments

A typical 1 mark response for showing the correct species but incorrect balancing, namely the **2** on the LHS is missing and **2**e^- is incorrect on the RHS.

(d)

A significant number of excellent answers were noted by the examiners, gaining the maximum 6 marks, Level 3. There was good recognition of the movement of sodium ions and chloride ions to the correct electrodes and the subsequent reduction and oxidation reactions. The use of half equations for the reduction and oxidation processes was seen occasionally. Very few candidates discussed the fact that two chlorine atoms joined to form a chlorine molecule.

Level 2 responses often showed less detail regarding electron transfer following movement of ions to the electrodes. Often candidates incorrectly referred to chlorine ions instead of chloride ions. Some candidates confused the electrolysis of an aqueous solution of sodium chloride / brine with that of molten sodium chloride in the question, despite some detailed explanations, which often limited the answers to Level 2. In some cases, it was disappointing to see atoms with charges or ions going to the wrong electrodes, or confusing the anode with the cathode.

*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

In electrolysis, the sodium ions are attracted towards the cathode as they contain positive ions. which converts it into a sodium metal. The chloride ions are attracted towards the anode as they contain negative ions which forms a chlorine gas.

Sodium goes to the cathode because its a negative electrode and the sodium ions are negative. positive. Chloride ions go to the anode because its a positive electrode and the chloride ions are negative.

This forms sodium and chlorine as they are born attracted to the different electrodes.

Results Plus: Examiner Comments

This response correctly mentions the movement of sodium ions and chloride ions to the cathode and anode respectively. The formation of chlorine gas at the anode and sodium metal at the cathode have been discussed. There have been four relevant points made. This response scored 4 marks – Level 2.

*(d) Sodium chloride is an ionic compound.
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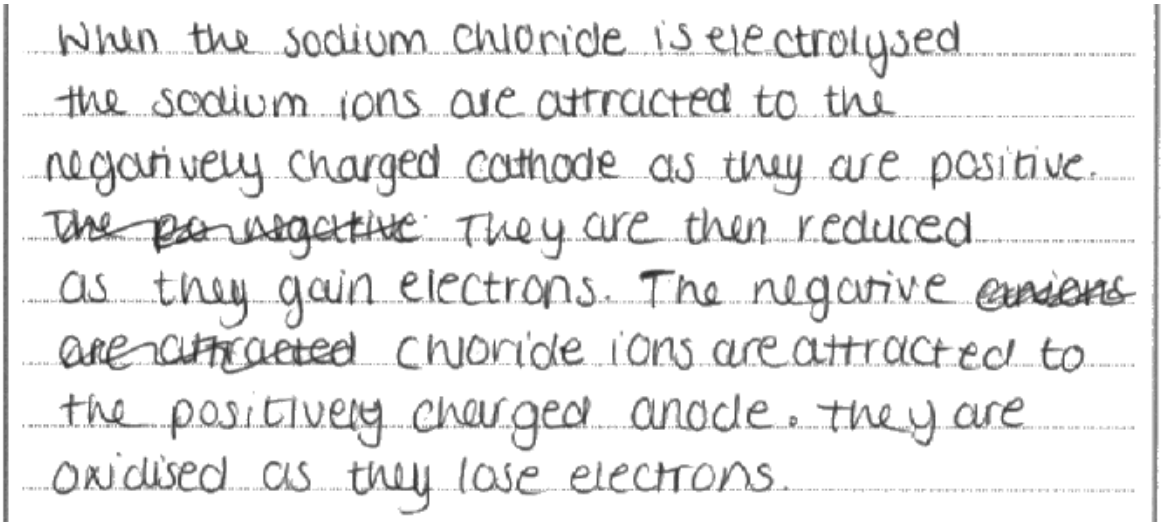
Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

The sodium ions from the solution are pulled towards the cathode of the electrolysis because opposite charges attract. The chloride ions are pulled towards the anode.

Results Plus: Examiner Comments

Two correct points have been made, namely the movement of sodium ions to the cathode and chloride ions to the anode. This response scored 2 marks – Level 1.


When the sodium chloride is electrolysed the sodium ions are attracted to the negatively charged cathode as they are positive. ~~The positive~~ They are then reduced as they gain electrons. The negative ~~anions are attracted~~ chloride ions are attracted to the positively charged anode. they are oxidised as they lose electrons.

Results Plus: Examiner Comments

The movement of the sodium ions to the cathode and chloride ions to the anode are mentioned. Redox reactions at the electrodes have been discussed, namely chloride ions losing electrons / oxidation and sodium ions gaining electrons / reduction. Overall, although the answer is relatively concise, there are six relevant points regarding both the electrode processes, so this response is sufficient for Level 3 and scored 6 marks.

Two inert electrodes are used, supplied with a current and put into an electrolyte of molten sodium chloride where Na^+ and Cl^- ions are free to move. At the negative cathode Na^+ cations are reduced, and gain electrons, to be deposited as solid sodium atoms. The half equation is: $Na^+_{(l)} + e^- \rightarrow Na_{(s)}$. The sodium is collected and used in street lamps and as a coolant in some nuclear reactors.

Chloride anions are instead attracted to the anode where they are oxidised, and lose electrons to form chlorine gas molecules. The half equation is: $2Cl^-_{(l)} \rightarrow Cl_{2(g)} + 2e^-$. Chlorine is collected at the anode as a toxic green gas and is used to treat water, produce bleach and to make PVC and other polymers.

Results Plus: Examiner Comments

This is an excellent example of typical Level 3 response – 6 marks.

The movement of ions to the respective electrodes has been discussed and the electrode processes at the anode and cathode have been described and explained in detail, coupled with detailed halfequations. There are greater than the minimum valid points required for Level 3.

Q7.

(a)

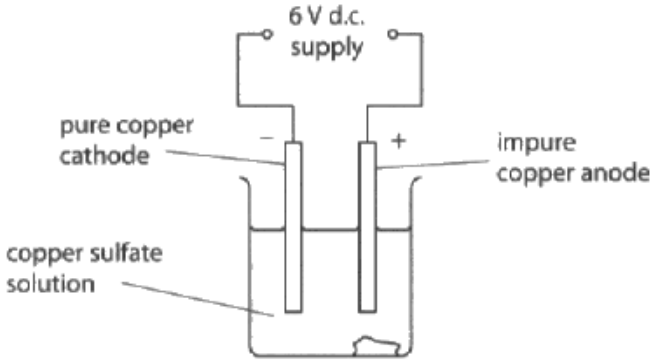
The majority of candidates were able to score the 1 mark available, with references to 'improves resistance to corrosion'. The most common error was to mention 'to prevent rusting' which is clearly only specific to iron and steel. However, this was credited only if the rusting, when mentioned, was specifically linked to iron and steel. Some candidates confused 'corrosive' with 'corrosion'. Several candidates incorrectly referred to 'making the metal stronger' or 'making the metal conduct' or simply repeated the reason already given in stem of the question.

(b)

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The electrolysis was carried out for a period of time.
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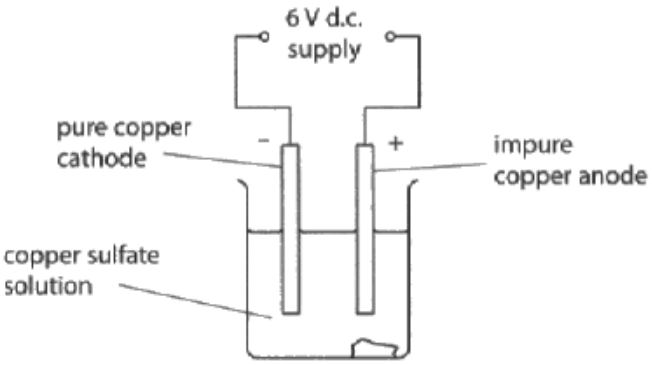
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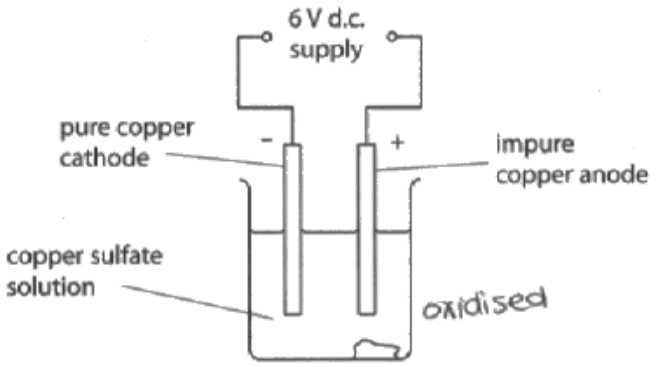
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Results Plus: Examiner Comments

This response correctly mentions the movement of sodium ions and chloride ions to the cathode and anode respectively. The formation of chlorine gas at the anode and sodium metal at the cathode have been discussed. There have been four relevant points made. This response scored 4 marks – Level 2.

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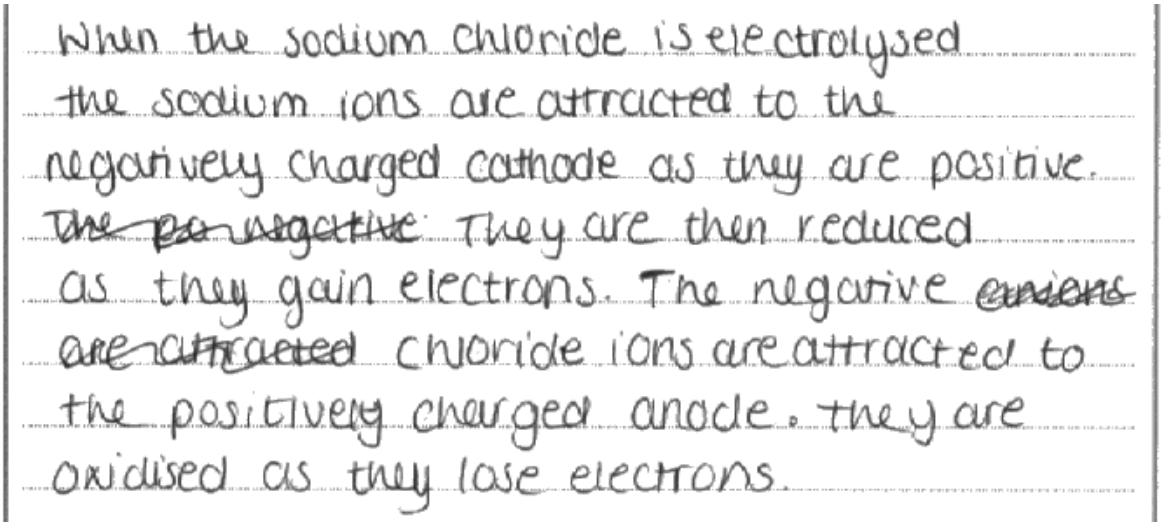
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Results Plus: Examiner Comments

Two correct points have been made, namely the movement of sodium ions to the cathode and chloride ions to the anode. This response scored 2 marks – Level 1.


When the sodium chloride is electrolysed the sodium ions are attracted to the negatively charged cathode as they are positive. ~~The positive~~ They are then reduced as they gain electrons. The negative ~~anions are attracted~~ chloride ions are attracted to the positively charged anode. they are oxidised as they lose electrons.

Results Plus: Examiner Comments

The movement of the sodium ions to the cathode and chloride ions to the anode are mentioned. Redox reactions at the electrodes have been discussed, namely chloride ions losing electrons / oxidation and sodium ions gaining electrons / reduction. Overall, although the answer is relatively concise, there are six relevant points regarding both the electrode processes, so this response is sufficient for Level 3 and scored 6 marks.

Two inert electrodes are used, supplied with a current and put into an electrolyte of molten sodium chloride where Na^+ and Cl^- ions are free to move. At the negative cathode Na^+ cations are reduced, and gain electrons, to be deposited as solid sodium atoms. The half equation is: $Na^+_{(l)} + e^- \rightarrow Na_{(s)}$. The sodium is collected and used in street lamps and as a coolant in some nuclear reactors.

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Results Plus: Examiner Comments

This is an excellent example of typical Level 3 response – 6 marks.

The movement of ions to the respective electrodes has been discussed and the electrode processes at the anode and cathode have been described and explained in detail, coupled with detailed halfequations. There are greater than the minimum valid points required for Level 3.

Q8.

(a)(i)

Mainly correct, but capital and small letters must be clear.

(a)(ii)

This part was not well answered with a high proportion of blanks or incorrect answers. Many said it was a good conductor, but omitted 'heat' or said "a good conductor of electricity". Others latched on to the word 'molten' and made comments about free moving electrons/ions being

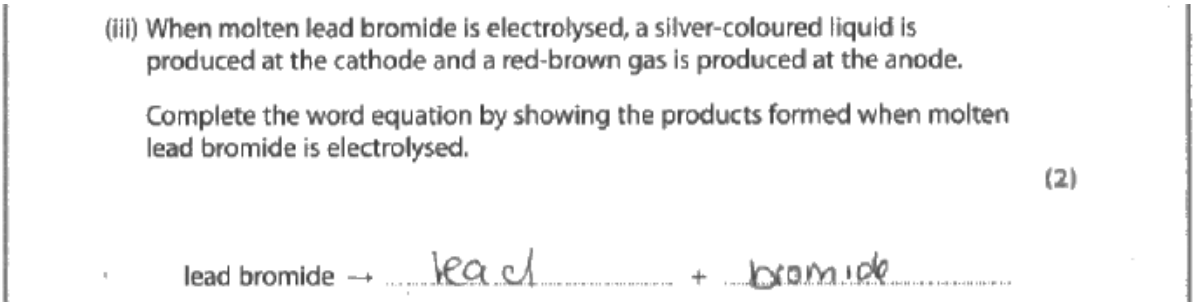
present in a molten substance allowing electrolysis to take place (or that solid sodium could not be used). Others latched on to 'sodium' and described that it was suitable due to its high reactivity.

(b)(i)

Reasonably well know, with 'OIL RIG' regularly seen jotted down beside correct answers. A useful mnemonic!

(b)(iii)

Whilst there were many correct answers here, a surprising number of other elements (or even compounds) were generated out of lead bromide (including iron, copper, silver, chlorine and nitrogen). Bromide was an obvious error as a product, and candidates are advised that rather than superimposing 'n' over 'd' to correct an error, it would be better to cross out the incorrect answer and write in the correct answer above. The question clearly required the completion of the word equation, so symbols were not credited.



(iii) When molten lead bromide is electrolysed, a silver-coloured liquid is produced at the cathode and a red-brown gas is produced at the anode.

Complete the word equation by showing the products formed when molten lead bromide is electrolysed.

(2)

lead bromide → lead + bromide

Results Plus: Examiner Comments

This answer scored 1.

Results Plus: Examiner Tip

Remember that the halogens are called fluorine, chlorine, bromine and iodine, but the ions are fluoride, bromide, chloride and iodide.

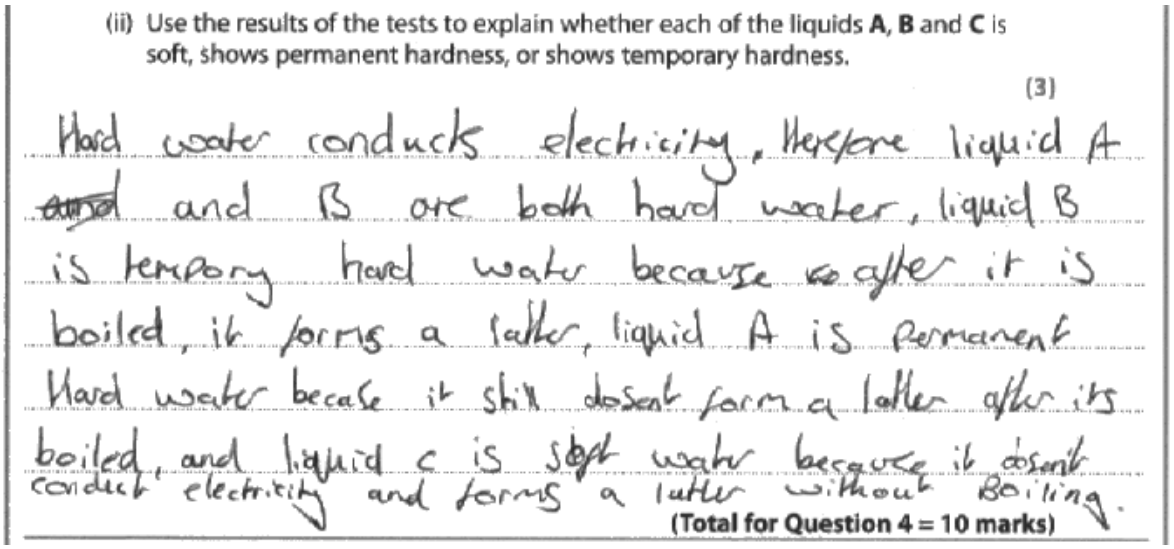
(c)(i)

It is important in a question like this that **all** of the correct answers are given.

(c)(ii)

Many excellent 3 mark answers were seen here, where the type of hardness in the three liquids was clearly stated with evidence from the data, some candidates using the conductivity data effectively. Some candidates just stated the types of hardness but gave no explanations, and only scored one mark. In some cases, there was a lack of clarity over liquid B; not showing that scum formed before and lather after.

There were some apparent 'slips of the pen' where one liquid was repeated with a different explanation and one liquid was omitted. Candidates are strongly advised to read through such answers before moving on.



(ii) Use the results of the tests to explain whether each of the liquids **A**, **B** and **C** is soft, shows permanent hardness, or shows temporary hardness.

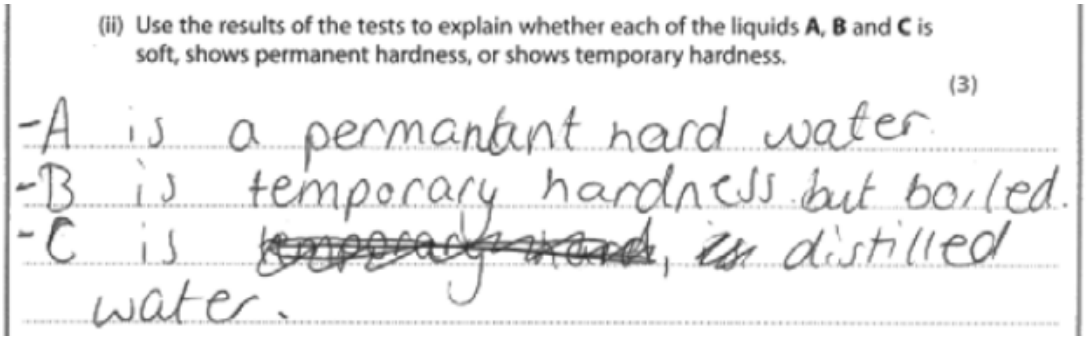
(3)

Hard water conducts electricity, therefore liquid A ~~and~~ and B are both hard water, liquid B is tempory hard water because ~~so~~ after it is boiled, it forms a latter, liquid A is Permanent Hard water becase it still dosent form a latter after its boiled, and liquid C is ~~soft~~ water because it dosent conduct electricity and forms a latter without Boiling.

(Total for Question 4 = 10 marks)

Results Plus: Examiner Comments

This is an excellent answer that uses the data given to explain whether the liquids are soft or show permanent or temporary hardness.



(ii) Use the results of the tests to explain whether each of the liquids **A**, **B** and **C** is soft, shows permanent hardness, or shows temporary hardness.

(3)

-A is a permanant hard water
-B is temporary hardness but boiled.
-C is ~~temporary hard~~, is distilled water.

Results Plus: Examiner Comments

This candidate has some knowledge but has not applied it to answer the question as required.

Results Plus: Examiner Tip

Read through your answers and check that they do what is asked. If the question says 'use the results...' then you must refer to the data given.

Q9.

(a)(i)

Mainly correct, but capital and small letters must be clear.

(a)(ii)

This part was not well answered with a high proportion of blanks or incorrect answers. Many said it was a good conductor, but omitted 'heat' or said "a good conductor of electricity". Others latched on to the word 'molten' and made comments about free moving electrons/ions being present in a molten substance allowing electrolysis to take place (or that solid sodium could not be used). Others latched on to 'sodium' and described that it was suitable due to its high reactivity.

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Complete the word equation by showing the products formed when molten lead bromide is electrolysed.

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This answer scored 1.

Results Plus: Examiner Tip

Remember that the halogens are called fluorine, chlorine, bromine and iodine, but the ions are fluoride, bromide, chloride and iodide.

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(c)(ii)

Many excellent 3 mark answers were seen here, where the type of hardness in the three liquids was clearly stated with evidence from the data, some candidates using the conductivity data effectively. Some candidates just stated the types of hardness but gave no explanations, and only scored one mark. In some cases, there was a lack of clarity over liquid B; not showing that scum formed before and lather after.

There were some apparent 'slips of the pen' where one liquid was repeated with a different explanation and one liquid was omitted. Candidates are strongly advised to read through such answers before moving on.

(ii) Use the results of the tests to explain whether each of the liquids **A**, **B** and **C** is soft, shows permanent hardness, or shows temporary hardness.

(3)

Hard water conducts electricity, therefore liquid A ~~and~~ and B are both hard water, liquid B is tempory hard water because ~~so~~ after it is boiled, it forms a latter, liquid A is Permanent Hard water becase it still dosent form a latter after its boiled, and liquid C is soft water because it dosent conduct electricity and forms a latter without Boiling.

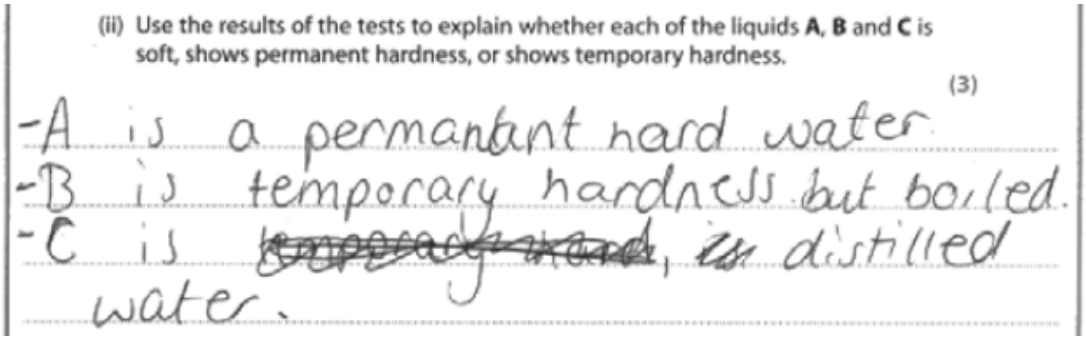
(Total for Question 4 = 10 marks)

Results Plus: Examiner Comments

This is an excellent answer that uses the data given to explain whether the liquids are soft or show permanent or temporary hardness.

(ii) Use the results of the tests to explain whether each of the liquids **A**, **B** and **C** is soft, shows permanent hardness, or shows temporary hardness.

(3)



Results Plus: Examiner Comments

This candidate has some knowledge but has not applied it to answer the question as required.

Results Plus: Examiner Tip

Read through your answers and check that they do what is asked. If the question says 'use the results...' then you must refer to the data given.

Q10.

(b)(i)

The majority of candidates knew that argon can be used to put out fires because it is nonflammable.

(b)(ii)

The majority of candidates knew that helium is used in airships because it has a low density.

(c)(i)

It was disappointing that not many candidates knew the appearance of chlorine at room temperature. The appearance of bromine and iodine were given as a colour and a physical state and there were 2 marks for this question, so candidates should also have given the appearance of chlorine as a colour and a physical state. A common incorrect answer was that chlorine is a blue liquid, showing that candidates were probably confused with the use of chlorine in swimming pools. Candidates would benefit from being shown a gas jar of chlorine.

halogen	appearance at room temperature
chlorine	gas
bromine	dark red liquid
iodine	grey solid

Results Plus: Examiner Comments

This candidate scored 1 mark for gas.

Results Plus: Examiner Tip

If you are given some information in a question, try to see if there is a pattern and answer in a similar way. In this question, the appearances of bromine and iodine are described with a colour and a physical state. The appearance of chlorine should also include the colour and physical state.

halogen	appearance at room temperature
chlorine	Green gas
bromine	dark red liquid
iodine	grey solid

Results Plus: Examiner Comments

This is an example of an answer that scored 2 marks as it includes the correct colour and physical state for chlorine.

(c)(ii)

The majority of candidates could write the correct word equation.

Some candidates decided to attempt to write a balanced equation, but credit was only given if this was completely correct. Symbols such as H or Cl should not be used for hydrogen and chlorine gas. Candidates are advised to write word equations when they are asked to do so in a question.

Some candidates also lost marks by writing CL as the symbol for chlorine and others changed the product to hydrochloric acid, hydrochloride or hydrogen chlorine.



Results Plus: Examiner Comments

This answer scores 1 mark for hydrogen + chlorine. The candidate has written the name of the product as hydrogen chlorine, which is incorrect.

Results Plus: Examiner Tip

Copy the names of chemicals carefully from the question.



Results Plus: Examiner Comments

This candidate tried to write a balanced equation, but the formulae are incorrect so no marks were given.

Results Plus: Examiner Tip

If a question asks for a word equation, do not try to write a balanced equation.



Results Plus: Examiner Comments

This is an example of a correct word equation, scoring 2 marks.

Q11.

(b)(i)

The majority of candidates knew that argon can be used to put out fires because it is nonflammable.

(b)(ii)

The majority of candidates knew that helium is used in airships because it has a low density.

(c)(i)

It was disappointing that not many candidates knew the appearance of chlorine at room temperature. The appearance of bromine and iodine were given as a colour and a physical state and there were 2 marks for this question, so candidates should also have given the appearance of chlorine as a colour and a physical state. A common incorrect answer was that chlorine is a blue liquid, showing that candidates were probably confused with the use of chlorine in swimming pools. Candidates would benefit from being shown a gas jar of chlorine.

halogen	appearance at room temperature
chlorine	gas
bromine	dark red liquid
iodine	grey solid

Results Plus: Examiner Comments

This candidate scored 1 mark for gas.

Results Plus: Examiner Tip

If you are given some information in a question, try to see if there is a pattern and answer in a similar way. In this question, the appearances of bromine and iodine are described with a colour and a physical state. The appearance of chlorine should also include the colour and physical state.

halogen	appearance at room temperature
chlorine	Green gas
bromine	dark red liquid
iodine	grey solid

Results Plus: Examiner Comments

This is an example of an answer that scored 2 marks as it includes the correct colour and physical state for chlorine.

(c)(ii)

The majority of candidates could write the correct word equation.

Some candidates decided to attempt to write a balanced equation, but credit was only given if this was completely correct. Symbols such as H or Cl should not be used for hydrogen and chlorine gas. Candidates are advised to write word equations when they are asked to do so in a question.

Some candidates also lost marks by writing CL as the symbol for chlorine and others changed the product to hydrochloric acid, hydrochloride or hydrogen chlorine.

Hydrogen + chlorie → hydrogen chlorine

Results Plus: Examiner Comments

This answer scores 1 mark for hydrogen + chlorine. The candidate has written the name of the product as hydrogen chlorine, which is incorrect.

Results Plus: Examiner Tip

Copy the names of chemicals carefully from the question.

CL + H → CHL

Results Plus: Examiner Comments

This candidate tried to write a balanced equation, but the formulae are incorrect so no marks were given.

Results Plus: Examiner Tip

If a question asks for a word equation, do not try to write a balanced equation.

hydrogen + chlorine → hydrogen chloride

Results Plus: Examiner Comments

This is an example of a correct word equation, scoring 2 marks.

Q12.

(a)(i)

Many candidates stated that the temperature increased, although quite a few skipped that statement and stated that heat is released. Some candidates did not then link that to an exothermic reaction.

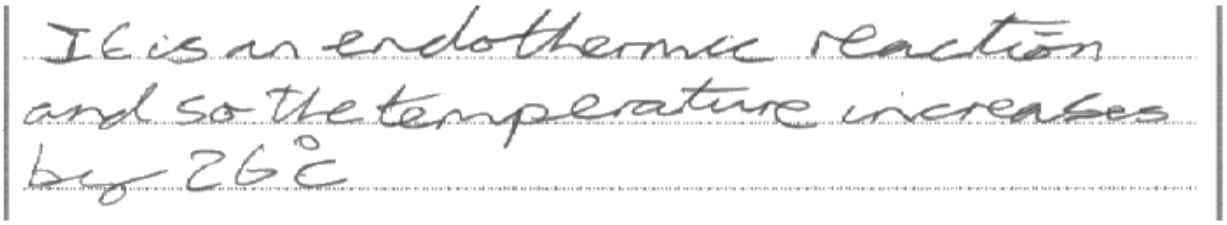
There was quite a lot of confusion between exothermic and endothermic reactions when the temperature rises and many contradictory statements were seen, for example 'the temperature increased so the reaction takes in heat'. Many candidates are unclear about the difference between heat and temperature and it was not unusual to see statements such as 'the heat increased by 26°C'.

(2)

This is an ~~exothermic~~ endothermic reaction. Heat energy has been absorbed by the ~~solution~~ reaction.

Results Plus: Examiner Comments

This candidate knows the meaning of endothermic but unfortunately this is the wrong answer to this question so no mark was scored.

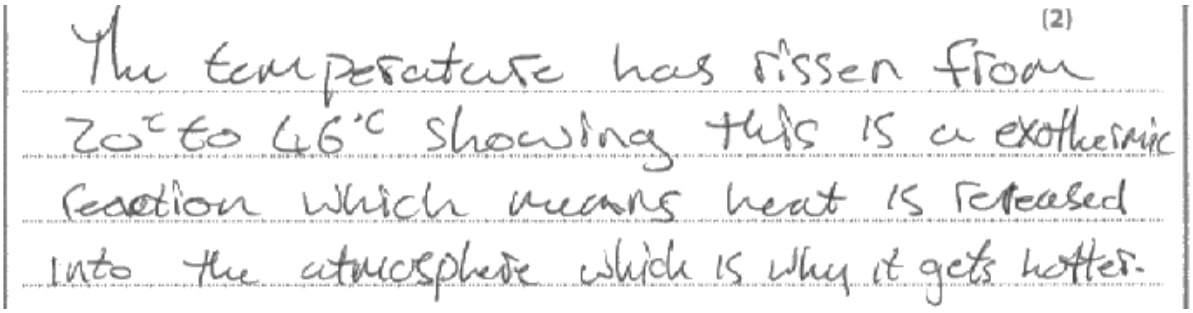


Results Plus: Examiner Comments

This candidate has stated that the temperature has increased, so scores 1 mark. Unfortunately they have mixed up the meaning of exothermic and endothermic.

Results Plus: Examiner Tip

Learn the difference between exothermic and endothermic reactions.



Results Plus: Examiner Comments

This is a very good answer that scored 2 marks. The candidate has written about the temperature change and linked this to an exothermic reaction.

(a)(ii)

Many candidates were able to complete the equation for the reaction with the correct formulae. Some candidates completed the equation as a word equation and received no credit.

Some candidates would benefit from more practice in writing balanced equations.



Results Plus: Examiner Comments

This candidate has written the names of the substances formed and scored no marks. If a question asks for formulae, you will not receive any marks for a word equation.

Results Plus: Examiner Tip

Practise writing balanced equations.

$Zn + CuSO_4 \rightarrow ZnCu + ZnSO_4$

Results Plus: Examiner Comments

This candidate has scored 1 mark for the correct formula for zinc sulfate. ZnCu is incorrect. Look at the information given in the question. The start of this question states that zinc sulfate and copper are formed.

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Results Plus: Examiner Comments

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

(b)

There were some excellent answers to this question. However, some candidates are confused between rate and time and wrote about time getting quicker rather than shorter. Some candidates just described the pattern in the graph and they scored 1 mark. Other candidates knew that the rate increases as the concentration increases and they also scored a mark. A common incorrect answer was that the rate decreases as the concentration increases as they had not realised that the graph was a plot of time against concentration.

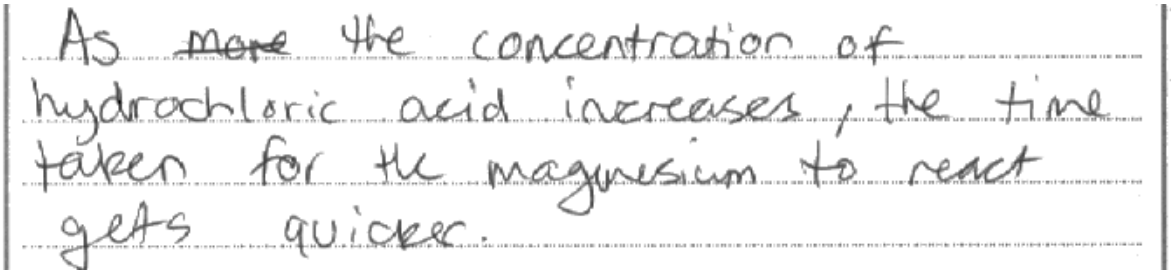
The more concentration of hydrochloric acid increased the less time taken for the magnesium to react.

Results Plus: Examiner Comments

This answer scored 1 mark as it gives a clear description of the pattern shown in the graph.

Results Plus: Examiner Tip

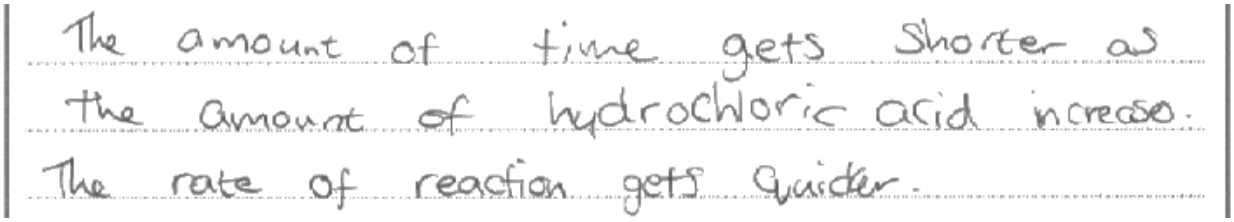
Use the labels on the axes of the graph to help you to describe the pattern shown.



Results Plus: Examiner Comments

This candidate has confused rate and time so has not scored a mark.

Try to understand the difference between rate and time. As the time taken for a reaction to take place decreases, the rate of reaction increases.



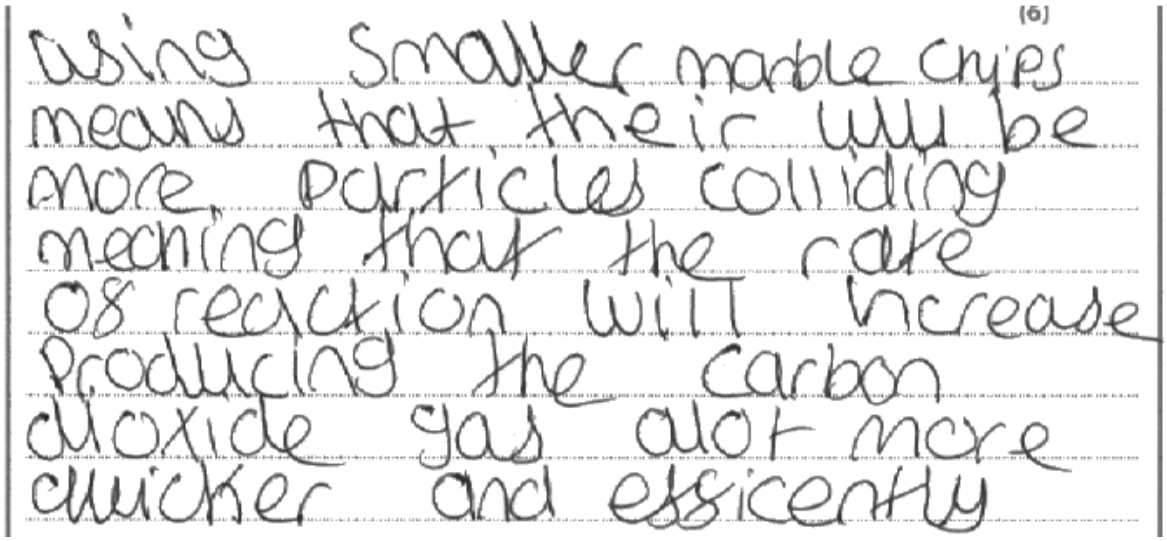
Results Plus: Examiner Comments

This is a correct answer and scored 2 marks.

(c)

Some candidates gave excellent experimental details of how to investigate the effect of using different size marble chips on the rate of reaction, showing that they had carried out these experiments. Some candidates tried to describe an experiment of adding the marble chips to a beaker of hydrochloric acid but they gave no indication of how they could measure the volume of gas produced, the mass loss or time for limewater to go milky. Some candidates seemed unfamiliar with this type of experiment but they gave good descriptions of the results they would expect and they received some credit for this. Some candidates were unfamiliar with the idea of

a fair test and thought that they could investigate the rate by comparing one large chip and one small chip or use different masses of marble chips. A common misunderstanding was that smaller marble chips have a smaller surface area so they react faster. A few candidates thought that the marble chips were acting as a catalyst. Some candidates spent time writing about other factors that affect the rate of reaction but that was not needed in this question.


(6)

using smaller marble chips means that their will be more particles colliding meaning that the rate of reaction will increase producing the carbon dioxide gas alot more quicker and effiicently

Results Plus: Examiner Comments

This is an example of a level 1 answer that scored 2 marks. The candidate has not described the experiments but does know that smaller marble chips will increase the rate of reaction.

Results Plus: Examiner Tip

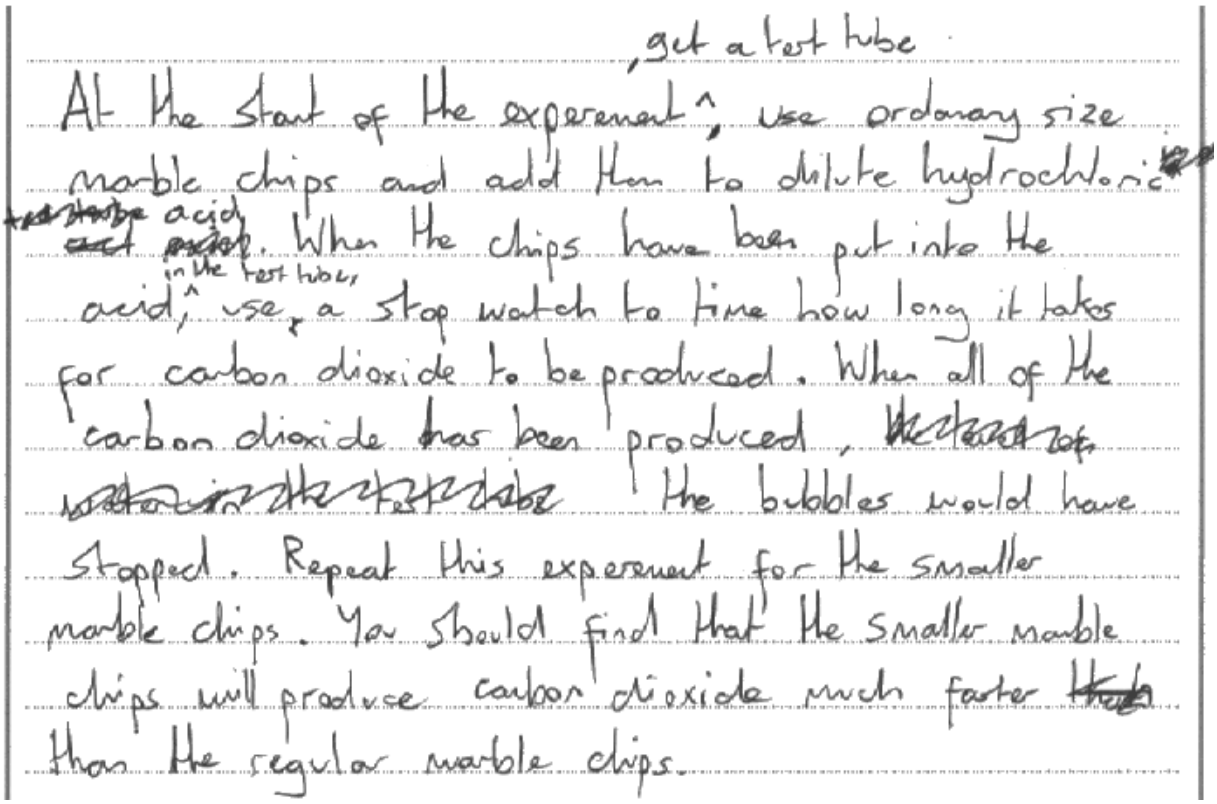
Revise the experiments that you have carried out or seen demonstrated to you so that you can describe them.

Using smaller marble chips, means that there is a larger surface area. When you have a larger surface area, it means that the particas of the hydrochloric acid are more likely to collide with the smaller marble chips than the large marble chips, as the large marble chips have a smaller surface area. With more particas colliding with the marble chips, the faster the rate of ~~the reaction~~ the reaction will happen. If you have a small surface area, the particas will not collide with the marble as frequently, therefor creating the rate of the reaction happen slower.

Results Plus: Examiner Comments

This is an example of a level 2 answer that scored 4 marks. The candidate has explained that the smaller marble chips have a larger surface area so the reaction will be faster. However, they have not described an experiment so they cannot achieve level 3.

You will only achieve the highest level if you answer the question and include a description of the experiments.



Results Plus: Examiner Comments

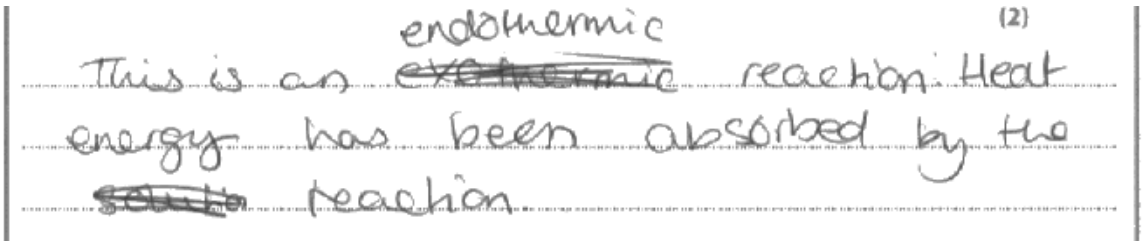
This is an example of a level 3 answer that scored 6 marks. The answer gives a description of two experiments and the results that would be expected.

Q13.

(a)(i)

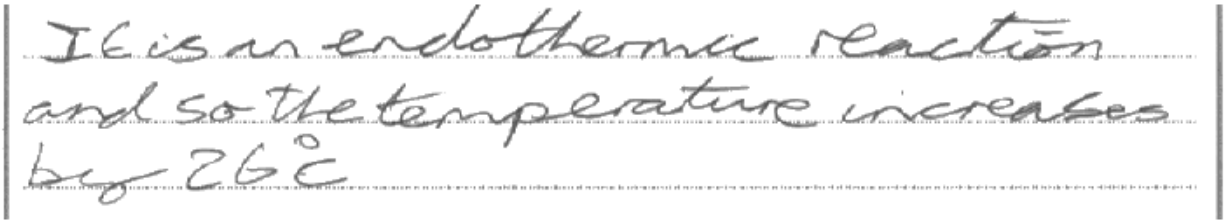
Many candidates stated that the temperature increased, although quite a few skipped that statement and stated that heat is released. Some candidates did not then link that to an exothermic reaction.

There was quite a lot of confusion between exothermic and endothermic reactions when the temperature rises and many contradictory statements were seen, for example 'the temperature increased so the reaction takes in heat'. Many candidates are unclear about the difference between heat and temperature and it was not unusual to see statements such as 'the heat increased by 26°C'.



Results Plus: Examiner Comments

This candidate knows the meaning of endothermic but unfortunately this is the wrong answer to this question so no mark was scored.

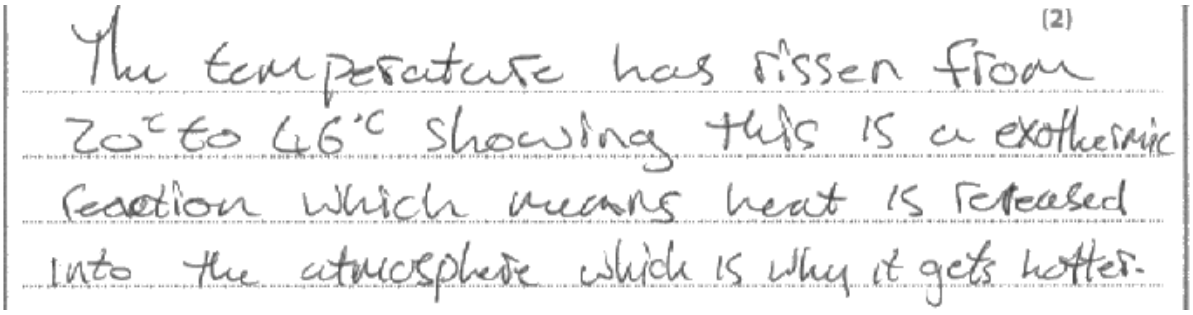


Results Plus: Examiner Comments

This candidate has stated that the temperature has increased, so scores 1 mark. Unfortunately they have mixed up the meaning of exothermic and endothermic.

Results Plus: Examiner Tip

Learn the difference between exothermic and endothermic reactions.



Results Plus: Examiner Comments

This is a very good answer that scored 2 marks. The candidate has written about the temperature change and linked this to an exothermic reaction.

(a)(ii)

Many candidates were able to complete the equation for the reaction with the correct formulae. Some candidates completed the equation as a word equation and received no credit.

Some candidates would benefit from more practice in writing balanced equations.



Results Plus: Examiner Comments

This candidate has written the names of the substances formed and scored no marks. If a question asks for formulae, you will not receive any marks for a word equation.

Results Plus: Examiner Tip

Practise writing balanced equations.



Results Plus: Examiner Comments

This candidate has scored 1 mark for the correct formula for zinc sulfate. ZnCu is incorrect. Look at the information given in the question. The start of this question states that zinc sulfate and copper are formed.



Results Plus: Examiner Comments

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

(b)

There were some excellent answers to this question. However, some candidates are confused between rate and time and wrote about time getting quicker rather than shorter. Some candidates just described the pattern in the graph and they scored 1 mark. Other candidates knew that the rate increases as the concentration increases and they also scored a mark. A common incorrect answer was that the rate decreases as the concentration increases as they had not realised that the graph was a plot of time against concentration.

The more concentration of hydrochloric acid increased the less time taken for the magnesium to react.

Results Plus: Examiner Comments

This answer scored 1 mark as it gives a clear description of the pattern shown in the graph.

Results Plus: Examiner Tip

Use the labels on the axes of the graph to help you to describe the pattern shown.

As ~~more~~ the concentration of hydrochloric acid increases, the time taken for the magnesium to react gets quicker.

Results Plus: Examiner Comments

This candidate has confused rate and time so has not scored a mark.

Try to understand the difference between rate and time. As the time taken for a reaction to take place decreases, the rate of reaction increases.

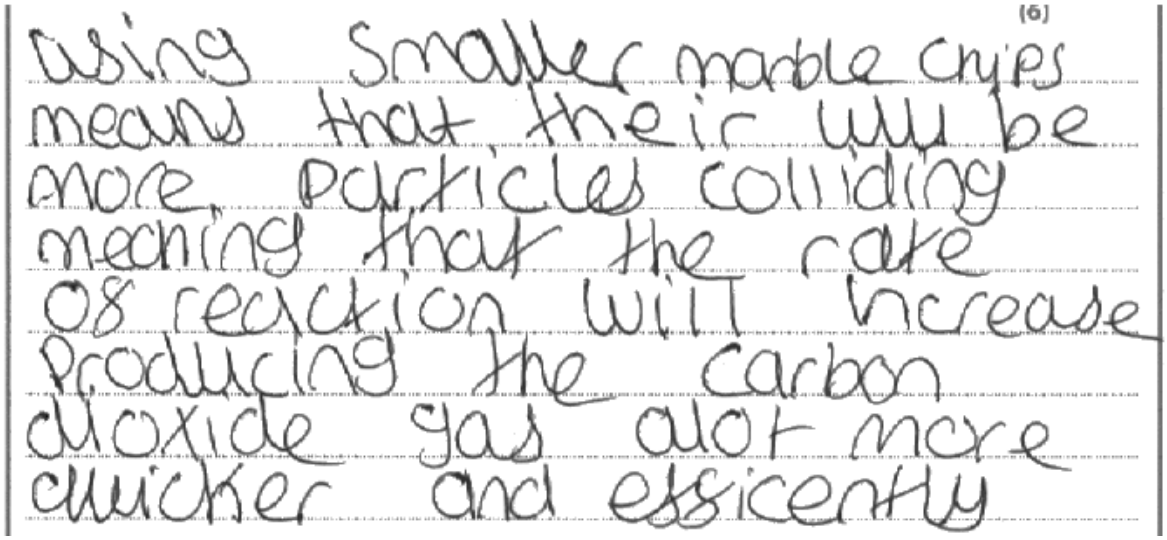
The amount of time gets shorter as the amount of hydrochloric acid increase. The rate of reaction gets quicker.

Results Plus: Examiner Comments

This is a correct answer and scored 2 marks.

(c)

Some candidates gave excellent experimental details of how to investigate the effect of using different size marble chips on the rate of reaction, showing that they had carried out these experiments. Some candidates tried to describe an experiment of adding the marble chips to a beaker of hydrochloric acid but they gave no indication of how they could measure the volume of gas produced, the mass loss or time for limewater to go milky. Some candidates seemed unfamiliar with this type of experiment but they gave good descriptions of the results they would expect and they received some credit for this. Some candidates were unfamiliar with the idea of a fair test and thought that they could investigate the rate by comparing one large chip and one small chip or use different masses of marble chips. A common misunderstanding was that smaller marble chips have a smaller surface area so they react faster. A few candidates thought that the marble chips were acting as a catalyst. Some candidates spent time writing about other factors that affect the rate of reaction but that was not needed in this question.


(6)
using smaller marble chips means that their will be more particles colliding meaning that the rate of reaction will increase producing the carbon dioxide gas alot more quicker and essicently

Results Plus: Examiner Comments

This is an example of a level 1 answer that scored 2 marks. The candidate has not described the experiments but does know that smaller marble chips will increase the rate of reaction.

Results Plus: Examiner Tip

Revise the experiments that you have carried out or seen demonstrated to you so that you can describe them.

Using smaller marble chips, means that there is a larger surface area. When you have a larger surface area, it means that the particas of the hydrochloric acid are more likely to collide with the smaller marble chips than the large marble chips, as the large marble chips have a smaller surface area. With more particas colliding with the marble chips, the faster the rate of ~~the reaction~~ the reaction will happen. If you have a small surface area, the particas will not collide with the marble as frequently, therefor creating the rate of the reaction happen slower.

Results Plus: Examiner Comments

This is an example of a level 2 answer that scored 4 marks. The candidate has explained that the smaller marble chips have a larger surface area so the reaction will be faster. However, they have not described an experiment so they cannot achieve level 3.

You will only achieve the highest level if you answer the question and include a description of the experiments.

, get a test tube
At the start of the experiment, use ordinary size marble chips and add them to dilute hydrochloric acid in the test tube. When the chips have been put into the acid, use a stop watch to time how long it takes for carbon dioxide to be produced. When all of the carbon dioxide has been produced, the bubbles would have stopped. Repeat this experiment for the smaller marble chips. You should find that the smaller marble chips will produce carbon dioxide much faster than the regular marble chips.

Results Plus: Examiner Comments

This is an example of a level 3 answer that scored 6 marks. The answer gives a description of two experiments and the results that would be expected.

Q14.

Generally poorly answered with the majority of candidates scoring 1 mark only of the 3 available.

The most commonly seen responses scored 1 mark either for the left hand side or the right hand side – but few candidates managed both. Few candidates were able to correctly write a balanced equation. There were a few lost marks through a capital L as the second letter in a symbol.

Aluminium reacts with chlorine to form aluminium chloride.

Write the balanced equation for this reaction.

$Al^3 Cl^-$
$AlCl_3$

$Al + 3Cl \rightarrow AlCl_3$

Results Plus: Examiner Comments

This response scored 1 of the 3 marks available.

The response is awarded 1 mark for the correct formula of aluminium chloride shown on the right hand side of the equation. The formula of chlorine shown on the left hand side of the equation is incorrect since the subscripted 2 is missing from the formula. The balancing mark cannot be awarded, since it is dependent on the correct formulae of all species being shown.

Results Plus: Examiner Tip

Ensure that you can write the formula for the simple molecules used in the specification, *e.g.* remember that the formula of a molecule of chlorine is Cl_2.

Aluminium reacts with chlorine to form aluminium chloride.

Write the balanced equation for this reaction.

(3)

$2Al + Cl_2 \rightarrow 2AlCl$

Results Plus: Examiner Comments

This response scored 1 of the 3 marks available.

The response is awarded 1 mark for the correct species, namely Al + Cl_2, shown on the left hand side of the equation. The formula of aluminium chloride shown on the right hand side of the equation is incorrect. The balancing mark cannot be awarded, since it is dependent on the correct formulae of all species being shown.

Q15.

Generally very well answered with most candidates able to score 2 or 3 of the 3 marks available for balancing the equation and giving the correct state symbols.

Common errors in responses were:

Writing numbers instead of state symbols or candidates thinking that the formula needed to be completed, *e.g.* Na(OH) where OH was written in the space for the state symbol or incorrectly giving (aq) as the state symbol for water.

Sodium reacts with water to form sodium hydroxide solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

.....Na(..S.....) + $2H_2O$(..L.....) → ..... NaOH(..aq...) + H_2(..g.....)

Results Plus: Examiner Comments

This response scored 1 mark only.

The candidate has not attempted to balance the equation. The mark awarded is for the correct state symbols which are marked independently of the balancing.

Sodium reacts with water to form sodium hydroxide solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

..2..Na(..S.....) + $2H_2O$(.....) → ..2.. NaOH(.....) + H_2(.....)

Results Plus: Examiner Comments

This response scored 2 of the 3 marks available.

The equation is correctly balanced and scores 1 mark for 2 Na and 1 mark for 2 NaOH. Clearly the mark for the state symbols is not scored. This is marked independently of the balancing. Although the OH in brackets is clearly changing the formula of Na to NaOH, this would not affect the awarding of the first two marks for balancing the equation.

Q16.

The balancing here was refreshingly well done. As in question 3e, state symbols were poor, with water as aq a common mistake.

The 2 in front of the sodium was very often correct and more so than the 2 in front of the sodium hydroxide.

Again, it was clear that some candidates had not used state symbols before and tried to add further elements, compounds or numbers in the brackets.

Sodium reacts with water to form sodium hydroxide in solution and hydrogen.

Complete the balancing of the equation for this reaction and add the state symbols for each substance.

(3)

$2\ Na(s) + 2H_2O(l) \rightarrow 2\ NaOH(aq) + H_2(g)$

Na	2	Na	2
H	4	H	4
O	2	O	2

Results Plus: Examiner Comments

This candidate has carefully counted the atoms of each element on each side of the equation.

Q17.

(c)

This was very well answered on the whole, with the majority of responses giving a colour for Universal indicator within the correct 'yellow / orange / red' range. In the few incorrect responses seen either 'blue/purple' or 'green' were commonly seen, confusing the colour with that for alkalis or neutral solutions.

(d)

Most candidates scored at least 1 mark of the 2 marks available, either for showing the correct reactant or product formula. A few candidates thought that the formula for the reactant was NaH_2, or carelessly, showed the second letter in the symbol for sodium using an upper case 'A', namely NAOH.

(d) The word equation for the reaction of dilute ethanoic acid with sodium hydroxide solution is

ethanoic acid + sodium hydroxide → sodium ethanoate + water

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Results Plus: Examiner Comments

The most commonly seen fully correct response, with both the correct reactant and product formulae shown, so this scored 2 marks.

(d) The word equation for the reaction of dilute ethanoic acid with sodium hydroxide solution is

ethanoic acid + sodium hydroxide → sodium ethanoate + water

Complete the balanced equation for this reaction. (2)

$CH_3COOH + NaH_2 \rightarrow CH_3COONa + H_2O$

Results Plus: Examiner Comments

A commonly seen error, showing the reactant formula, NaH_2, but giving the correct formula for water, so this response clearly scored 1 mark only.

(e)

Most candidates could recall 'hydrogen', as being the correct gas from the 'pop' test, to score the 1 mark available.

(f) (i)

Few candidates gained the full 2 marks available, that is for correctly writing both the correct reactants and products. The majority simply gained credit for writing the reactants, which were clearly given in the stem of the question. The most common mistake was to omit 'water' as the other product besides ethyl ethanoate. In a few cases, 'carbon dioxide' was incorrectly given as one of the products, instead of water, or careless, misspelled names meant a mark could not be awarded.

(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction. (2)

Ethanoic acid + Ethanol → Ethyl ethanoate

Results Plus: Examiner Comments

The correct reactants have been shown, but there is the omission of 'water' from the products, so this response was awarded just 1 of the 2 marks available.

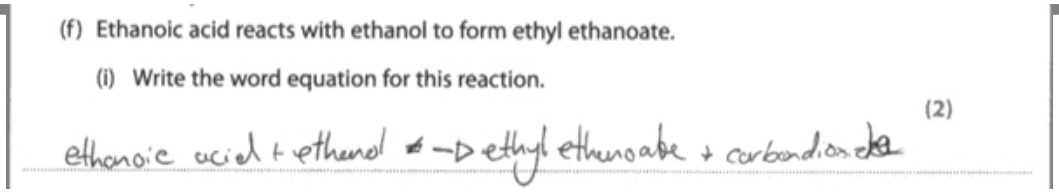
(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction. (2)

ethanoic acid + ethanol → ethyl ethanoate + water

Results Plus: Examiner Comments

A typical correct answer. Both the reactants and products have been shown correctly, so this was awarded the full 2 marks available.



(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction.

(2)

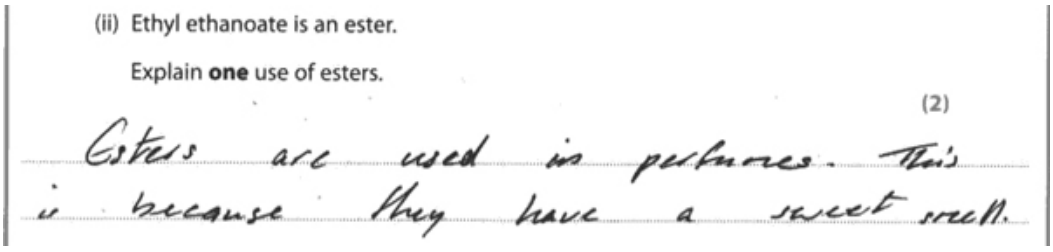
ethanoic acid + ethanol → ethyl ethanoate + carbon dioxide

Results Plus: Examiner Comments

A commonly seen response. The reactants are correct, but 'carbon dioxide' has been given as one of the products in addition to ethyl ethanoate, instead of the correct product 'water'. This response scored 1 mark only.

(f) (ii)

Most candidates scored at least 1 of the 2 marks available. By far the most commonly seen correct 2 mark responses linked 'perfumes' (use) to 'pleasant smelling' (property) or less commonly 'flavourings/sweets' to 'tastes nice' or words to that effect. Occasionally, candidates scored just 1 mark by reference to 'in clothing' (polyesters), but rarely linked this to 'can be made into fibres'.



(ii) Ethyl ethanoate is an ester.

Explain **one** use of esters.

(2)

Esters are used in perfumes. This is because they have a sweet smell.

Results Plus: Examiner Comments

The mentioning of 'perfume' is a suitable use. However, although commonly seen in responses 'sweet' is not a correct description of a smell, so the mark for the linked property was not awarded. Overall this was awarded just 1 mark.

Results Plus: Examiner Tip

When answering typical 2 marked responses linking the use and property of esters, be careful to avoid 'sweet' when referring to (pleasant) smells.

(ii) Ethyl ethanoate is an ester.

Explain **one** use of esters.

(2)

a holiday which you collect chocolate eggs.

Results Plus: Examiner Comments

A response seen in quite a few cases 'esters' confused with 'Easter'! This was awarded 0 marks.

Q18.

(c)

This was very well answered on the whole, with the majority of responses giving a colour for Universal indicator within the correct 'yellow / orange / red' range. In the few incorrect responses seen either 'blue/purple' or 'green' were commonly seen, confusing the colour with that for alkalis or neutral solutions.

(d)

Most candidates scored at least 1 mark of the 2 marks available, either for showing the correct reactant or product formula. A few candidates thought that the formula for the reactant was NaH_2, or carelessly, showed the second letter in the symbol for sodium using an upper case 'A', namely NAOH.

(d) The word equation for the reaction of dilute ethanoic acid with sodium hydroxide solution is

ethanoic acid + sodium hydroxide → sodium ethanoate + water

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Results Plus: Examiner Comments

The most commonly seen fully correct response, with both the correct reactant and product formulae shown, so this scored 2 marks.

(d) The word equation for the reaction of dilute ethanoic acid with sodium hydroxide solution is

ethanoic acid + sodium hydroxide → sodium ethanoate + water

Complete the balanced equation for this reaction.

(2)

CH_3COOH + NaH_2 → CH_3COONa + H_2O

Results Plus: Examiner Comments

A commonly seen error, showing the reactant formula, NaH_2, but giving the correct formula for water, so this response clearly scored 1 mark only.

(e)

Most candidates could recall 'hydrogen', as being the correct gas from the 'pop' test, to score the 1 mark available.

(f) (i)

Few candidates gained the full 2 marks available, that is for correctly writing both the correct reactants and products. The majority simply gained credit for writing the reactants, which were clearly given in the stem of the question. The most common mistake was to omit 'water' as the other product besides ethyl ethanoate. In a few cases, 'carbon dioxide' was incorrectly given as one of the products, instead of water, or careless, misspelled names meant a mark could not be awarded.

(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction.

(2)

Ethanoic acid + Ethanol → Ethyl ethanoate

Results Plus: Examiner Comments

The correct reactants have been shown, but there is the omission of 'water' from the products, so this response was awarded just 1 of the 2 marks available.

(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction.

(2)

ethanoic acid + ethanol → ethyl ethanoate + water

Results Plus: Examiner Comments

A typical correct answer. Both the reactants and products have been shown correctly, so this was awarded the full 2 marks available.

(f) Ethanoic acid reacts with ethanol to form ethyl ethanoate.

(i) Write the word equation for this reaction.

(2)

ethanoic acid + ethanol → ethyl ethanoate + carbon dioxide

Results Plus: Examiner Comments

A commonly seen response. The reactants are correct, but 'carbon dioxide' has been given as one of the products in addition to ethyl ethanoate, instead of the correct product 'water'. This response scored 1 mark only.

(f) (ii)

Most candidates scored at least 1 of the 2 marks available. By far the most commonly seen correct 2 mark responses linked 'perfumes' (use) to 'pleasant smelling' (property) or less commonly 'flavourings/sweets' to 'tastes nice' or words to that effect. Occasionally, candidates scored just 1 mark by reference to 'in clothing' (polyesters), but rarely linked this to 'can be made into fibres'.

(ii) Ethyl ethanoate is an ester.

Explain **one** use of esters.

(2)

Esters are used in perfumes. This is because they have a sweet smell.

Results Plus: Examiner Comments

The mentioning of 'perfume' is a suitable use. However, although commonly seen in responses 'sweet' is not a correct description of a smell, so the mark for the linked property was not awarded. Overall this was awarded just 1 mark.

Results Plus: Examiner Tip

When answering typical 2 marked responses linking the use and property of esters, be careful to avoid 'sweet' when referring to (pleasant) smells.

(ii) Ethyl ethanoate is an ester.

Explain **one** use of esters.

(2)

a holiday which you collect chocolate eggs.

Results Plus: Examiner Comments

A response seen in quite a few cases 'esters' confused with 'Easter'! This was awarded 0 marks.

Q19.

(i)

The question was well answered, with the most popular choice of conditions being anaerobic conditions and a warm temperature/ correctly specified temperature range.

Ethanol

3 (a) Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

There must be no oxygen. The temperature must be at the yeast optimum degrees and there must be a good supply of nutrients.

Results Plus: Examiner Comments

Temperature is relevant, here, but needs to be specified or say 'warm'.

Results Plus: Examiner Tip

Please specify conditions carefully - what is the optimum temperature?

(iii)

This equation was poorly done. It is possible than many candidates did not think through working out the products and writing the formulae. Ethanol was, after all, mentioned in every other part of this question, yet a huge variety of formulae were given with no similarity to ethanol's formula at all. Photosynthesis and respiration equations were sometimes given.

Q20.

(i)

The question was well answered, with the most popular choice of conditions being anaerobic conditions and a warm temperature/ correctly specified temperature range.

Ethanol

3 (a) Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

Yeast must be present. The temperature must be at the yeast optimum degrees and there must be a good supply of nutrients.

Results Plus: Examiner Comments

Temperature is relevant, here, but needs to be specified or say 'warm'.

Results Plus: Examiner Tip

Please specify conditions carefully - what is the optimum temperature?

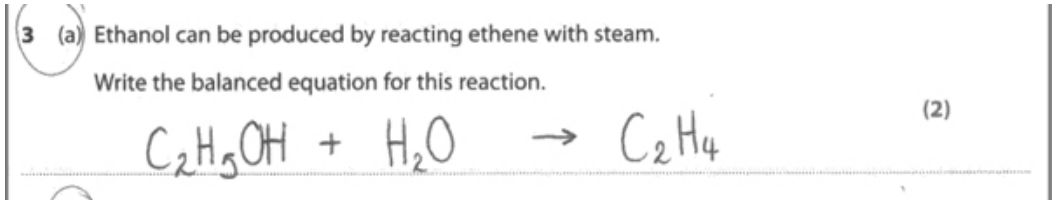
(iii)

This equation was poorly done. It is possible than many candidates did not think through working out the products and writing the formulae. Ethanol was, after all, mentioned in every other part of this question, yet a huge variety of formulae were given with no similarity to ethanol's formula at all. Photosynthesis and respiration equations were sometimes given.

Q21.

(a)

A large number of candidates could write the correct equation. However, a significant number did not know the formula for ethene.


3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

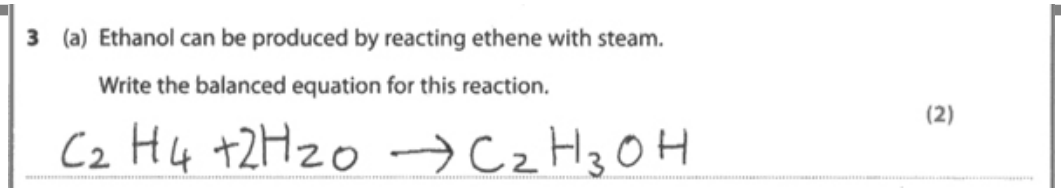
$C_2H_5OH + H_2O \rightarrow C_2H_4$ (2)

Results Plus: Examiner Comments

This candidate has mis-read the equation and written the equation in reverse, so did not score any marks.

Results Plus: Examiner Tip

Read the question carefully and write equations in the correct direction.


3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

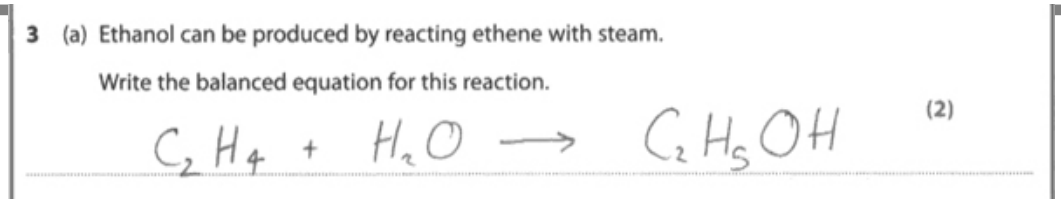
$C_2H_4 + 2H_2O \rightarrow C_2H_3OH$ (2)

Results Plus: Examiner Comments

This candidate has scored 1 mark for the correct formula for ethene as a reactant. The formula for ethanol is incorrect, even though this was given in part (d) of this question.

Results Plus: Examiner Tip

Use the correct formulae given on the examination paper.


3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

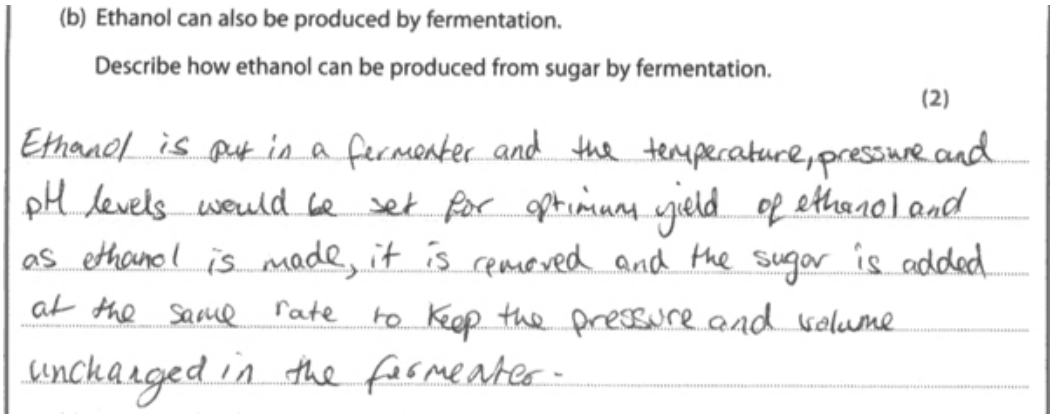
$C_2H_4 + H_2O \rightarrow C_2H_5OH$ (2)

Results Plus: Examiner Comments

This is an example of a completely correct equation, scoring 2 marks.

(b)

A number of candidates did not know how to produce ethanol by fermentation, but generally this question was well-answered with the majority of candidates scoring marks for adding yeast, using anaerobic conditions and a correct temperature. Very few candidates mentioned that sugar solution is used, although this was not necessary to score full marks.



(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

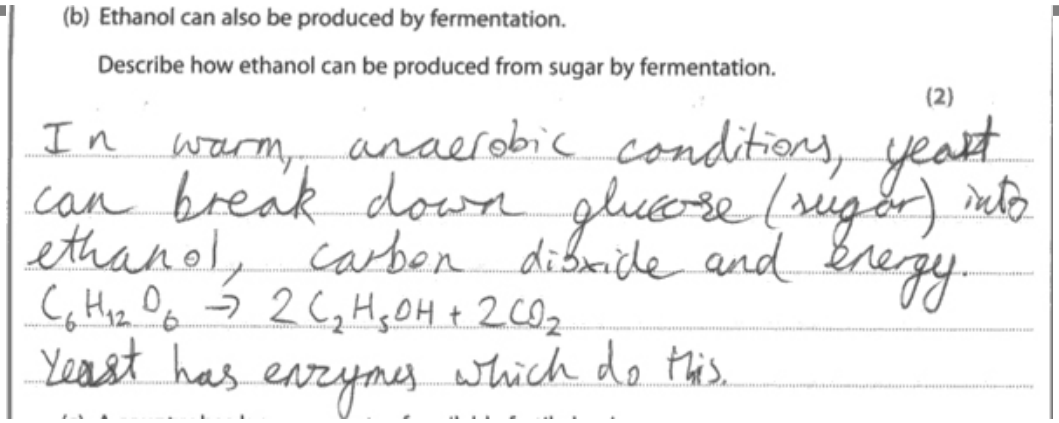
Ethanol is put in a fermenter and the temperature, pressure and pH levels would be set for optimum yield of ethanol and as ethanol is made, it is removed and the sugar is added at the same rate to keep the pressure and volume unchanged in the fermenter.

Results Plus: Examiner Comments

This is a vague answer that mentions temperature but does not suggest a suitable value. This answer did not score any marks.

Results Plus: Examiner Tip

When you describe an experiment, give specific details.



(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

In warm, anaerobic conditions, yeast can break down glucose (sugar) into ethanol, carbon dioxide and energy.

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

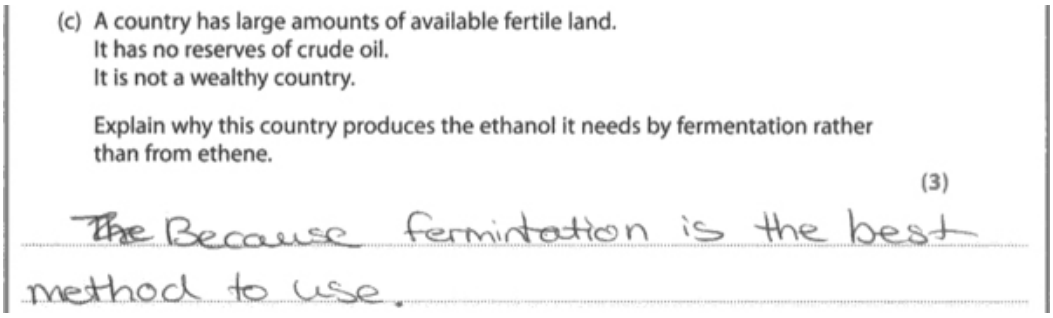
Yeast has enzymes which do this.

Results Plus: Examiner Comments

This is a very good answer, scoring both marks.

(c)

The majority of candidates were able to score at least two marks for this question as they could use the information given. A few candidates thought that the land would be useful for growing crops of yeast or for building the fermentation plant. Some candidates did not link the crude oil being used to produce ethene.



(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

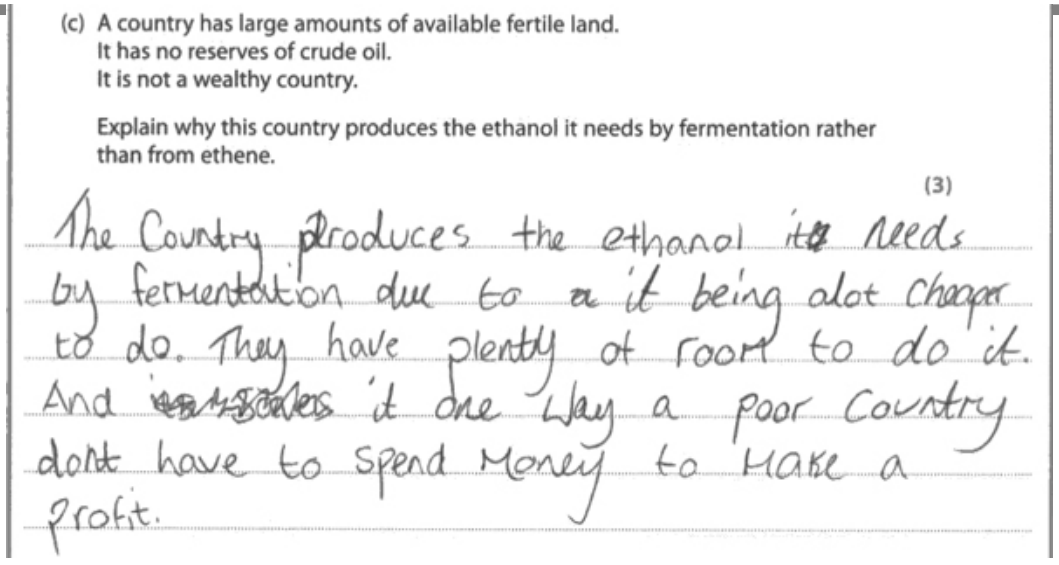
~~The~~ Because fermintation is the best method to use.

Results Plus: Examiner Comments

This type of answer did not use the information given in the question so did not score any marks.

Results Plus: Examiner Tip

Use the information given in the question.



(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

The Country produces the ethanol it needs by fermentation due to it being alot cheaper to do. They have plently of room to do it. And it one way a poor country dont have to spend Money to Make a profit.

Results Plus: Examiner Comments

This candidate has scored 1 mark for comparing the costs of the processes. They have mentioned 'plenty of room to do it', but this is too vague. If they had mentioned plenty of land to grow the crops needed to produce the sugar for fermentation, they would have scored another mark.

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

Fermentation is used to produce ethanol rather than from ethene because the county has fertile land. This land can be used to grow sugar beet or sugar cane to produce glucose for fermentation. The county also has no reserves of crude oil, meaning the crude oil can't be cracked to produce ethene, so no ethene is available in this county. Moreover, it is not wealthy therefore it cannot afford to produce ethanol from ethene as this is expensive (due to ~~crude~~ crude oil being a non-renewable resource of energy).

Results Plus: Examiner Comments

This is a very good answer and scored 3 marks.

(d)

Some excellent answers were seen to this question showing a clear understanding of the term 'homologous series'. A few candidates just wrote vague answers such as they all end in -ol or all contain the elements carbon, hydrogen and oxygen and these were not given any credit. A few candidates were also confused between the hydroxyl group and hydroxide ions. Some candidates gave an incorrect general formula, although the formulae for the alcohols were given in the question.

(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol	CH_3OH
ethanol	C_2H_5OH
propanol	C_3H_7OH

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

They have the same general formula ($C_nH_{2n+1}OH$) which is a property of the homologous series. They will also have similar chemical properties but show gradual change in their physical

Results Plus: Examiner Comments

This is an excellent answer, scoring both marks.

They are all members of the same homologous series as they contain the exact same elements, just in different proportions, and as more atoms are added, the higher the boiling point and the more viscous and less volatile it gets

(Total for Question 3 = 9 marks)

Results Plus: Examiner Comments

This candidate did not score any marks as 'contain the same elements in different proportions' is not the same as 'have the same general formula'.

Results Plus: Examiner Tip

Use correct scientific terminology, such as general formula' in your answers.

Q22.

(a)

A large number of candidates could write the correct equation. However, a significant number did not know the formula for ethene.

3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

$C_2H_5OH + H_2O \rightarrow C_2H_4$ (2)

Results Plus: Examiner Comments

This candidate has mis-read the equation and written the equation in reverse, so did not score any marks.

Results Plus: Examiner Tip

Read the question carefully and write equations in the correct direction.

3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

$C_2H_4 + 2H_2O \rightarrow C_2H_3OH$

Results Plus: Examiner Comments

This candidate has scored 1 mark for the correct formula for ethene as a reactant. The formula for ethanol is incorrect, even though this was given in part (d) of this question.

Results Plus: Examiner Tip

Use the correct formulae given on the examination paper.

3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

$C_2H_4 + H_2O \rightarrow C_2H_5OH$

Results Plus: Examiner Comments

This is an example of a completely correct equation, scoring 2 marks.

(b)

A number of candidates did not know how to produce ethanol by fermentation, but generally this question was well-answered with the majority of candidates scoring marks for adding yeast, using anaerobic conditions and a correct temperature. Very few candidates mentioned that sugar solution is used, although this was not necessary to score full marks.

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

Ethanol is put in a fermenter and the temperature, pressure and pH levels would be set for optimum yield of ethanol and as ethanol is made, it is removed and the sugar is added at the same rate to keep the pressure and volume uncharged in the fermenter.

Results Plus: Examiner Comments

This is a vague answer that mentions temperature but does not suggest a suitable value. This answer did not score any marks.

Results Plus: Examiner Tip

When you describe an experiment, give specific details.

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

In warm, anaerobic conditions, yeast can break down glucose (sugar) into ethanol, carbon dioxide and energy.

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Yeast has enzymes which do this.

Results Plus: Examiner Comments

This is a very good answer, scoring both marks.

(c)

The majority of candidates were able to score at least two marks for this question as they could use the information given. A few candidates thought that the land would be useful for growing crops of yeast or for building the fermentation plant. Some candidates did not link the crude oil being used to produce ethene.

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

The Because fermintation is the best method to use.

Results Plus: Examiner Comments

This type of answer did not use the information given in the question so did not score any marks.

Results Plus: Examiner Tip

Use the information given in the question.

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
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Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

The Country produces the ethanol it needs by fermentation due to it being alot cheaper to do. They have plently of room to do it. And it one way a poor country dont have to spend Money to Make a profit.

Results Plus: Examiner Comments

This candidate has scored 1 mark for comparing the costs of the processes. They have mentioned 'plenty of room to do it', but this is too vague. If they had mentioned plenty of land to grow the crops needed to produce the sugar for fermentation, they would have scored another mark.

(c) A country has large amounts of available fertile land.
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It is not a wealthy country.

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(3)

Fermentation is used to produce ethanol rather than from ethene because the country has fertile land. This land can be used to grow sugar beet or sugar cane to produce glucose for fermentation. The country also has no reserves of crude oil, meaning the crude oil can't be cracked to produce ethene, so no ethene is available in this country. Moreover, it is not wealthy therefore it cannot afford to produce ethanol from ethene as this is expensive (due to ~~cattle~~ crude oil being a non-renewable resource of energy).

Results Plus: Examiner Comments

This is a very good answer and scored 3 marks.

(d)

Some excellent answers were seen to this question showing a clear understanding of the term 'homologous series'. A few candidates just wrote vague answers such as they all end in -ol or all contain the elements carbon, hydrogen and oxygen and these were not given any credit. A few candidates were also confused between the hydroxyl group and hydroxide ions. Some candidates gave an incorrect general formula, although the formulae for the alcohols were given in the question.

(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol	CH_3OH
ethanol	C_2H_5OH
propanol	C_3H_7OH

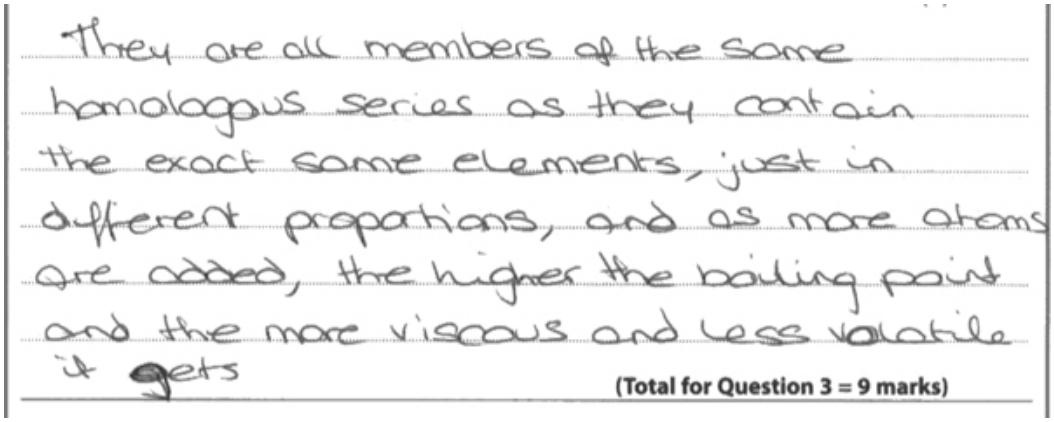
Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

They have the same general formula ($C_nH_{2n+1}OH$) which is a property of the homologous series. They will also have similar chemical properties but show gradual change in their physical

Results Plus: Examiner Comments

This is an excellent answer, scoring both marks.



Results Plus: Examiner Comments

This candidate did not score any marks as 'contain the same elements in different proportions' is not the same as 'have the same general formula'.

Results Plus: Examiner Tip

Use correct scientific terminology, such as general formula' in your answers.

Q23.

(b)

Most candidates gained full credit for showing the correct formulae for both reactants for the hydration of ethene.

Despite the reactants being given in the question, a large number of candidates were unable to recall the formula for ethene. Often the formula of ethane, C_2H_6, was shown, or C_2H_5 was given. Occasionally, candidates got the reactants and products the wrong way round. Several even got the formula for water wrong. Many candidates attempted to add a hydrocarbon and water to arrive at the product, a method that might have worked, but unfortunately were unable to work out the number hydrogen atoms in ethanol, with the hydrogen atom in the hydroxyl group omitted.

(c)(i)

Many candidates were able to gain full credit.

The majority of candidates scored the 2 marks for references to 'same general formula' and 'similar chemical properties'. Often candidates could correctly recall the general formulae for various homologous series.

Often candidates failed to score due to being too vague, referring to 'same properties', 'similar structure', 'similar formula'. In a few cases, confused the definition for an homologous series with that of a hydrocarbon.

(i) Describe what is meant by an **homologous series**.

(2)

A homologous Series is a grop of compands that all have a similar formula. This moans they have a similar molecular structure, and have similar properties.

Results Plus: Examiner Comments

This was a commonly seen incorrect response seen by examiners. The three points made regarding 'similar chemical formula, structure and similar properties' are not specific enough, so this response did not score.

(i) Describe what is meant by an **homologous series**.

(2)

This means that they all share very similar properties and all follow the same general formula.

Results Plus: Examiner Comments

This candidate mentions 'similar properties', but this is too vague, since there is no reference to 'similar chemical properties'. However, the reference to 'same general formula' is correct, so this scored 1 mark only.

(i) Describe what is meant by an **homologous series**.

(2)

A group of compounds all with the same general formula and the same functional group so that makes them all have similar chemical properties and react in same way

Results Plus: Examiner Comments

This is a very good example of a fully correct response. There are three creditworthy points made. The response scored the maximum 2 marks.

(c)(ii)

This was very well answered on the whole. Most candidates could correctly draw the displayed formula for methanol.

Most incorrect responses showed an C–HO bond for an C–OH, or tried to make the oxygen double bonded, as in C=OH or C=O, as in an aldehyde.

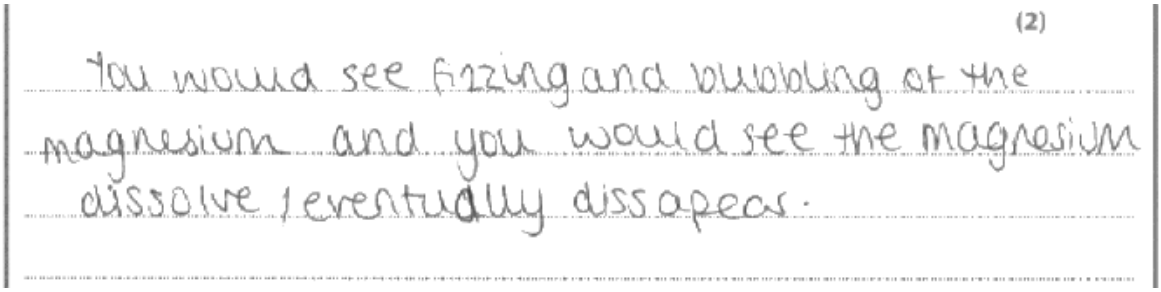
(d)(i)

Most candidates could correctly state that the type of reaction which occurs when ethanol changes into ethanoic acid is 'oxidation'. The most common incorrect responses often confused the oxidation process with 'fermentation' or 'reduction'.

(d)(ii)

Most candidates typically scored at least 1 of the 2 marks available for 'fizzing and/or 'disappear'. Although, not desirable, 'dissolve' was credited as an alternative to 'disappear'.

The most commonly seen error was for candidates not giving observations, but either mentioning 'gas given off' or simply naming the species formed, hydrogen and/or magnesium ethanoate, or explaining the chemical process. The question specifically asks for what you would **see**, as opposed to an explanation.


(2)

You would see fizzing and bubbling of the magnesium and you would see the magnesium dissolve / eventually dissapears.

Results Plus: Examiner Comments

A good example of a fully correct response. Marking points 1 and 2 are for the correct references to 'fizzing/bubbling' and 'disappear'.

Results Plus: Examiner Tip

Read the question carefully. This is a commonly asked question on the examination, so make sure you write down what is **seen**, rather than simply naming the chemical products or stating that a gas is given off. You cannot see a gas.

Q24.

(b)

Most candidates gained full credit for showing the correct formulae for both reactants for the hydration of ethene.

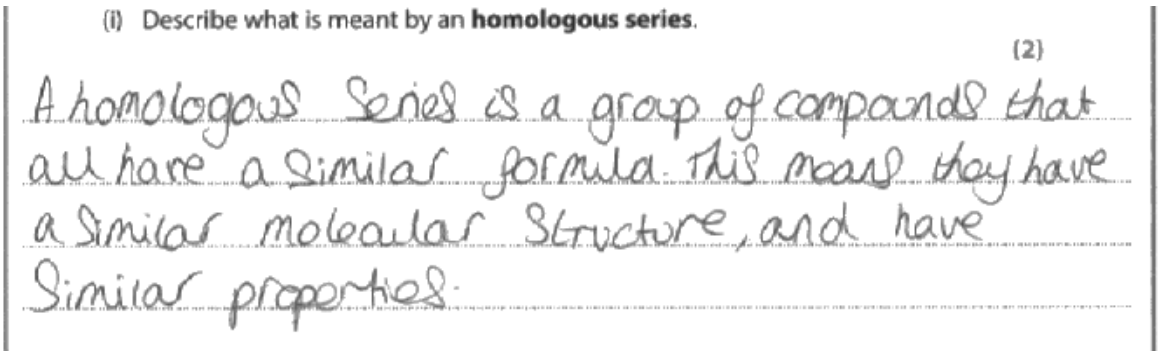
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(c)(i)

Many candidates were able to gain full credit.

The majority of candidates scored the 2 marks for references to 'same general formula' and 'similar chemical properties'. Often candidates could correctly recall the general formulae for various homologous series.

Often candidates failed to score due to being too vague, referring to 'same properties', 'similar structure', 'similar formula'. In a few cases, confused the definition for an homologous series with that of a hydrocarbon.



(i) Describe what is meant by an **homologous series**.

(2)

A homologous Series is a group of compounds that all have a similar formula. This means they have a similar molecular structure, and have similar properties.

Results Plus: Examiner Comments

This was a commonly seen incorrect response seen by examiners. The three points made regarding 'similar chemical formula, structure and similar properties' are not specific enough, so

this response did not score.

(i) Describe what is meant by an **homologous series**.

(2)

This means that they all share very similar properties and all follow the same general formula.

Results Plus: Examiner Comments

This candidate mentions 'similar properties', but this is too vague, since there is no reference to 'similar chemical properties'. However, the reference to 'same general formula' is correct, so this scored 1 mark only.

(i) Describe what is meant by an **homologous series**.

(2)

A group of compounds all with the same general formula and the same functional group so that makes them all have similar chemical properties and react in same way

Results Plus: Examiner Comments

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This was very well answered on the whole. Most candidates could correctly draw the displayed formula for methanol.

Most incorrect responses showed an C–HO bond for an C–OH, or tried to make the oxygen double bonded, as in C=OH or C=O, as in an aldehyde.

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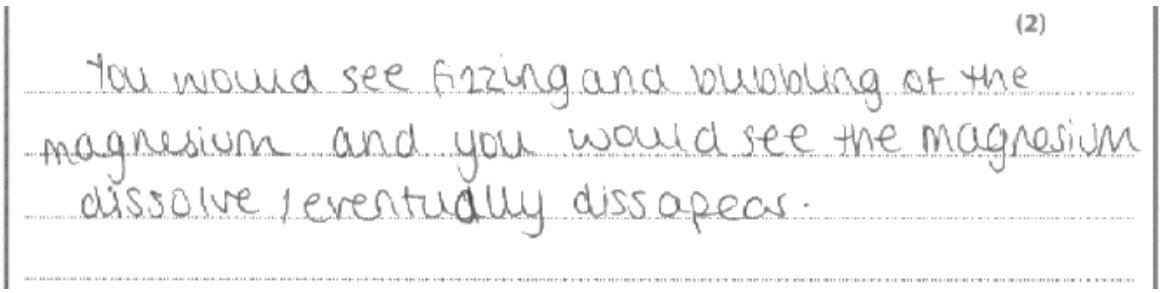
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(2)

You would see fizzing and bubbling of the magnesium and you would see the magnesium dissolve / eventually dissapear.

Results Plus: Examiner Comments

A good example of a fully correct response. Marking points 1 and 2 are for the correct references to 'fizzing/bubbling' and 'disappear'.

Results Plus: Examiner Tip

Read the question carefully. This is a commonly asked question on the examination, so make sure you write down what is **seen**, rather than simply naming the chemical products or stating that a gas is given off. You cannot see a gas.

Q25. No Examiner's Report available for this question

Q26. No Examiner's Report available for this question

Q27.

(ii)

It was pleasing to see that many candidates had obviously seen this practical demonstrated and gave a good response, with very few blank responses. Many were able to describe how the teacher could demonstrate the experiment.

In addition to describing the experiment, better candidates also described how the results of the experiment give the order of reactivity of the metals.

Common safety precautions credited were the used of safety goggles, gloves, use of a safety shield and ensuring that the students were stood well back. Some candidates gave generic lab rules such as wearing your hair up, tucking chairs under tables etc; these were not credited. Concerned, if not necessarily high-scoring, candidates suggested the teacher should "stay calm", "have a fire extinguisher close", "tell students to wear PPE" and "carry out the experiment whilst still thinking of maximum safety".

Other points such as the need to cut the metal into small pieces, the fact that a large bowl would be needed, that tweezers should be used to transfer the metals were less common.

The biggest source of error in the description was to do the experiment in beakers or test tubes or simply not stress the size of the container of water. When it came to the analysis of the results, some candidates simply copied out the table, which gained no marks. As with the other 6 mark question lots of candidates finished their answer with one aspect (method of experiment) and did not talk about the reactivities at all; again they need to tackle the whole question.

It was encouraging (although not necessary) to see some candidates giving the science behind the observations, most of this seemed correct.

*(ii) A teacher demonstrated this experiment.

The results are shown in Figure 14.

	lithium	sodium	potassium
position of metal in water	floats	floats	floats
movement of metal	slow	fast	very fast
effervescence / bubbling	slow	fast	very fast

Figure 14

Describe, in detail, how the teacher would demonstrate this experiment safely, showing how the results give the order of reactivity of the metals.

(6)

Half-fill a small tank with water. Weigh and record a sample of solid lithuim, wearing safety goggles. ~~Continuing to wear safety goggles, add the piece of lithium to the water tank using a pair of tongs~~ Place a screen around the tank of water to avoid being hurt. Continuing to wear safety goggles, add the piece of Lithuim to the water tank using a pair of tongs. The lithuim does not move very quickly and produces a small amount of bubbling. This is because

Lithuim is at the top of group 1 (alkali metals) and so the forces of attraction between the nucleus and electrons are strong as it only has 2 shells of electrons. This means it will be difficult for these forces of attraction to be overcome, on hence the lithium is not very reactive. Repeat this experiment in the same way with clean water. Weigh a piece of sodium of the same size as the piece of lithium. Place the sodium in the water tank. Sodium moves faster and bubbles faster than lithium. It is below lithium in group 1 of the Periodic Table. This means it is less reactive than lithuim as the atom has an extra electron shell, so the outer electron is further from the nucleus and the forces of attraction between the nucleus and electron are easier to overcome, so sodium is more reactive. Potassium moves very fast and bubbles very fast. This is because it is more reactive than lithuim and sodium as it is below both in group 1 of the Periodic Table. The electrons are further from the nucleus, and so the electron is able to leave the atom more easily.

Results Plus: Examiner Comments

This is a Level 3 answer. The explanation of the reactivity in terms of electronic configuation was NOT expected. Even without this, the answer covers both the method in enough detail and the trend.

*(ii) A teacher demonstrated this experiment.

The results are shown in Figure 14.

	lithium	sodium	potassium
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Figure 14

Describe, in detail, how the teacher would demonstrate this experiment safely, showing how the results give the order of reactivity of the metals.

(6)

The teacher would demonstrate this safely by standing up rather than getting acid in her lap. She would wear gloves and goggles to protect acid ~~the~~ irritating skin and splashing in eyes. Use Lithium, then Sodium and potassium in order of their reactivity series. Lithium was least reactive as it was slow bubbeling, however sodium was next and then potassium as it gave the ~~&~~ very fast bubbling.

Results Plus: Examiner Comments

This is a Level 2 answer.

There are some practical details and the trends is given. Unfortunately, in using data from the table the candidate just copies these out. It would have been better to say that potassium bubbbles the fastest, then sodium, and lithium bubbles the slowest. giving an interpretation to the words in the table.

Q28.

This was the most difficult equation on the paper but many candidates scored all 3 marks.

Many scored 2 marks for all the correct formulae but could not balance the equation correctly. Many had the incorrect formula for iron – Fe_2, which then only allowed them to score one mark for the correct reactants.

(c) Iron is extracted from iron oxide, Fe_2O_3.

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

$4Fe_2O_3 + 3C_2 \rightarrow 8Fe + 6CO_2$

Results Plus: Examiner Comments

A tricky balanced equation placed here on the last question. Many tried to balance it by using 'C_2' on the reactants side. Only 1 mark here for the correct products.

(c) Iron is extracted from iron oxide, Fe_2O_3.

In the extraction process the iron oxide is heated with carbon to form iron and carbon dioxide.

Write the balanced equation for this reaction.

(3)

$2Fe_2O_3 + 3C \rightarrow Fe_4 + 3CO_2$

Results Plus: Examiner Comments

Some candidates tried balancing the equtaion using Fe_2 on the products side - or Fe_4 as in this case. Only 1 mark for the correct reactants here.

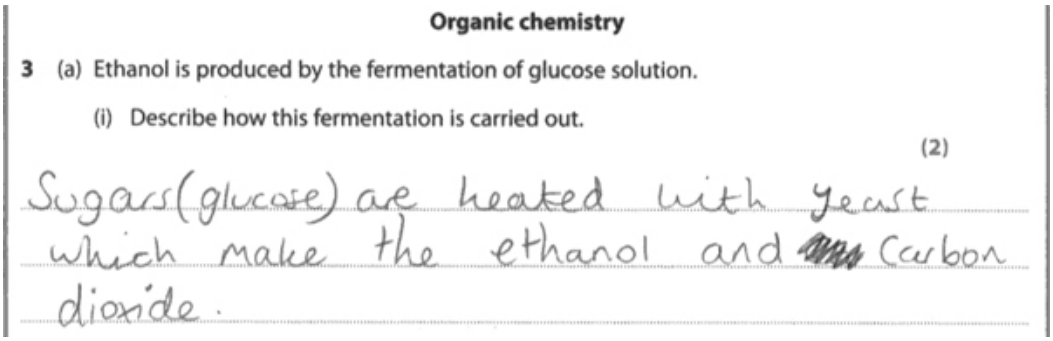
Results Plus: Examiner Tip

Make sure you know the formulae of the compounds used in the course. Also make sure you know which elements exist as molecules.

Q29.

(i)

This was poorly answered, with few candidates scoring either 1 or 2 marks. Many incorrect answers simply mentioned either 'fractional distillation', 'put in a fermenter' or 'boiling'. Of those answers which scored a mark it was invariably for mentioning the use of 'yeast'. Many candidates were not explicit, since they vaguely referred to using 'optimum / optimum conditions', using 'enzymes' or just 'heating', so could not score.



Organic chemistry

3 (a) Ethanol is produced by the fermentation of glucose solution.

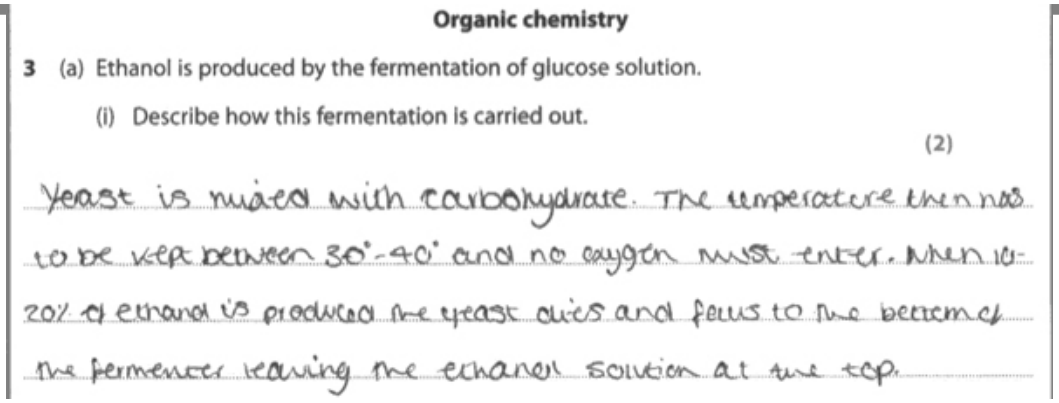
(i) Describe how this fermentation is carried out.

(2)

Sugars (glucose) are heated with yeast which make the ethanol and ~~~~ Carbon dioxide.

Results Plus: Examiner Comments

This candidate simply mentioned 'heated', which alone was too vague to score. However, the mention of '(with) yeast', was sufficient to score 1 mark.



Organic chemistry

3 (a) Ethanol is produced by the fermentation of glucose solution.

(i) Describe how this fermentation is carried out.

(2)

Yeast is mixed with carbohydrate. The temperature then has to be kept between 30°-40° and no oxygen must enter. When 10-20% of ethanol is produced the yeast dies and falls to the bottom of the fermenter leaving the ethanol solution at the top.

Results Plus: Examiner Comments

This is a good example of a fully correct response, worth 2 marks. All the marking points have been adequately covered. On a minor point, the extra slightly incorrect mentioning of '20% ethanol is produced' could be ignored.

(ii)

The majority of responses simply scored 1 of the 2 marks available for 'ethanol' by failing to mention 'carbon dioxide'. The main misconception from most responses was that 'water' was formed as one of the products, besides ethanol.

(ii) Complete the word equation for the fermentation of glucose.

glucose → Ethanol acid + water (2)

Results Plus: Examiner Comments

Both products mentioned 'ethanol acid' and 'water' are incorrect, so this response scored 0 marks.

(ii) Complete the word equation for the fermentation of glucose.

glucose → ethanol + Carbon dioxide. (2)

Results Plus: Examiner Comments

Both the correct products have been mentioned, so this response scored the full 2 marks available.

(ii) Complete the word equation for the fermentation of glucose.

glucose → Ethanol + water. (2)

Results Plus: Examiner Comments

By far the most commonly seen answer for 1 mark only, correctly referring to 'ethanol' but putting 'water' instead of the correct 'carbon dioxide'.

(iv)

This was very well answered, with the most commonly seen responses referring simply to 'liver damage', or various spellings of 'cirrhosis', for the 1 mark available. In a few cases, slightly vague responses referring simply to 'affects reaction time' without qualifying this with 'increases', failed to score.

Q30.

(i)

This was poorly answered, with few candidates scoring either 1 or 2 marks. Many incorrect answers simply mentioned either 'fractional distillation', 'put in a fermenter' or 'boiling'. Of those answers which scored a mark it was invariably for mentioning the use of 'yeast'. Many

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Organic chemistry

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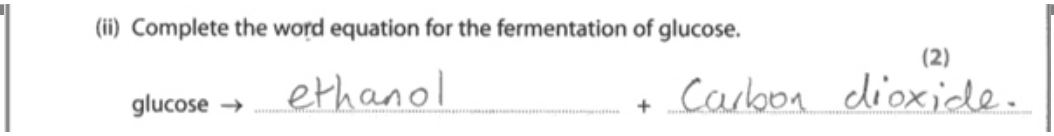
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(2)

glucose → Ethanol acid + ~~water~~ CO_2

Results Plus: Examiner Comments

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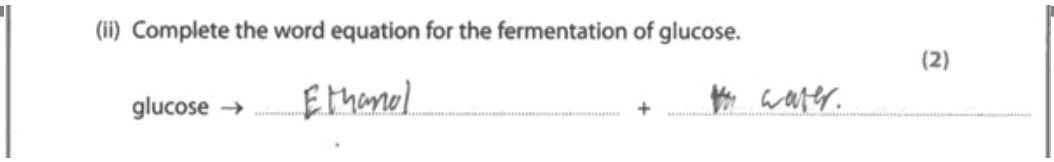

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(2)

glucose → ethanol + Carbon dioxide.

Results Plus: Examiner Comments

Both the correct products have been mentioned, so this response scored the full 2 marks available.


(ii) Complete the word equation for the fermentation of glucose.

(2)

glucose → Ethanol + water.

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By far the most commonly seen answer for 1 mark only, correctly referring to 'ethanol' but putting 'water' instead of the correct 'carbon dioxide'.

(iv)

This was very well answered, with the most commonly seen responses referring simply to 'liver damage', or various spellings of 'cirrhosis', for the 1 mark available. In a few cases, slightly vague responses referring simply to 'affects reaction time' without qualifying this with 'increases', failed to score.

Q31.

(a)

This part allowed many candidates to get off to a good start. There was, however, some confusion between fertilisers and pesticides or herbicides. There were a few references to fertilisers being catalysts (not credited) because they speed up the rate of growth (credited). Others suggested that the main function of fertilisers was to neutralise acidic soils.

Some good, detailed descriptions were given.

Fertilisers and ammonia

1 (a) State why farmers spread fertilisers on their fields.

(1)

To increase the crop yield, Fertilisers are made from nitrates which makes the crops grow bigger and faster

Results Plus: Examiner Comments

This answer includes plenty of relevant detail.

Fertilisers and ammonia

1 (a) State why farmers spread fertilisers on their fields.

(1)

Farmers spread fertilisers to help there crops grow quicker and to keep animals away

Results Plus: Examiner Comments

Fertilisers are not used to keep animals away.

Results Plus: Examiner Tip

Learn the difference between fertilisers, pesticides and herbicides.

(b)

This question had a good response with many candidates giving well-explained answers. Most candidates recognised that run-off of fertilisers into water was an issue, and a good number of candidates gained a further mark with answers related to eutrophication, named by some and described by others. However, some candidates thought that fertilisers may kill plants and animals on land, or were unclear what the effect was on water life. Candidates are advised not to be vague, for example "affecting fish" does not tell us whether fish are helped or harmed.

(b) Using too much fertiliser can harm the environment.

Describe how the spreading of too much fertiliser on fields can harm the environment.

(2)

If there is too much, it could be washed into rivers and lakes. It will encourage algae and plants to grow on the surface of the lake. This will block sunlight getting in the river so plants can't photosynthesis so die. Fish and animals also die as there is little oxygen. This is eutrophication.

Results Plus: Examiner Comments

This answer is explained very clearly using good, scientific terminology.

(b) Using too much fertiliser can harm the environment.

Describe how the spreading of too much fertiliser on fields can harm the environment.

(2)

The Fertiliser can damage living things that currently live in the area

Results Plus: Examiner Comments

This answer contrasts with the first example, giving little detail.

Results Plus: Examiner Tip

Be clear about what you mean. Fertilisers that are washed into lakes, for example, can lead to the death of fish, but this answer is much too vague.

(c)(i)

Despite being given so much information in the question, i.e. all of the reactants and products, there were a surprising number of blanks or the misuse of ammonia for ammonium and vice versa (which of course had to be penalised in this example). A few candidates unwisely attempted to use formulae; all of those that did were incorrect.

(c) Ammonium nitrate is a fertiliser.

Ammonium nitrate is formed when nitric acid reacts with ammonia.

(i) Write the word equation for this reaction.

(2)

Nitric acid + Ammonia → Ammonia nitrate.

Results Plus: Examiner Comments

Be careful – the product 'ammonium nitrate' was written in the question, and information like this should be carefully transferred.

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(2)

N_2 + NH_3 → N_3H_3

Results Plus: Examiner Comments

Some candidates give symbol equations when asked for word equations. They have to be completely correct – and rarely are – to score.

(d)(i)

Most responses were given as some spelling of "reversible". Some incorrect responses included "the Haber Process" (an understanding of 'type' is important), "reverse/ reverse reaction", "interchangeable", "vice versa" and "static equilibrium".

(d) In the Haber process, nitrogen and hydrogen react to form ammonia.

nitrogen + hydrogen ⇌ ammonia

(i) The ⇌ symbol in the word equation shows that the reaction goes forwards and backwards at the same time.

Give the name of this type of reaction.

(1)

Two - way reaction.

Results Plus: Examiner Comments

Reversible reaction / equilibrium was required.

Results Plus: Examiner Tip

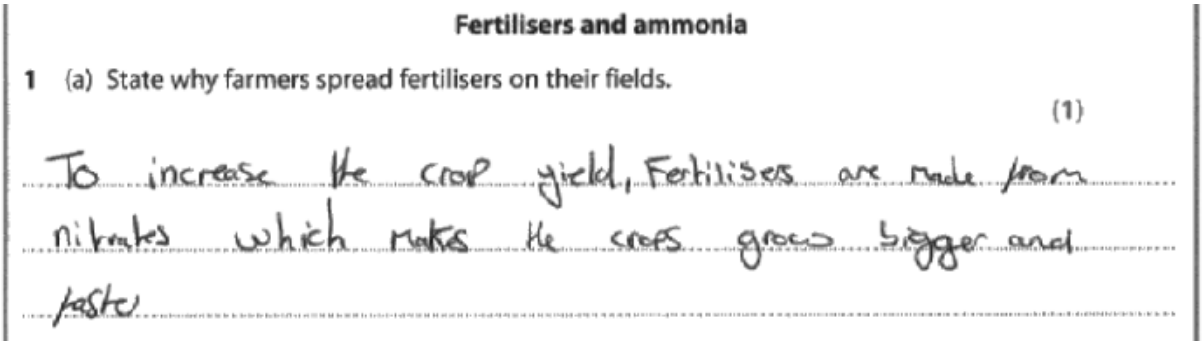
You must learn correct scientific terms – why not produce a list of all the key words you learn in each topic?

Q32.

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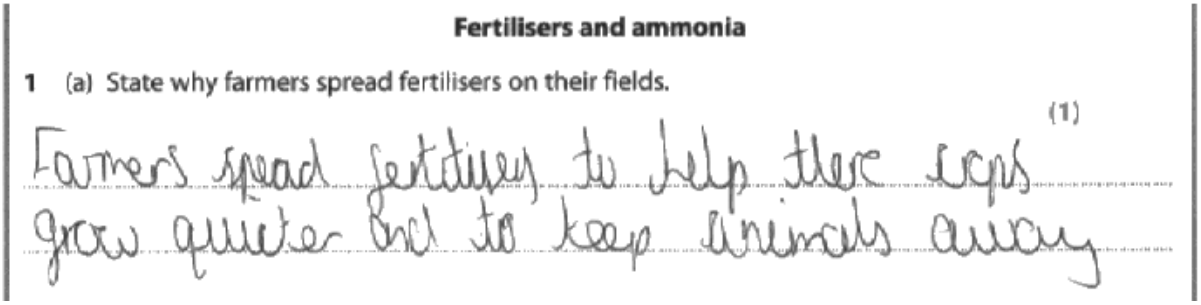
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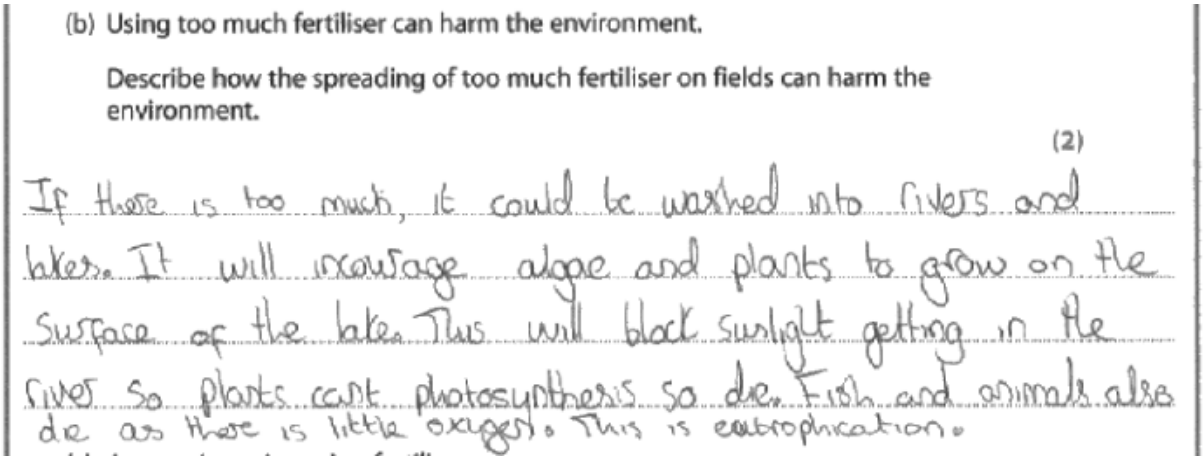
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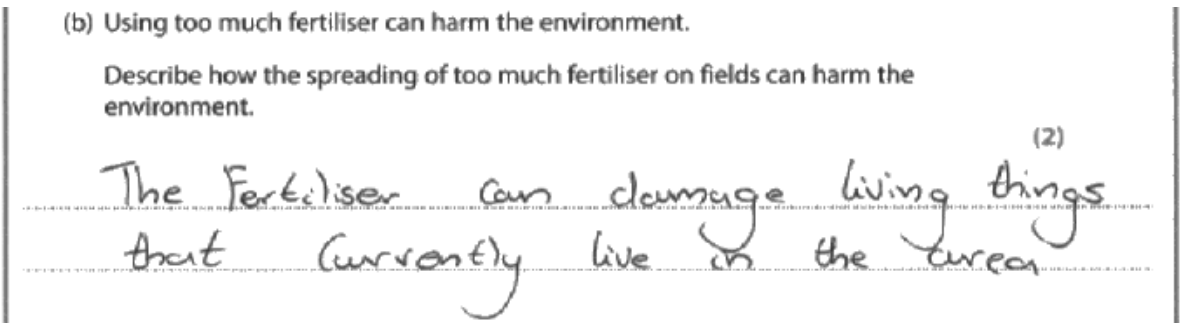
Describe how the spreading of too much fertiliser on fields can harm the environment.

(2)

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Results Plus: Examiner Comments

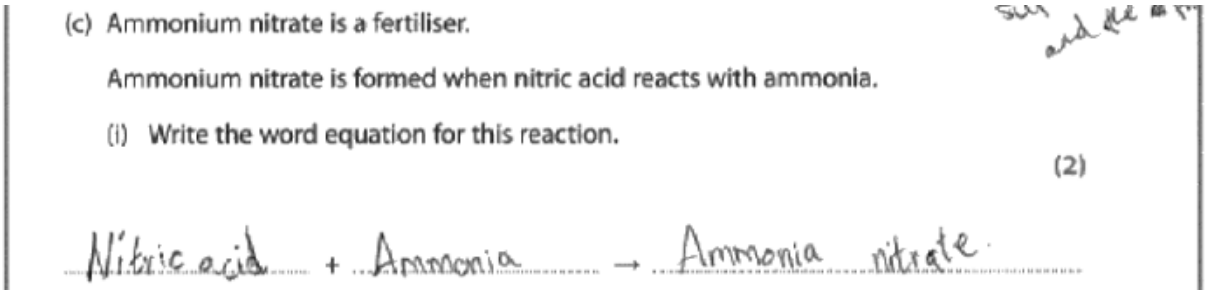
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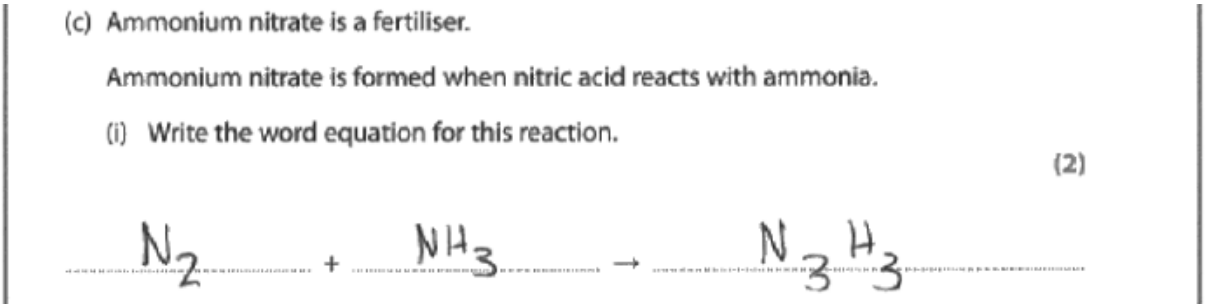
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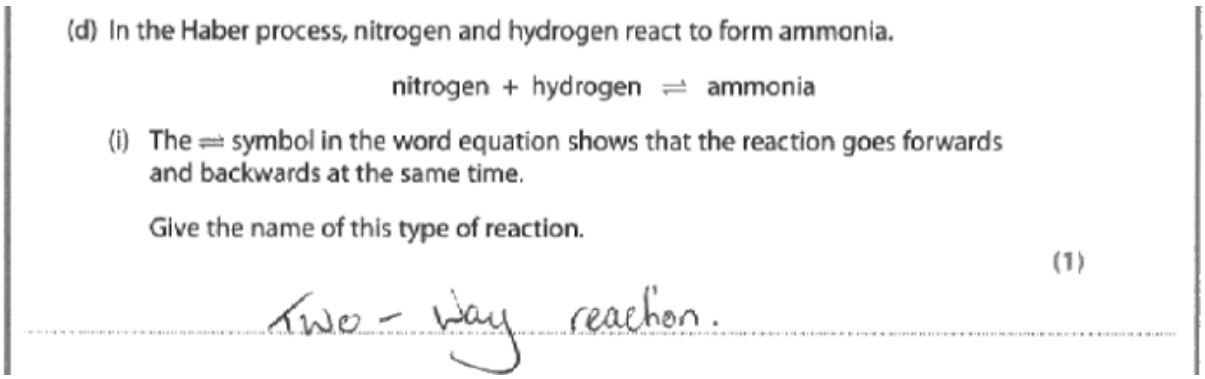
Results Plus: Examiner Comments

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Most responses were given as some spelling of "reversible". Some incorrect responses included "the Haber Process" (an understanding of 'type' is important), "reverse/ reverse reaction", "interchangeable", "vice versa" and "static equilibrium".



(d) In the Haber process, nitrogen and hydrogen react to form ammonia.

nitrogen + hydrogen ⇌ ammonia

(i) The ⇌ symbol in the word equation shows that the reaction goes forwards and backwards at the same time.

Give the name of this type of reaction.

(1)

Two - way reaction.

Results Plus: Examiner Comments

Reversible reaction / equilibrium was required.

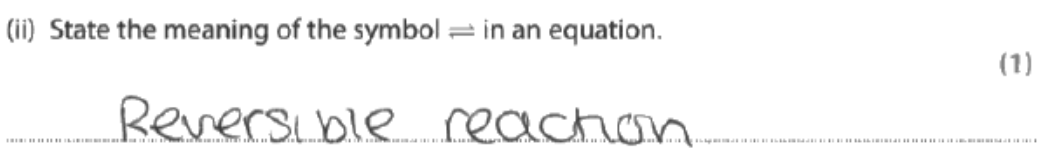
Results Plus: Examiner Tip

You must learn correct scientific terms – why not produce a list of all the key words you learn in each topic?

Q33.

(a) (ii)

Most candidates gained credit for their answers, since they were able to identify the meaning of the symbol for a reversible reaction. It was noted, however, that few candidates appeared to spell reversible correctly.



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

(1)

Reversible reaction

Results Plus: Examiner Comments

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

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

(1)

this is the equals sign in an equation

Results Plus: Examiner Comments

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

(b) (i)

Very few candidates were able to score both marking points here. Although many were able to identify that urea contained the highest percentage of nitrogen, they did not go on to link it to plant growth. A commonly seen error was that responses stated that urea contained a lot of nitrogen but failed to make a comparative statement. Many responses incorrectly tried to make links to the percentage of nitrogen and oxygen in the atmosphere.

(b) Ammonia is used in the manufacture of some fertilisers.

(i) The table shows information about three fertilisers manufactured from ammonia.

substance	% by mass of nitrogen	% by mass of oxygen
ammonium nitrate	35	60
ammonium sulfate	21	48
urea	47	27

Use the information in the table to explain why urea might be the best fertiliser.

(2)

it has the highest percentage by mass of nitrogen, plants need lots of nitrogen to use as minerals to grow, and it has the lowest percentage of oxygen which plants are able to absorb from the air so is unnecessary in a fertiliser.

Results Plus: Examiner Comments

A good example of a 2 mark response.

(b) (ii)

Most candidates were able to score at least 1 of the 2 marks available, mainly by reference to the first, second and fourth marking points, namely 'fertiliser is washed into rivers', 'increased growth' and 'fish die'. Overall, this question presented many problems to many candidates. Many simply stated eutrophication' as their answer, although they were unable to explain what it meant. Many candidates linked fish death with too much fertiliser, although their explanations were often confused.

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

This process is called eurtrophication. Nitrogen speeds up the process of phorosynthesis, so algae on the surface of the water grows more. This blocks out the sunlight, so other specias of plants can not grow. They die, and bacteria decompose them, and use up the oxygen in the pond in respiration. This means species of animals in the pond have no oxygen and also die.

Results Plus: Examiner Comments

This response scored the 2 marks available. The increased growth of algae, oxygen being used up (by bacteria) when plants decompose and animals (in the pond) dying are correctly mentioned.

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

Eutrophacation happens because farmers use to much nitrogen fertilizers. When it rains the excess fertilizer is washed into ponds, lakes and rivers.

Results Plus: Examiner Comments

This response scored 1 mark only for a correct reference to 'excess fertiliser being washed into the river' (the first marking point). The mention of eutrophication, is not required for the specification and this would need to be explained to gain credit.

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

The fertiliser can cause the plants to grow which causes them to use more oxygen meaning animals living in rivers may not have enough oxygen.

Results Plus: Examiner Comments

This response did not score. There is no mention of plants (in the river) growing bigger or more quickly (so the second marking point was not scored). The idea of plants using up the oxygen in incorrect, since a reference to decaying/dead plants is necessary. Also, from the response, the effect on animals simply states '...may not have enough oxygen'. This is insufficient, since 'animals dying' is required (so fourth marking point was not scored).

Q34.

(a) (ii)

Most candidates gained credit for their answers, since they were able to identify the meaning of the symbol for a reversible reaction. It was noted, however, that few candidates appeared to spell reversible correctly.

(ii) State the meaning of the symbol $\rightleftharpoons$ in an equation.

(1)

Reversible reaction

Results Plus: Examiner Comments

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

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

(1)

this is the equals sign in an equation

Results Plus: Examiner Comments

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

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Very few candidates were able to score both marking points here. Although many were able to identify that urea contained the highest percentage of nitrogen, they did not go on to link it to plant growth. A commonly seen error was that responses stated that urea contained a lot of nitrogen but failed to make a comparative statement. Many responses incorrectly tried to make links to the percentage of nitrogen and oxygen in the atmosphere.

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A good example of a 2 mark response.

(b) (ii)

Most candidates were able to score at least 1 of the 2 marks available, mainly by reference to the first, second and fourth marking points, namely 'fertiliser is washed into rivers', 'increased growth' and 'fish die'. Overall, this question presented many problems to many candidates. Many simply stated eutrophication' as their answer, although they were unable to explain what it meant. Many candidates linked fish death with too much fertiliser, although their explanations were often confused.

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

This process is called eurtrophication. Nitrogen speeds up the process of photosynthesis, so algae on the surface of the water grows more. This blocks out the sunlight, so other species of plants can not grow. They die, and bacteria decompose them, and use up the oxygen in the pond in respiration. This means species of animals in the pond have no oxygen and also die.

Results Plus: Examiner Comments

This response scored the 2 marks available. The increased growth of algae, oxygen being used up (by bacteria) when plants decompose and animals (in the pond) dying are correctly mentioned.

(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

Eutrophacation happens because farmers use to much nitrogen fertilizers. When it rains the excess fertilizer is washed into ponds, lakes and rivers.

Results Plus: Examiner Comments

This response scored 1 mark only for a correct reference to 'excess fertiliser being washed into the river' (the first marking point). The mention of eutrophication, is not required for the specification and this would need to be explained to gain credit.

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(ii) When rivers flow through areas where fertilisers have been spread on the land, plants and animals that live in the rivers can be affected.

Explain how this happens.

(2)

The fertiliser can cause the plants to grow which causes them to use more oxygen meaning animals living in rivers may not have enough oxygen.

Results Plus: Examiner Comments

This response did not score. There is no mention of plants (in the river) growing bigger or more quickly (so the second marking point was not scored). The idea of plants using up the oxygen in incorrect, since a reference to decaying/dead plants is necessary. Also, from the response, the effect on animals simply states '...may not have enough oxygen'. This is insufficient, since 'animals dying' is required (so fourth marking point was not scored).

Q35.

A surprising number of candidates were unable to give the correct formula for the hydroxide ion and an even smaller number were able to work out the formula for aluminium hydroxide. However, a significant number of candidates did score 3 marks for this question.

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

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+} + 3OH^- \rightarrow AlOH_3$

Results Plus: Examiner Comments

This candidate has written the correct formula for hydroxide ions so has scored 1 mark. If this candidate had drawn brackets around the OH in the formula for aluminium hydroxide, they would have scored 3 marks.

Results Plus: Examiner Tip

Learn how to write formulae for ionic compounds.

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}$

Results Plus: Examiner Comments

This is an excellent answer, scoring 3 marks. The state symbols were not necessary in this question.

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+} + OH^- \rightarrow Al(OH)_3$

$Al^{3+} + OH^- \rightarrow AL(OH)_3$

Results Plus: Examiner Comments

This candidate has written all the correct formulae so has scored 2 marks. If they had balanced the equation, they would have scored an extra mark.

Results Plus: Examiner Tip

Remember to balance all equations.

Q36.

A surprising number of candidates were unable to give the correct formula for the hydroxide ion and an even smaller number were able to work out the formula for aluminium hydroxide. However, a significant number of candidates did score 3 marks for this question.

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

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+} + 3OH^- \rightarrow AlOH_3$

Results Plus: Examiner Comments

This candidate has written the correct formula for hydroxide ions so has scored 1 mark. If this candidate had drawn brackets around the OH in the formula for aluminium hydroxide, they would have scored 3 marks.

Results Plus: Examiner Tip

Learn how to write formulae for ionic compounds.

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}$

Results Plus: Examiner Comments

This is an excellent answer, scoring 3 marks. The state symbols were not necessary in this question.

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

$Al^{3+} + OH^- \rightarrow Al(OH)_3$

$Al^{3+} + OH^- \rightarrow AL(OH)_3$

Results Plus: Examiner Comments

This candidate has written all the correct formulae so has scored 2 marks. If they had balanced the equation, they would have scored an extra mark.

Results Plus: Examiner Tip

Remember to balance all equations.

Q37.

Half the candidates wrote a correct balanced half equation which was pleasing to see, as in the past this has normally the preserve of the top students. The main errors seen were where the equation was reversed or not balanced.

When sodium sulfate solution is electrolysed, using inert electrodes, hydrogen is formed at the cathode.

Write the half equation for the formation of hydrogen gas, H_2, from hydrogen ions, H^+.

(2)

$H_2 \rightarrow 2H^+ + 2e^-$

Results Plus: Examiner Comments

This half equation contained the correct species but in the wrong places - the equation is back to front. The first point was not scored and there was no mark for balancing an incorrect equation.

When sodium sulfate solution is electrolysed, using inert electrodes, hydrogen is formed at the cathode.

Write the half equation for the formation of hydrogen gas, H_2, from hydrogen ions, H^+.

(2)

$H^+ - 2e^- \rightarrow H_2$

Results Plus: Examiner Comments

The mark scheme has the first point the correct species in their place and the second point is for the balancing of those species. Unfortunately this candidate had chosen to use '-2 e-' on the left hand side instead of '+ 2e-' which meant the first mark could not be awarded. Had the left side contained '+2 e-', the second point could have been awarded as the half equation was not balanced.

Results Plus: Examiner Tip

In half equations, balancing of the charges is also needed.

Q38.

(i)

Candidates generally performed well in this question, with many able to complete the word equation for the reaction between ammonia and nitric acid.

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

Ammonia + Nitric acid → ammonium nitrate

Results Plus: Examiner Comments

The correct answer, that scored the mark.

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

nitric acid + Ammonium → ammonium nitrate

Results Plus: Examiner Comments

Where candidates lost the mark is was often because they stated that ammonium rather ammonia was reacting or that ammonia reacts with nitrate.

Results Plus: Examiner Tip

Candidates should be taught to use the information given in the stem of the question to help them form their answer.

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

NH_3 + NCL → $2NH_3$ CL

Results Plus: Examiner Comments

In some cases, candidates tried to write the symbol rather than the word equation. To be allowed marks, the symbol equation would have to be entirely correct.

Results Plus: Examiner Tip

Candidates should be taught that if a word equation is asked for, they should not attempt a symbol equation as it is much harder to gain credit.

(iii)

Candidates generally performed well on this question, with most scoring at least 1 mark for showing an understanding that the ammonium nitrate promotes crop growth or yield. Many knew that it was a fertilizer.

(iii) Explain why farmers spread ammonium nitrate on their fields.

(2)

They increase the efficiency of their crops growing, and acts as a fertiliser.

Results Plus: Examiner Comments

This good answer scored both marks.

(iii) Explain why farmers spread ammonium nitrate on their fields.

(2)

To make the yield of their crops increase and kill any pest.

Results Plus: Examiner Comments

A common misconception seen was that the ammonium nitrate was used as a pesticide.

This example still gained 1 mark for improving crop yield.

Q39. No Examiner's Report available for this question

Q40.

The majority of candidates scored well in this question, with most being able to give a precaution that should be taken when using the copper sulfate solution as wearing goggles or gloves. In some cases, candidates did not read the question carefully and tried to describe what the symbol shows, often incorrectly, rather than a precaution. In other cases, candidates lost marks as they gave answers that were too unspecific and which were ignored.

Give one precaution that should be taken when using copper sulfate solution or sodium hydroxide solution as this hazard symbol is on the bottle.

(1)

You should wear goggles

Results Plus: Examiner Comments

This shows a correct answer that achieved the mark.

Give one precaution that should be taken when using copper sulfate solution or sodium hydroxide solution as this hazard symbol is on the bottle.

(1)

That it may be an irritant → if in contact with skin wash it strait off.

Results Plus: Examiner Comments

Is this case, the candidate has stated what the symbol represents and given a way to deal with the incident if the copper sulfate gets on the skin. As this is not a precaution to prevent harm, this was not given credit.

Q41. No Examiner's Report available for this question

Q42.

(i)

This question was very well answered on the whole with most candidates gaining the 1 mark available.

Responses mainly referred to the required specific term 'reversible', and less frequently 'equilibrium' was seen by examiners.

Commonly seen incorrect responses incorrectly stated 'reversed' which is not specific enough to score. In a few cases the incorrect terms 'equal', 'mutual', 'opposite', 'reduction' were seen.

(ii)

This question was very poorly answered with very few correct responses seen for the 1 mark available.

Very few candidates were able to recall the formulae for ammonia, namely NH_3. Often this was left blank by candidates. This was surprising since ammonia and its formation, in relation to the fertilisers, is a frequently tested part of the specification and also in the previous specification.

The most commonly seen errors in those who attempted this question were NH_2 and NH_4.

(iii)

This question was extremely well answered with a significant majority of responses scoring the 1 mark available.

Most candidates were able to state the overall trend in the graph shown, namely that world ammonia increases over time.

The only thing that was highlighted by examiners was that many responses gave a lot more detail than necessary for the 1 mark available.

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
	$\frac{2.24}{56.0} = 0.04$ and $\frac{0.96}{16.0} = 0.06$ (1) 1 : 1.5 / 2 : 3 (1) Fe_2O_3 (1) $4Fe + 3O_2 \rightarrow 2\mathbf{Fe_2O_3}$ (1)	allow ECF for MP2 and MP3 only. allow $\frac{2.24}{56.0} = 0.04$ and $\frac{0.96}{32.0} = 0.03$ (1) 1.33 : 1 / 4 : 3 (1) Fe_2O_3 (1) $4Fe + 3O_2 \rightarrow 2\mathbf{Fe_2O_3}$ (1) NOTE: equation alone gains no marks.	**(4)**

Q2.

Question number	Answer	Mark
(i)	x = 6	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	allow 2 for correct answer with or without working 170 (g) dodecane forms 114 (g) octane 1 (g) dodecane forms $\frac{114}{170}$ (g) octane (1) 340 (g) dodecane forms $\frac{114}{170}$ x 340 (1) (= 228(g))	OR $\frac{340}{170}$ (1) (= 2) 2 x 114 (1) (= 228 (g))	**(2)**

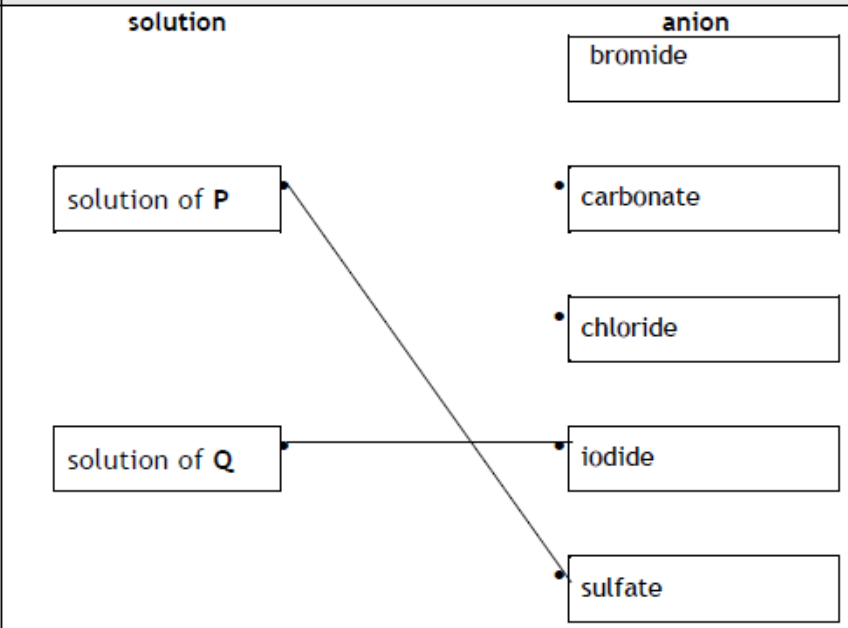
Q3.

Question number	Answer	Additional guidance	Mark
(i)	both are {soluble/will dissolve} (in water)		(1)

Question number	Answer	Additional guidance	Mark
(ii)	$NH_3 + HNO_3 \rightarrow NH_4NO_3$ LHS (1) RHS (1)	allow multiples	(2)

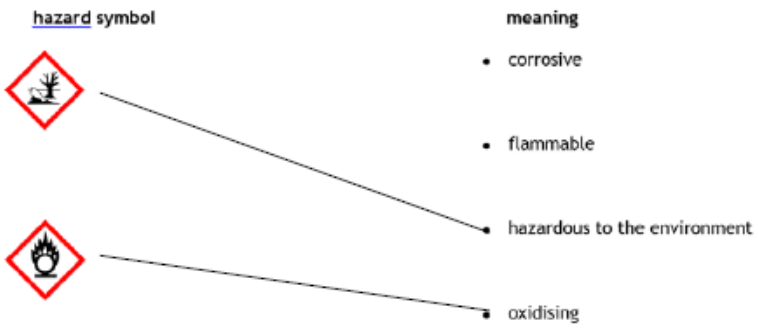
Question number	Answer		Mark
(iii)	a similarity from : both use sulfuric acid (1) both (are examples of) neutralisation (1) and a difference from : the industrial process is on a much larger scale than the laboratory process / ORA (1) the industrial process involves more stages than the laboratory process / ORA (1) ammonia is a gas in the industrial process but a solution in the laboratory process (1) laboratory preparation uses titration and crystallisation (1)	 ignore both produce ammonium sulfate allow both use same reactants allow both give out heat energy / exothermic (1) allow laboratory preparation is a batch process, industrial preparation is continuous process (1) ignore industrial is more dangerous	(2)

Q4.

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

Question number	Answer	Mark
(ii)	3 / three	(1)

Q5.

Question number	Answer	Additional guidance	Mark
		1 mark for each symbol. If more than one line comes from a symbol, that mark cannot be scored	(2) AO1

Q6.

Question Number	Answer	Acceptable answers	Mark
(a)	improves resistance to corrosion	ignore rusting	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation to include • anode dissolves / half equation given / atoms lose electrons /copper becomes ions/copper (atoms) oxidised (1) • copper ions moving from anode to cathode (1) • copper plated on cathode / half equation given / ions gain electrons/copper ions reduced/copper ions form atoms (1) • {difference/0.2g} is impurities (1) • would expect same decrease in mass (as increase) (1)	ignore references to mass increase of cathode and mass decrease of anode ignore 'impure copper (ions)' for the second marking point allow difference is metal around it eaten away/ impurities/sludge fallen to bottom of container /under anode (1) (there needs to be a reference to the difference in electrode masses for this point)	**(3)**

Question Number	Answer	Acceptable answers	Mark
(c)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ (2) OR $O^{2-} \rightarrow O + 2e^{(-)}$ (1) $2O \rightarrow O_2$ (1)	Unbalanced equation (1)	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description including some of the following points • sodium chloride is melted and ions are free to move at cathode • {sodium / positive} ions move to cathode • (sodium) metal forms at cathode • sodium ions gain electrons ... • to form atoms • this is reduction • $Na^+ + e^- \rightarrow Na$ at anode • {chloride / negative} ions move to anode • (chlorine) gas forms at anode • chloride ions lose electrons ... • to form atoms • this is oxidation • two chlorine atoms combine to form a chlorine molecule / share electrons • $Cl^- \rightarrow Cl + e^-$ / $2Cl^- \rightarrow Cl_2 + 2e^-$ • $2\,Cl \rightarrow Cl_2$	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. gives at least one relevant description or explanation • 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. for anode or cathode gives at least three descriptions or relevant explanations • 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**	• a detailed description e.g. for both anode and cathode gives a total of at least five descriptions or relevant explanations • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q7.

Question Number	Answer	Acceptable answers	Mark
(a)	improves resistance to corrosion	ignore rusting	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation to include • anode dissolves / half equation given / atoms lose electrons /copper becomes ions/copper (atoms) oxidised (1) • copper ions moving from anode to cathode (1) • copper plated on cathode / half equation given / ions gain electrons/copper ions reduced/copper ions form atoms (1) • {difference/0.2g} is impurities (1) • would expect same decrease in mass (as increase) (1)	ignore references to mass increase of cathode and mass decrease of anode ignore 'impure copper (ions)' for the second marking point allow difference is metal around it eaten away/ impurities/sludge fallen to bottom of container /under anode (1) (there needs to be a reference to the difference in electrode masses for this point)	**(3)**

Question Number	Answer	Acceptable answers	Mark
(c)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ (2) OR $O^{2-} \rightarrow O + 2e^{(-)}$ (1) $2O \rightarrow O_2$ (1)	Unbalanced equation (1)	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description including some of the following points • sodium chloride is melted and ions are free to move at cathode • {sodium / positive} ions move to cathode • (sodium) metal forms at cathode • sodium ions gain electrons ... • to form atoms • this is reduction • $Na^+ + e^- \rightarrow Na$ at anode • {chloride / negative} ions move to anode • (chlorine) gas forms at anode • chloride ions lose electrons ... • to form atoms • this is oxidation • two chlorine atoms combine to form a chlorine molecule / share electrons • $Cl^- \rightarrow Cl + e^-$ / $2Cl^- \rightarrow Cl_2 + 2e^-$ • $2\,Cl \rightarrow Cl_2$	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. gives at least one relevant description or explanation • 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. for anode or cathode gives at least three descriptions or relevant explanations • 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**	• a detailed description e.g. for both anode and cathode gives a total of at least five descriptions or relevant explanations • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q8.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	NaCl	Must be capital N, C; small a, l	**(1)**

Question Number	Answer	acceptable answers	Mark
(a)(ii)	as a coolant/ removes **heat** energy	(good) conductor of heat Ignore what would happen if no coolant eg 'meltdown' etc.	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	reduction Exact spelling required.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	**A** ions can only move freely in molten lead bromide		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	(lead bromide →) lead (1) + bromi**n**e (1)	reject bromide or any formulae ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	**A** and **B** both required for mark.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	• **A** permanent hardness because scum/ no lather (even after boiling) (1) • **B** temporary hardness because lather /no scum (only) after boiling (1) • **C** soft because lather / no scum (before boiling) / does not conduct /no ions (1)	If no or some/all incorrect explanations, then allow: 3 correctly classified with 2 correct explanations = 3 marks 3 correctly classified with 1 correct explanation = 2 marks 3 correctly classified with 0 correct explanations = 1 Allow statements such as 'only in test 3' to mean 'after boiling'	**(3)**

Q9.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	NaCl	Must be capital N, C; small a, l	**(1)**

Question Number	Answer	acceptable answers	Mark
(a)(ii)	as a coolant/ removes **heat** energy	(good) conductor of heat Ignore what would happen if no coolant eg 'meltdown' etc.	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	reduction Exact spelling required.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	**A** ions can only move freely in molten lead bromide		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	(lead bromide →) lead (1) + bromi**n**e (1)	reject bromide or any formulae ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	**A** and **B** both required for mark.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	• **A** permanent hardness because scum/ no lather (even after boiling) (1) • **B** temporary hardness because lather /no scum (only) after boiling (1) • **C** soft because lather / no scum (before boiling) / does not conduct /no ions (1)	If no or some/all incorrect explanations, then allow: 3 correctly classified with 2 correct explanations = 3 marks 3 correctly classified with 1 correct explanation = 2 marks 3 correctly classified with 0 correct explanations = 1 Allow statements such as 'only in test 3' to mean 'after boiling'	**(3)**

Q10.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	D the transition metals		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	D malleable		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	non-flammable		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	has a low density		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description including (yellow-) green (1) gas (1)	 any shade of green do not allow just 'yellow' do not allow green in combination with other colours eg blue-green	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	hydrogen + chlorine → hydrogen chloride lhs (1) rhs (1) Ignore formulae in addition to all of the names	if formulae are used, do not allow h or CL or superscripts H_2 + Cl_2 on lhs 2HCl on rhs reactants in either order do not allow a mixture of words and formulae for both marks eg H_2 + Cl_2 → hydrogen chloride scores 1 mark for rhs do not allow hydrochloric acid /hydrochloride/hydrogen chlorine	 **(2)**

(Total for Question = 8 marks)

Q11.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	D the transition metals		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	D malleable		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	non-flammable		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	has a low density		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description including (yellow-) green (1) gas (1)	 any shade of green do not allow just 'yellow' do not allow green in combination with other colours eg blue-green	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	hydrogen + chlorine → hydrogen chloride lhs (1) rhs (1) Ignore formulae in addition to all of the names	if formulae are used, do not allow h or CL or superscripts H_2 + Cl_2 on lhs 2HCl on rhs reactants in either order do not allow a mixture of words and formulae for both marks eg H_2 + Cl_2 → hydrogen chloride scores 1 mark for rhs do not allow hydrochloric acid /hydrochloride/hydrogen chlorine	 **(2)**

(Total for Question = 8 marks)

Q12.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	An explanation linking {the temperature/it} {increased / went up (by 26°C)} (1) (so the reaction is) exothermic (1)	 it got hotter/it gets hot heat (energy){released /given out} ignore incorrect temperature rise do not allow just 'heat increases'	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	$ZnSO_4$ (1) Cu (1)	allow formulae in either order maximum if additional formulae are included maximum if balancing numbers added do not allow upper case N /superscript 4	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking **First mark – relating concentration to time** (as the concentration/amount of acid increases) the time (taken for the magnesium to react) decreases (1) Ignore any reference to negative correlation Ignore time gets faster/quicker **Second mark – effect on rate** (so){ the rate/it} increases/reaction becomes {faster/quicker} (1) Ignore any reference to positive correlation	Reverse arguments if candidate has related time and rate to decreasing concentration of acid {less/shorter} time	 **(2)**

Question Number		Indicative Content	Mark
QWC	***(c)**	A description including some of the following points **Experiment 1** • measure volume of acid/stated volume • measure mass of marble chips/stated mass • add acid to marble or marble to acid in a suitable container eg flask, beaker, boiling tube, test tube • collect the gas in a {gas syringe/measuring cylinder over water/ tube over water}/bubble gas through limewater/bubble gas through water • measure {amount/volume} of carbon dioxide/count the bubbles/fixed volume of carbon dioxide • measure mass/mass loss (on a balance) • time/measure how long the reaction takes **Experiment 2** • do another experiment with different size marble chips • use the same mass of marble chips • use the same {volume/concentration/mass} of acid/same acid • crush the marble/use powdered marble **Results** • smaller chips (of marble) have a more vigorous reaction/produce more {fizzing/bubbles} ORA • smaller chips take less time to {react/produce a certain volume of gas /have a certain mass loss} ORA • smaller chips have a larger surface area ORA • smaller chips react faster ORA • larger surface gives a faster reaction	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. crush the marble chips/smaller marble chips give more fizzing • 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. put marble chips and acid in a flask and repeat with the same mass of small marble chips / collect the gas in a syringe, smaller pieces of marble react faster • 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**	• a detailed description e.g. put marble chips and acid in a flask, repeat the experiment with the same mass of crushed marble, crushed marble takes less time to react • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question = 12 marks)

Q13.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	An explanation linking {the temperature/it} {increased / went up (by 26°C)} (1) (so the reaction is) exothermic (1)	 it got hotter/it gets hot heat (energy){released /given out} ignore incorrect temperature rise do not allow just 'heat increases'	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	$ZnSO_4$ (1) Cu (1)	allow formulae in either order maximum if additional formulae are included maximum if balancing numbers added do not allow upper case N /superscript 4	 **(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking **First mark – relating concentration to time** (as the concentration/amount of acid increases) the time (taken for the magnesium to react) decreases (1) Ignore any reference to negative correlation Ignore time gets faster/quicker **Second mark – effect on rate** (so){ the rate/it} increases/reaction becomes {faster/quicker} (1) Ignore any reference to positive correlation	Reverse arguments if candidate has related time and rate to decreasing concentration of acid {less/shorter} time	 **(2)**

Question Number		Indicative Content	Mark
QWC	***(c)**	A description including some of the following points **Experiment 1** • measure volume of acid/stated volume • measure mass of marble chips/stated mass • add acid to marble or marble to acid in a suitable container eg flask, beaker, boiling tube, test tube • collect the gas in a {gas syringe/measuring cylinder over water/ tube over water}/bubble gas through limewater/bubble gas through water • measure {amount/volume} of carbon dioxide/count the bubbles/fixed volume of carbon dioxide • measure mass/mass loss (on a balance) • time/measure how long the reaction takes **Experiment 2** • do another experiment with different size marble chips • use the same mass of marble chips • use the same {volume/concentration/mass} of acid/same acid • crush the marble/use powdered marble **Results** • smaller chips (of marble) have a more vigorous reaction/produce more {fizzing/bubbles} ORA • smaller chips take less time to {react/produce a certain volume of gas /have a certain mass loss} ORA • smaller chips have a larger surface area ORA • smaller chips react faster ORA • larger surface gives a faster reaction	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. crush the marble chips/smaller marble chips give more fizzing • 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. put marble chips and acid in a flask and repeat with the same mass of small marble chips / collect the gas in a syringe, smaller pieces of marble react faster • 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**	• a detailed description e.g. put marble chips and acid in a flask, repeat the experiment with the same mass of crushed marble, crushed marble takes less time to react • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question = 12 marks)

Q14.

Question Number	Answer	Additional guidance	Mark
	$2Al + 3Cl_2 \rightarrow 2AlCl_3$ (3) LHS (1) RHS (1) balancing of correct formulae (1)	penalise the use of 'CL' or 'AL' once only ignore state symbols allow multiples ignore use of capital L for MP3	**(3)** AO 2 1

Q15.

Question Number	Answer	Additional guidance	Mark
	$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$ 2 Na (1) 2 NaOH (1) s, l, aq, g (1)	 allow S, L, AQ, G ignore words	**(3)** AO 2 1

Q16.

Question Number	Answer	Additional guidance	Mark
	$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$ 2Na (1) 2NaOH (1) s, l, aq, g (1)	 allow S, L, AQ, G ignore words	**(3)** AO 2 1

Q17.

	Answer	Acceptable answers	Mark
(a)	**C** oxidised		**(1)**
(b)	**D** preservative		**(1)**
(c)	yellow / orange /red (1)	Combinations of yellow/orange/red pink	**(1)**
(d)	(CH_3COOH +) NaOH (1) (→ CH_3COONa +) H_2O (1)	NaHO ignore attempts to balance	**(2)**
(e)	hydrogen	H_2 ignore H	**(1)**
(f)(i)	ethanoic acid + ethanol → ethyl ethanoate + water (2)	correct spellings only left hand side (1) right hand side (1)	**(2)**
(f)(ii)	An explanation linking use (1) property (1)	property dependent on use ignore 'sweet smelling'	

	eg perfumes /cosmetics (1) pleasant smelling (1) other uses include flavourings / solvents	use – nail varnish remover property – acts as solvent for polyester: use – (polyester) to make clothing property – can be made into fibres	**(2)**

Q18.

	Answer	**Acceptable answers**	**Mark**
(a)	**C**oxidised		**(1)**
(b)	**D** preservative		**(1)**
(c)	yellow / orange /red (1)	Combinations of yellow/orange/red pink	**(1)**
(d)	(CH_3COOH +) NaOH (1) (→ CH_3COONa +) H_2O (1)	NaHO ignore attempts to balance	**(2)**
(e)	hydrogen	H_2 ignore H	**(1)**
(f)(i)	ethanoic acid + ethanol → ethyl ethanoate + water (2)	correct spellings only left hand side (1) right hand side (1)	**(2)**
(f)(ii)	An explanation linking use (1) property (1) eg perfumes /cosmetics (1) pleasant smelling (1) other uses include flavourings / solvents	property dependent on use ignore 'sweet smelling' use – nail varnish remover property – acts as solvent for polyester: use – (polyester) to make clothing property – can be made into fibres	**(2)**

Q19.

Question Number	Answer	Acceptable answers	Mark
(i)	A description including two of the following • dissolve the sugar/aqueous solution (1) • **warm**/ 25-40°C (1) • in absence of air / no oxygen/ anaerobic / attach airlock (1) • pH neutral / slightly acidic /4-7 • **sterile** conditions ignore any mention of pressure	ignore incorrect answers ignore heat / hot allow any temperature or range within 25-40 allowed ignore clean etc ignore 'optimum' {temp/pressure/pH}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	**B** fractional distillation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(iii)	$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (2) correct formulae (<u>with no others</u>) (1) balancing <u>the three</u> formulae (1) ignore state symbols	allow C_2H_6O/ CH_3CH_2OH for C_2H_5OH reject CO2 / CO^2 allow multiples	**(2)**

Q20.

Question Number	Answer	Acceptable answers	Mark
(i)	A description including two of the following • dissolve the sugar/aqueous solution (1) • **warm**/ 25-40°C (1) • in absence of air / no oxygen/ anaerobic / attach airlock (1) • pH neutral / slightly acidic /4-7 • **sterile** conditions ignore any mention of pressure	ignore incorrect answers ignore heat / hot allow any temperature or range within 25-40 allowed ignore clean etc ignore 'optimum' {temp/pressure/pH}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	**B** fractional distillation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(iii)	$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (2) correct formulae (with no others) (1) balancing the three formulae (1) ignore state symbols	allow C_2H_6O/ CH_3CH_2OH for C_2H_5OH reject CO2 / CO^2 allow multiples	**(2)**

Q21.

	Answer	Acceptable answers	Mark
(a)	$C_2H_4 + H_2o \rightarrow C_2H_5OH$ C_2H_4 as **reactant** (1) rest of equation correct conditional on C_2H_4 as a reactant (1)	do not allow H2O / H^2O / lower case h/HOH allow C_2H_6O for ethanol ignore state symbols	**(2)**
(b)	A description including any two from • dissolve sugar in water/sugar solution (1) • (add) yeast (1) • warm / any temperature or range within 15 to 40°C (1) • anaerobic /	allow glucose solution ignore carbohydrate allow room temperature ignore heat unless specified temperature ignore optimum temperature	**(2)**

	{no/little}{air/oxygen} can enter the apparatus (1)	do not allow just 'sealed container' ignore fractional distillation	
(c)	An explanation linking Marking point 1 – sugar- one from • sugar obtained from {plants /crops/specific crop} (1) • (plenty of) land available to grow {plants /crops/specific crop} (for fermentation)(1) Marking point 2 - ethene • ethene obtained from {crude oil / fractional distillation /cracking} (1) Marking point 3 – cost/energy – one from • cannot afford to buy crude oil (1) • crude oil is too expensive (1) • more expensive to {use/buy/produce} ethene (1) • cheaper to use fermentation (1)	ignore answers that just repeat the information in the question ignore vague answers such as carbon neutral/environmentally friendly for marking point 1 **OR**2, allow plants renewable/{crude oil/ethene} non-renewable (1) allow {little/no} {heat/energy} required for fermentation (1) allow {high temperature /high pressure} required for hydration of ethene (1)	**(3)**
(d)	An explanation including any two from • formulae differ by CH_2 • same general formula • all have {OH/hydroxyl group}	general formula is C_nH_{2n}+1OH (2) allow increase by {CH_2/1 carbon **and**2 hydrogens} do not allow incorrect general formula allow have similar **chemical** {reactions /properties}/same functional group/OH from an incorrect general formula ignore 'hydroxide'/all end in (an)ol /all alcohols ignore physical properties maximum (1) if hydroxide ions /carboxyl group	**(2)**

Q22.

	Answer	Acceptable answers	Mark
(a)	$C_2H_4 + H_2o \rightarrow C_2H_5OH$ C_2H_4 as **reactant** (1) rest of equation correct conditional on C_2H_4 as a reactant (1)	do not allow H2O / H^2O / lower case h/HOH allow C_2H_6O for ethanol ignore state symbols	**(2)**
(b)	A description including any two from • dissolve sugar in water/sugar solution (1) • (add) yeast (1) • warm / any temperature or range within 15 to 40°C (1) • anaerobic / {no/little}{air/oxygen} can enter the apparatus (1)	 allow glucose solution ignore carbohydrate allow room temperature ignore heat unless specified temperature ignore optimum temperature do not allow just 'sealed container' ignore fractional distillation	**(2)**
(c)	An explanation linking Marking point 1 – sugar- one from • sugar obtained from {plants /crops/specific crop} (1) • (plenty of) land available to grow {plants /crops/specific crop} (for fermentation)(1) Marking point 2 - ethene • ethene obtained from {crude oil / fractional distillation /cracking} (1) Marking point 3 – cost/energy – one from • cannot afford to buy crude oil (1) • crude oil is too expensive (1) • more expensive to {use/buy/produce} ethene (1) • cheaper to use fermentation (1)	ignore answers that just repeat the information in the question ignore vague answers such as carbon neutral/environmentally friendly for marking point 1 **OR**2, allow plants renewable/{crude oil/ethene} non-renewable (1) allow {little/no} {heat/energy} required for fermentation (1) allow {high temperature /high pressure} required for hydration of ethene (1)	**(3)**
(d)	An explanation including any two from • formulae differ by CH_2 • same general formula • all have {OH/hydroxyl group}	general formula is C_nH_{2n}+1OH (2) allow increase by {CH_2/1 carbon **and**2 hydrogens} do not allow incorrect general formula allow have similar **chemical**	**(2)**

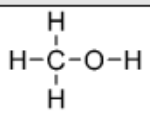
		{reactions /properties}/same functional group/OH from an incorrect general formula ignore 'hydroxide'/all end in (an)ol /all alcohols ignore physical properties maximum (1) if hydroxide ions /carboxyl group	

Q23.

Question Number	Answer	Acceptable answers	Mark
(a)	**B** add yeast, temperature of 35°C		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	C_2H_4 (1) + H_2O (1) → C_2H_5OH award one mark max if incorrectly balanced	allow correct molecular formula C_2H_6O allow H_4C_2 correct multiples ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description linking any two from • same **general** formula (1) • same functional group (1) • (consecutive) compounds differ by CH_2 (1) • gradual variation in physical properties (1) • {similar / same} chemical {properties / reactions} (1)	 allow $C_nH_{2n+1}OH$ (2) allow C_nH_{2n} or any correct general formula (2) ignore same properties/physical properties allow a correct trend, e.g. bp increases with number of carbon atoms (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)		allow –OH allow correct dot and cross diagram	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(i)	oxidation		**(1)**

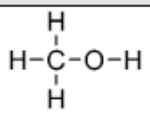
Question Number	Answer	Acceptable answers	Mark
(d)(ii)	A description including any two from • effervescence/fizzing/bubbling (1) • solid disappears (1) • colourless solution (1)	 ignore incorrectly named gases ignore gas given off/evolved allow magnesium floats on surface of acid allow solid dissolves (1) ignore solution <u>turns</u> colourless ignore clear	**(2)**

Q24.

Question Number	Answer	Acceptable answers	Mark
(a)	**B** add yeast, temperature of 35°C		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	C_2H_4 (1) + H_2O (1) → C_2H_5OH award one mark max if incorrectly balanced	allow correct molecular formula C_2H_6O allow H_4C_2 correct multiples ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description linking any two from • same **general** formula (1) • same functional group (1) • (consecutive) compounds differ by CH_2 (1) • gradual variation in physical properties (1) • {similar / same} chemical {properties / reactions} (1)	 allow $C_nH_{2n+1}OH$ (2) allow C_nH_{2n} or any correct general formula (2) ignore same properties/physical properties allow a correct trend, e.g. bp increases with number of carbon atoms (1)	**(2)**

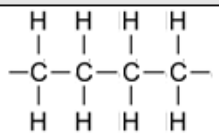
Question Number	Answer	Acceptable answers	Mark
(c)(ii)		allow –OH allow correct dot and cross diagram	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(i)	oxidation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(ii)	A description including any two from • effervescence/fizzing/bubbling (1) • solid disappears (1) • colourless solution (1)	 ignore incorrectly named gases ignore gas given off/evolved allow magnesium floats on surface of acid allow solid dissolves (1) ignore solution <u>turns</u> colourless ignore clear	**(2)**

Q25.

Question number	Answer	Additional guidance	Mark
(i)	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ (2) LHS (1) RHS (1)	ignore state symbols	(2)

Question number	Answer	Additional guidance	Mark
(ii)	 (2)	allow 1 mark for four carbon atoms joined by single bonds allow 1 mark for correct formula without continuation bonds	(2)

Q26.

Question Number	Answer	Mark
(i)	Diagram to show • filter funnel and filter paper (1) • collecting vessel / beaker / conical flask (1)	(2)

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)

Q27.

Question Number	Answer	Mark
(i)	C is the most reactive **The only correct answer is C** ***A*** *is not correct because this is irrelevant* ***B*** *is not correct because this is irrelevant* ***D*** *is not correct because this is irrelevant*	**(1)** AO 2 1

Question Number	Indicative content	Mark
* (ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **Aspect one: METHOD** • trough/large container of water • equal volumes of water for each experiment • remove metal from container with tongs • remove oil • cut small piece • add metal with tongs/tweezers etc. to water • teacher wears safety glasses • gloves • use of safety screen • class well back • class wear goggles ignore general safety ideas – hair tied back, lab coat etc. ignore equal sized pieces of metal **Aspect 2: ANALYSIS** • most vigorous effervescence of hydrogen with potassium and least with lithium • fastest movement with potassium and slowest with lithium • potassium is most reactive, then sodium, then lithium ignore copying of results from table e.g potassium bubbles very fast ignore writing up of results/ put in table etc	**(6)** AO 2 2 AO 3 1a AO 3 1b

Level	Descriptor
	No rewardable material.
Level 1	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. • Presents an explanation with some structure and coherence.
Level 2	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. • Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Q28.

Question Number	Answer	Acceptable answers	Mark
	$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ (3) lhs (1) rhs (1) balancing correct formulae (1)		**(3)**

Q29.

	Answer	**Acceptable answers**	**Mark**
(i)	A description including 2 points from add yeast (to the glucose solution) (1) anaerobic conditions/in absence of air/attach airlock/insert plug of cotton wool (1) warm / less than 40°C (1)	correctly named enzyme for fermentation eg zymase	**(2)**
(ii)	ethanol (1) carbon dioxide (1)	 C_2H_5OH CO_2	**(2)**
(iii)	C – fractional distillation		**(1)**
(iv)	any harmful effect eg alcoholism / liver damage / slows reactions / anti-social behaviour / injuries / become drunk / depression / damage to (suitable named) organs / damage to foetus	danger to others / alcohol poisoning ignore affects reaction times alone	**(1)**

Q30.

	Answer	**Acceptable answers**	**Mark**
(i)	A description including 2 points from	correctly named enzyme for fermentation eg zymase	**(2)**

	add yeast (to the glucose solution) (1) anaerobic conditions/in absence of air/attach airlock/insert plug of cotton wool (1) warm / less than 40°C (1)		
(ii)	ethanol (1) carbon dioxide (1)	 C_2H_5OH CO_2	**(2)**
(iii)	C – fractional distillation		**(1)**
(iv)	any harmful effect eg alcoholism / liver damage / slows reactions / anti-social behaviour / injuries / become drunk / depression / damage to (suitable named) organs / damage to foetus	danger to others / alcohol poisoning ignore affects reaction times alone	**(1)**

Q31.

Question Number	Answer	Acceptable answers	Mark
(a)	Increases {plant/ crop} growth/ yield/ size/ growth rate Adds minerals/ specified suitable element eg N, P, K/ nutrients	Allow synonyms for increase eg promote, helps, enhances etc Reject kills pests	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	A description linking two of the following • gets washed into water (1) • encourages growth of algae/ weed / algal bloom (1) • algae use up oxygen (1) • algae blocks sunlight (1) • **kills** aquatic life (1) • eutrophication (1) • contaminates drinking water (1)	Allow any sensible water eg river, lake etc but ignore sea Ignore damages, harms etc; allow any specified **water** life eg fish, **water** plants, animals **in water** Ignore effect of fertiliser on field eg on weeds.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	ammonia + nitric acid → ammonium nitrate (2) Spelling must be correct but allow missing one 'm' from ammonia and/or ammonium	LHS (1) R ammonium RHS (1) R ammonia nitrate Allow fully correct balanced equation for 2 Ignore state symbols. If mixed words/symbols, any side with symbols scores 0.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	**A** corrosive		**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(i)	(reaction is) **reversible** / (reaches dynamic) **equilibrium**	Allow equilibria R static equilibrium	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(ii)	**C** NH_3		**(1)**

Q32.

Question Number	Answer	Acceptable answers	Mark
(a)	Increases {plant/ crop} growth/ yield/ size/ growth rate Adds minerals/ specified suitable element eg N, P, K/ nutrients	Allow synonyms for increase eg promote, helps, enhances etc Reject kills pests	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	A description linking two of the following • gets washed into water (1) • encourages growth of algae/ weed / algal bloom (1) • algae use up oxygen (1) • algae blocks sunlight (1) • **kills** aquatic life (1) • eutrophication (1) • contaminates drinking water (1)	Allow any sensible water eg river, lake etc but ignore sea Ignore damages, harms etc; allow any specified **water** life eg fish, **water** plants, animals **in water** Ignore effect of fertiliser on field eg on weeds.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	ammonia + nitric acid → ammonium nitrate (2) Spelling must be correct but allow missing one 'm' from ammonia and/or ammonium	LHS (1) R ammonium RHS (1) R ammonia nitrate Allow fully correct balanced equation for 2 Ignore state symbols. If mixed words/symbols, any side with symbols scores 0.	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	**A** corrosive		**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(i)	(reaction is) **reversible** / (reaches dynamic) **equilibrium**	Allow equilibria R static equilibrium	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)(ii)	**C** NH_3		**(1)**

Q33.

Question Number	Answer	Acceptable answers	Mark
(a) (i)	**C** $N_2 + 3H_2 \rightleftharpoons 2\ NH_3$		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a) (ii)	reaction is reversible / goes both ways (1)	reaches equilibrium (1)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (i)	A description linking urea contains the highest percentage of nitrogen (1) (this is important because) nitrogen enables plants to grow (1)	 ignore references to oxygen	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	An explanation linking any **two** of the following points (excess) fertiliser is washed into rivers (by rainfall) (1) plants/algae (in the river) grow bigger / more quickly (1) oxygen is used up (by bacteria) when the plants decay/die (1) (this leads to) fish/animals die (due to lack of oxygen) (1)	 allow grow better / increases growth must indicate idea of an increase in growth/faster growth	**(2)**

Q34.

Question Number	Answer	Acceptable answers	Mark
(a) (i)	**C** $N_2 + 3H_2 \rightleftharpoons 2\ NH_3$		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a) (ii)	reaction is reversible / goes both ways (1)	reaches equilibrium (1)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (i)	A description linking urea contains the highest percentage of nitrogen (1) (this is important because) nitrogen enables plants to grow (1)	 ignore references to oxygen	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	An explanation linking any **two** of the following points (excess) fertiliser is washed into rivers (by rainfall) (1) plants/algae (in the river) grow bigger / more quickly (1) oxygen is used up (by bacteria) when the plants decay/die (1) (this leads to) fish/animals die (due to lack of oxygen) (1)	 allow grow better / increases growth must indicate idea of an increase in growth/faster growth	**(2)**

Q35.

	Answer	**Acceptable answers**	**Mark**
	$Al^{3+} + 3OH^- \rightarrow Al(OH)_3$ OH^- (1) $Al(OH)_3$ (1) balancing 3, conditional on correct formulae (1)	allow multiples allow HO^- (1) allow $Al(HO)_3$ (1) do not allow $Al(HO)^3$/lower case h ignore state symbols/$3Na^+$ on both sides	**(3)**

Q36.

	Answer	Acceptable answers	Mark
	$Al^{3+} + 3OH^- \rightarrow Al(OH)_3$ OH^- (1) $Al(OH)_3$ (1) balancing 3, conditional on correct formulae (1)	allow multiples allow HO^- (1) allow $Al(HO)_3$ (1) do not allow $Al(HO)^3$/lower case h ignore state symbols/$3Na^+$ on both sides	**(3)**

Q37.

Question Number	Answer	Additional guidance	Mark
	$2H^+ + 2e^{(-)} \rightarrow H_2$ / $2H^+ \rightarrow H_2 - 2e^{(-)}$ (2) species in correct place as shown above (1) balancing of correct species in correct place (1)	allow use of = or ⇌ in place of → allow multiples reject h2 / h_2 / H2 / H^2	**(2)** AO 1 1

Q38.

Question Number	Answer	Additional guidance	Mark
(i)	ammonia + nitric acid → ammonium nitrate	accept reactants in either order ignore formula	**(1)** AO 2 1

Question Number	Answer	Mark
(ii)	**C** NH_4NO_3 **1. The only correct answer is C** ***A** is factually incorrect* ***B** is factually incorrect* ***D** is factually incorrect*	**(1)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation linking two from: • as a fertiliser (1) • contains (a high percentage of) nitrogen (1) • help promote plant growth / increases crop yield (1)	allow make crops grow faster ignore use as a pesticide	(2) AO 1 1

Q39.

Question number	Answer	Mark
(i)	wear safety goggles/ gloves	(1) AO3

Question number	Answer	Additional guidance	Mark
(ii)	Measure mass of solid/ use a specified mass of solid	ignore changes to stirring ignore use a full spatula	(1) AO3

Question number	Answer	Mark
(iii)	**B** from 1 to 12 is the only correct answer. **A** and **C** are incorrect because the mixture does not start or end neutral **D** is incorrect because the pH is changing in the reverse direction	(1) AO2

Question number	Answer	Additional guidance	Mark
(iv)	start: red/pink (1) end: yellow (1)	allow (1) if colours reversed	(2) AO1

Q40.

Question number	Answer	Additional guidance	Mark
	wear goggles (to protect eyes)	ignore any other safety precautions given allow wear gloves (to protect skin)	(1)

Q41.

Question number	Answer	Mark
(i)	test tube/ boiling tube	(1) AO1

Question number	Answer	Mark
(ii)	**A** electrode is the only correct answer. **B**, **C** and **D** are incorrect because they are not electrodes.	(1) AO2

Question number	Answer	Additional guidance	Mark
(iii)	it conducts (electricity)/ is inert	ignore high melting point	(1) AO1

Question number	Answer	Mark
(iv)	2 $HCl \rightarrow H_2 + Cl_2$	(1) AO2

Q42.

Question number	Answer	Additional guidance	Mark
(i)	reversible	allow equilibrium / equilibria /dynamic equilibrium ignore static equilibrium	(1)
(ii)	NH_3	allow H_3N reject NH3, NH^3	(1)
(iii)	world ammonia production increases over time		(1)