PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 3: CHEMICAL CHANGES (PACK 1)

SCORE	PERCENTAGE
/131	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

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.

Q2. No Examiner's Report available for this question

Q3.

(a) (i)

Most candidates were able to state that the type of reaction when an acid reacts with a base is 'neutralisation'. Commonly seen incorrect responses were 'displacement' or 'precipitation'.

(b) (i-ii)

Few candidates scored the 2 marks available. Most responses scored 1 mark only for part (i), namely the method mark for '17.12 −17.02'. It was noted by the examiners that a surprisingly large number of candidates were unable to subtract 7.02 from 17.12 correctly or divide by 2. Whilst most candidates attempted part (ii), a large proportion of responses were incorrect. Many just appeared to insert any number on the answer line – it was impossible to work out what was their thinking. Occasionally, the error in part (i), could be carried forward to score the mark in part (ii). The most commonly seen incorrect methods for part (ii), included multiplying 10.1 by 2 or dividing the answer in part (i) by 3 or 1000.

(b) A solution of sodium hydroxide is prepared.

The mass of a container with solid sodium hydroxide is determined.
The sodium hydroxide is transferred to a flask.
The mass of the empty container is determined.
The sodium hydroxide is dissolved in water and the volume made up to 2 dm^3.

The results are
mass of container + solid sodium hydroxide = 17.12g
mass of empty container = 7.02g

The results are used to calculate the concentration of the sodium hydroxide solution.

(i) Calculate the mass of solid sodium hydroxide transferred to the flask.

(1)

17·12 − 7·02 = 10·1

mass of solid sodium hydroxide = 10·1 g

(ii) Calculate the concentration of the sodium hydroxide solution in g dm^{-3}.

(1)

concentration = mass ÷ volume
= 10·1 ÷ 2 = 5·05

concentration of sodium hydroxide solution = 5·05 g dm^{-3}

Results Plus: Examiner Comments

A very good example of rarely seen full marks answer, for part (i) - the correct subtraction, namely '17.12 - 7.02' and for part (ii) - the correct calculation of the concentration, namely (17.12 - 7.02)/2. The candidate has also written the correct formula for calculating the mass concentration.

(b) A solution of sodium hydroxide is prepared.

The mass of a container with solid sodium hydroxide is determined.
The sodium hydroxide is transferred to a flask.
The mass of the empty container is determined.
The sodium hydroxide is dissolved in water and the volume made up to 2 dm^3.

The results are
mass of container + solid sodium hydroxide = 17.12 g
mass of empty container = 7.02 g

The results are used to calculate the concentration of the sodium hydroxide solution.

(i) Calculate the mass of solid sodium hydroxide transferred to the flask.

(1)

17.12
7.02
10.10

mass of solid sodium hydroxide = 10.1 g

(ii) Calculate the concentration of the sodium hydroxide solution in g dm^{-3}.

(1)

10.1 ÷ 1000 = 0.0101

concentration of sodium hydroxide solution = 0.0101 g dm^{-3}

Results Plus: Examiner Comments

A typical response seen for 1 mark only, for part (i) - the correct subtraction , '17.12 - 7.02'. The attempt at part (ii), namely calculating the concentration is incorrect.

(b) A solution of sodium hydroxide is prepared.

The mass of a container with solid sodium hydroxide is determined.
The sodium hydroxide is transferred to a flask.
The mass of the empty container is determined.
The sodium hydroxide is dissolved in water and the volume made up to 2 dm^3.

The results are
mass of container + solid sodium hydroxide = 17.12 g
mass of empty container = 7.02 g

The results are used to calculate the concentration of the sodium hydroxide solution.

(i) Calculate the mass of solid sodium hydroxide transferred to the flask.

(1)

17.12 g ÷ 7.02 g =

mass of solid sodium hydroxide = ... g

(ii) Calculate the concentration of the sodium hydroxide solution in g dm^{-3}.

(1)

concentration of sodium hydroxide solution = ... g dm^{-3}

Results Plus: Examiner Comments

Another commonly seen incorrect response - 0 marks. Looking closely at the response - the calculation for part (i) is incorrect, since the masses have been divided and not subtracted. There has been no attempt to calculate the concentration.

Q4.

(a) (i)

Most candidates correctly identified electrolysis.

(i) Give the name of this process in which substances, such as hydrochloric acid, are decomposed by a direct electric current.

(1)

decomposition

Results Plus: Examiner Comments

A rephrasing of the question is not creditworthy.

(a) (ii)

This question asked for this well known test in a slightly different way. It was well answered, with "squeaky pop" a frequent response. Some candidates just stated "squeaky pop test", which is rather lacking in detail as a description (but was credited). Some answers just mentioned "pop"; the fact that the question was worth 2 marks should indicate that this answer is insufficient. The alternatives of the hydrogen burning or water being formed (allowed in this case due to the way the question was phrased) were rarely seen.

Where the answer was incorrect there was confusion particularly with the test for oxygen - "splint relights" - or just stating that the "splint goes out".

(ii) Describe what happens when a burning splint is applied to a mixture of hydrogen and air in a test tube.

(2)

When a burning splint is applied there is a squeaky pop as the hydrogen is ignited.

Results Plus: Examiner Comments

A good, clearly written answer that even explains why a squeaky pop occurs.

Results Plus: Examiner Tip

Try to spell words correctly!

(ii) Describe what happens when a burning splint is applied to a mixture of hydrogen and air in a test tube.

(2)

The burning splint will go out.

Results Plus: Examiner Comments

The candidate has not learnt the gas tests.

Results Plus: Examiner Tip

Tests are an important part of Chemistry and often feature in exam papers.

(b) (iii)

This part was well answered. Most candidates knew that the indigestion remedy neutralised the acid (although poor terminology let some down - the remedy "breaks down" or "dissolves" the acid).

Many candidates also knew the remedy was an alkali/base or that the acid was in excess. In fact, some answers covered three or four of the available mark points. It was a pity that some answers knew about neutralisation but stated that the pH would be lowered. Incorrect responses often seemed to reflect advertising - cooling, calming or soothing the acid. Others did not read the question and referred to functions of the acid - aiding digestion/ breaking up food or killing bacteria.

(iii) Explain how an indigestion remedy works when it cures acid indigestion.

(2)

an indigestion remedy is called a antacid, people take them when there is too much acid in one stomach. The antacids neutrelise the excess stomach acid.

Results Plus: Examiner Comments

A well expressed answer.

(iii) Explain how an indigestion remedy works when it cures acid indigestion.

(2)

The remedy clears the body of the acid build up.

Results Plus: Examiner Comments

This answer is not worded correctly to allow credit - what do 'clear' and 'build up' mean?

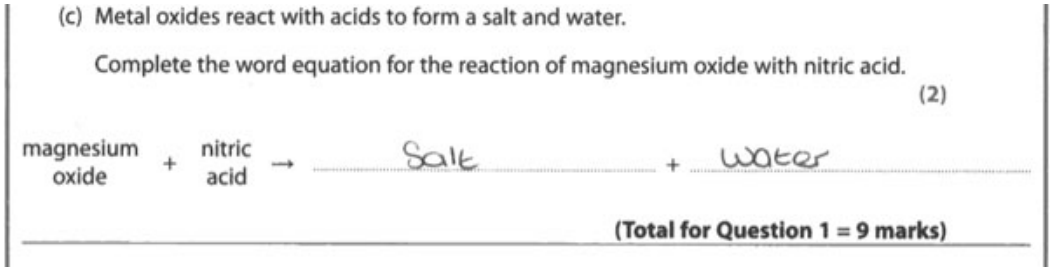
Results Plus: Examiner Tip

Use scientific terminology in your answer - in this case, neutralised and excess.

(c)

Many answers scored one mark for water which just needed to be transposed (although a

significant minority did not include water as a product). Most candidates did not recognise that nitrates are formed from nitric acid, so naming the salt was a good discriminator. A very large number just gave "salt". Other incorrect responses included magnesium nitric, magnesium acid, nitrogen oxide, hydrogen or oxygen. Some answers gave too many products, when the answer space clearly indicated the correct number.


(c) Metal oxides react with acids to form a salt and water.

Complete the word equation for the reaction of magnesium oxide with nitric acid.

(2)

magnesium oxide + nitric acid → Salt + water

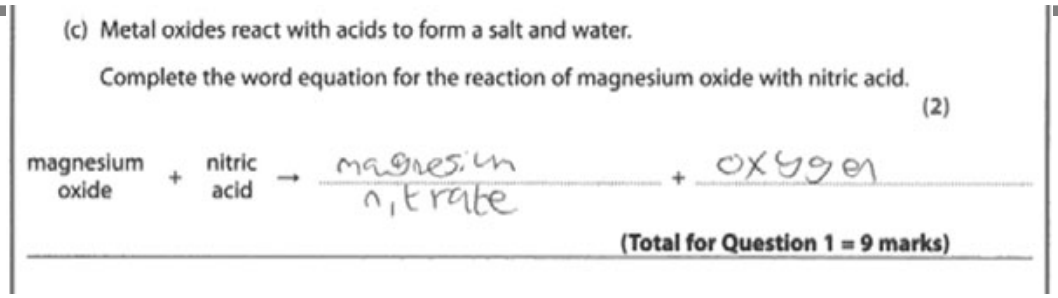
(Total for Question 1 = 9 marks)

Results Plus: Examiner Comments

The most common answer to this question.

Results Plus: Examiner Tip

Remember that the salt formed depends on the acid used.


(c) Metal oxides react with acids to form a salt and water.

Complete the word equation for the reaction of magnesium oxide with nitric acid.

(2)

magnesium oxide + nitric acid → magnesium nitrate + oxygen

(Total for Question 1 = 9 marks)

Results Plus: Examiner Comments

There were examples of correctly identified salts.

Results Plus: Examiner Tip

It's a pity that the candidate has completed the hard task of identifying the salt but has not read the question where water was given as the other product. The examiners give lots of clues in the questions.

Q5.

(a)

Many candidates scored here as they knew that magnesium nitrate was one of the products of the reaction. However a minority of candidates could also state that water and carbon dioxide were also formed.

Some incorrectly gave salt instead of magnesium nitrate.

More students gave only gave one additional product so failed to gain full credit.



Results Plus: Examiner Comments

A good answer that scored both marks.



Results Plus: Examiner Comments

This candidate gave just the generic answer to the question and did not link their knowledge to the question posed.

Results Plus: Examiner Tip

Remember to link your knowledge of chemistry to the context given in the question.

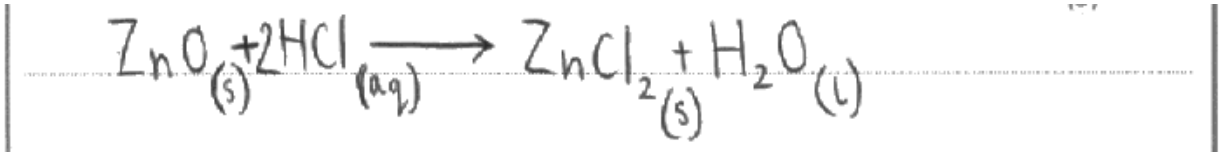


Results Plus: Examiner Comments

This response gained one mark for showing an understanding that magnesium nitrate and one other product (carbon dioxide) was produced, full credit was not awarded as they did not state that water was also produced.

(b)(ii)

Again, students showed a better understanding of how to balance equations than in previous sessions. Many students gained credit for their knowledge of correct formulae of either the product or reactants or both. Many provided a correct balanced equation as a result.



Results Plus: Examiner Comments

An excellent answer which scored full credit, state symbols were not asked for and so were ignored.

(c)

It was pleasing to see that the majority of candidates were familiar with this practical and had obviously carried it out, or at the very least seen it, as some very good explanations and diagrams were seen. However, many candidates lost marks as they did not fully address the question posed. Some candidates gave a fantastic description of how to set up the equipment including a detailed diagram but then failed to explain how they would test for each of the gases produced. Others gave an excellent description of how to test for the gases, including good detail such as damp blue litmus turning red before bleaching, instead of just stating litmus paper turned white, but then failed to describe how the experiment could be carried out. Some candidates gave incorrect methods for the tests such as using a glowing splint instead of a lit splint to test for hydrogen and some just stated that the squeaky pop test should be used, which did not gain credit.

Electrolysis is the process of breaking down ionic substances ~~into~~ ~~small~~ by passed electricity through it using a direct current. To break these substances down, we use two carbon ~~rod~~ rods and a testube for each. There should also be a container with ~~water~~ hydrochloric acid for electrolysis to take place. There are two electrodes, ~~for the~~ ~~where~~ (one is positive and the other is negative) When the direct current is on, the hydrochloric acid should be seperated. Chlorine is form on the positive electrode and hydrogen is formed at the negative electrode. The positively charged atom moves to the negative electrode and gain electrons and ~~are~~ is reduced. The negatively charged atoms move to the positive electrode and lose electrons so they are oxidised.

Results Plus: Examiner Comments

In this response, the candidate has given a good description of how the apparatus can be used to electrolyse the hydrochloric acid. However they have not fully addressed the question as they are also asked how the gases produced can be tested, and this has not been covered in the answer.

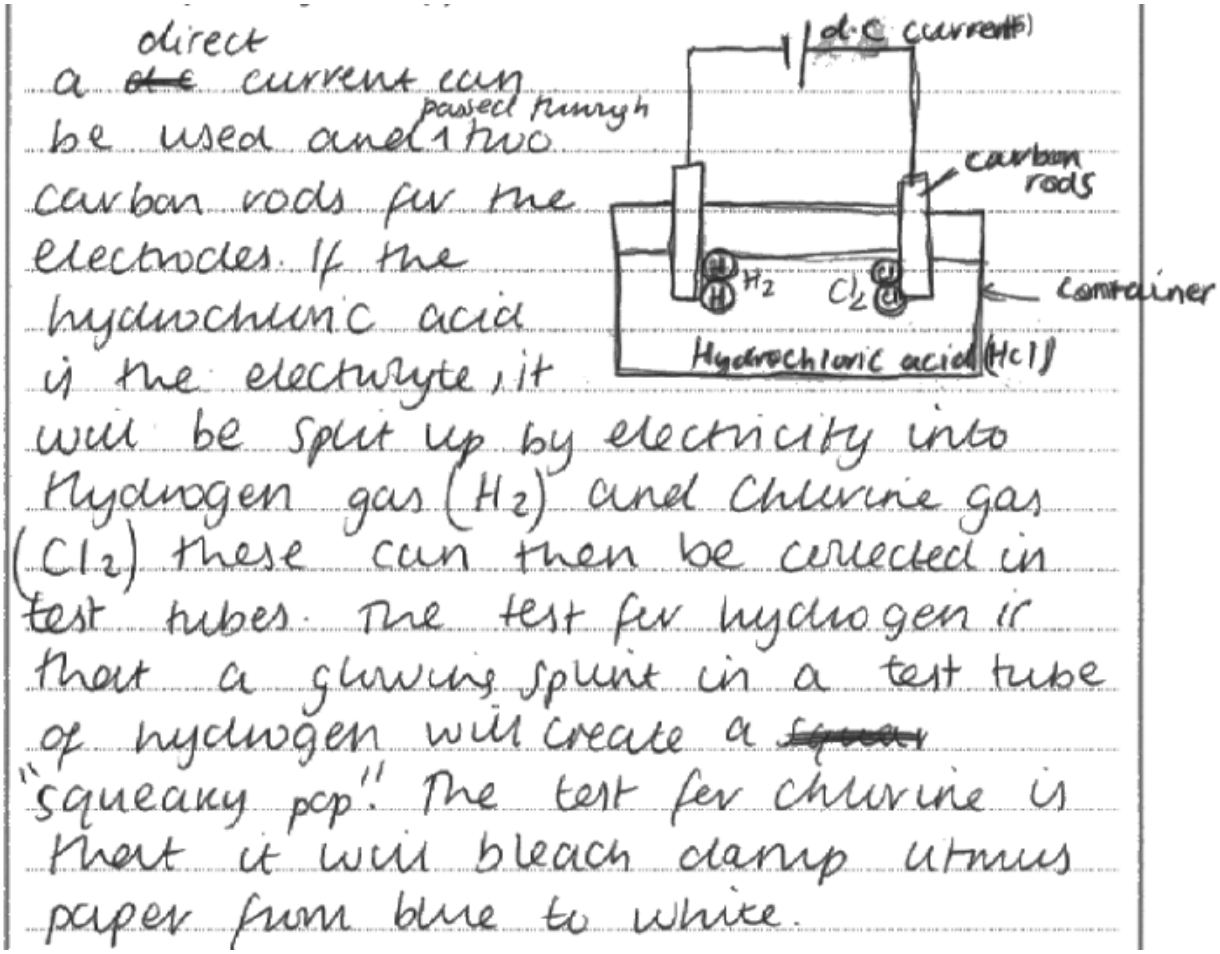
Results Plus: Examiner Tip

It is important that you address all parts of the question posed. Always re-read the question, followed by your answer to check that your answer is relevant to the question posed and that you have addressed all the appropriate points.

Par the hydrochloric acid into the container + put it on a flat surface. Put the two carbon rods into the container held stright by a clampstand or something sturdy. Connect the electricity to the rods and watch the reaction. One is a negative rod + the other is positive. The hydrogen + chlorine will go to the opposite charged rod. The hydrogen$^+$ will go to the negative rod and the chlorine$^-$ will go to the positive. Then put some indicator in the acid and the hydrogen + chlorine will change colour if they are acidic or alkali.

Results Plus: Examiner Comments

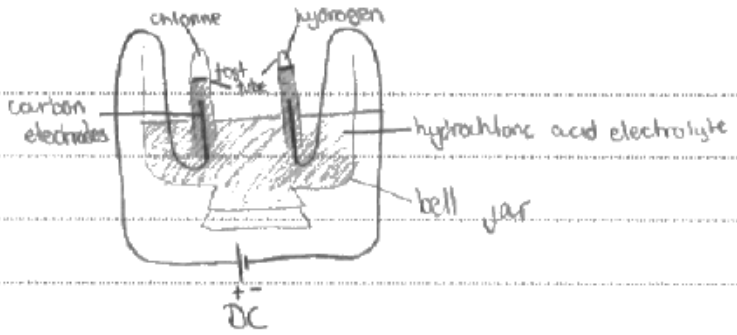
This candidate has given a description of how the apparatus can be used to electrolyse the hydrochloric acid which gains credit. However the tests for hydrogen and chlorine are incorrect so do not gain credit.



Results Plus: Examiner Comments

This candidate gives a good description of how to carry out the experiment. The diagram is useful and helps inform the candidate's answer. The response then goes on to describe the tests, chlorine is described correctly and gains credit. Because of the error in the description of the test (glowing splint) for the hydrogen test, credit could not be gained for this part of the answer...

(6)



ELECTROLYSIS:

In the process of electrolysis, a direct current is passed through an electrolyte to decompose it. The electrolyte, via two carbon electrodes. Hydrogen is produced at the cathode & chlorine at the anode, as collected in the test tubes.

To test for chlorine you would hold damp blue litmus paper over the test tube: which will turn red then white in the presence of chlorine, as it is bleached.

To test for hydrogen, hold a lit splint over the test tube & if you hear a squeaky pop, then hydrogen is present.

Results Plus: Examiner Comments

A very good answer that scored the full six marks available.

Q6.

(ii)

This question was generally poorly answered. The majority scored a mark for some mention of fizzing/bubbles etc. but responses mentioning the solid disappearing were rare. A few mentioned there would be a colour change but did not state the colour. Some thought it would change from green to black – possibly thinking about heating copper carbonate to form copper oxide. Only a minority of candidates scored two marks and finding an answer containing the correct colour of the final solution was indeed a rarity. Many candidates thought they could name the substances formed as their answer e.g. 'Carbon dioxide would be formed'.

Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

(2)

Bubbles and the copper carbonate would dissolve (disappear).

Results Plus: Examiner Comments

Marks were obtained for bubbles (1) and the copper carbonate disappearing (1). The majority just made comment about bubbles or fizzes.

(ii) Acids can also be neutralised by metal carbonates.

Dilute sulfuric acid is neutralised by copper carbonate as shown in the word equation.

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

Copper carbonate is a green powder.

Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

(2)

It would turn from green to blue and it would also fizz

Results Plus: Examiner Comments

Marks were given for the correct colour seen - blue (1) and for fizz (1). Only a very small number wrote that a 'blue solution' forms.

Results Plus: Examiner Tip

Questions like this ask for observations that are made. Look at the information that is given in a question. Giving the names of substances that are formed (eg carbon dioxide) will not gain credit.

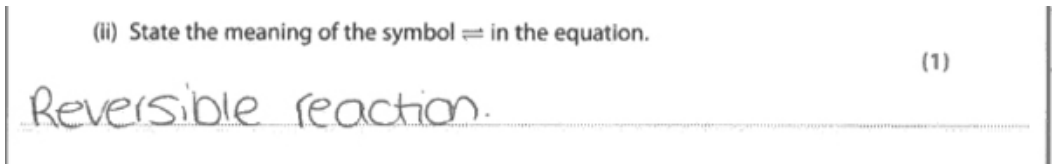
Q7.

(b) (i)

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

(b) (ii)

Most candidates gained credit for their answers.

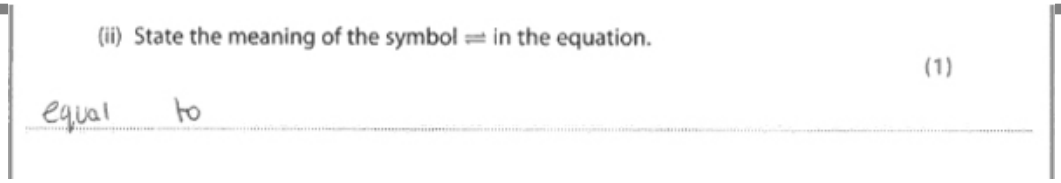

(ii) State the meaning of the symbol ⇌ in the equation.

(1)

Reversible reaction.

Results Plus: Examiner Comments

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


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

(1)

equal to

Results Plus: Examiner Comments

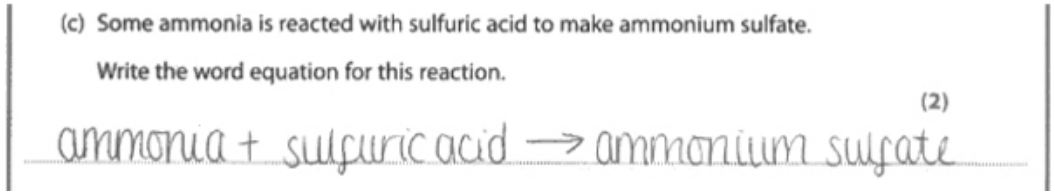
A typical incorrect answer, where the reversible sign was confused with simply an equal sign, so does not score.

(c)

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

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

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


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

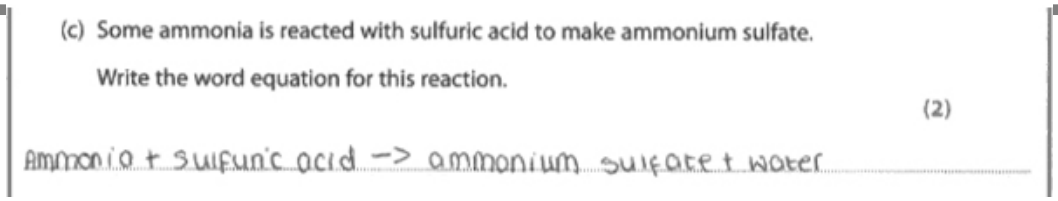
Write the word equation for this reaction.

(2)

ammonia + sulfuric acid → ammonium sulfate

Results Plus: Examiner Comments

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


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

Write the word equation for this reaction.

(2)

ammonia + sulfuric acid -> ammonium sulfate + water

Results Plus: Examiner Comments

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

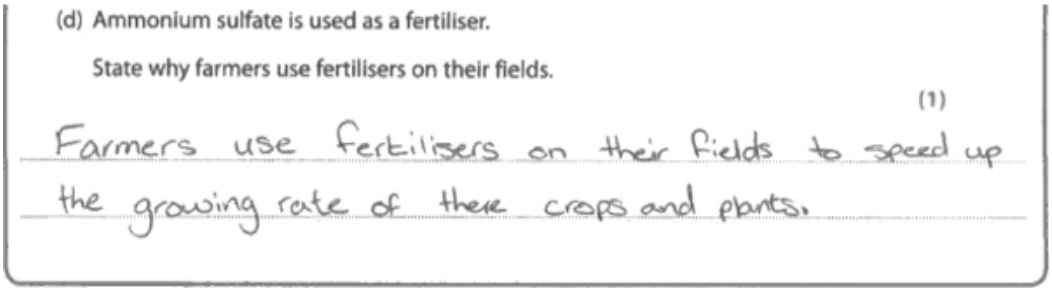
(d)

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

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

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

A typically seen correct response for 1 mark.


(d) Ammonium sulfate is used as a fertiliser.

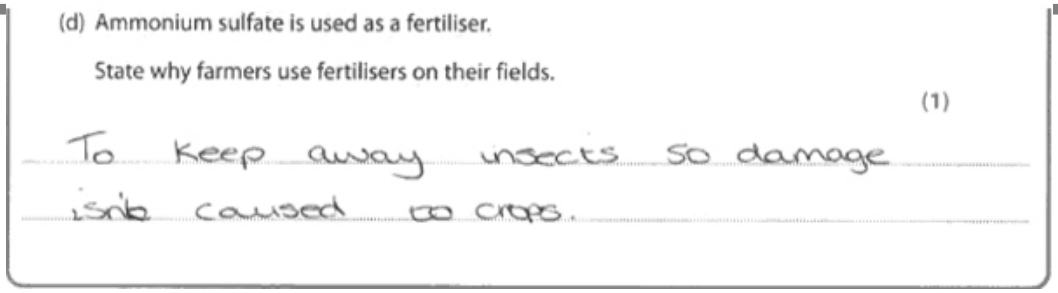
State why farmers use fertilisers on their fields.

(1)

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

Results Plus: Examiner Comments

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


(d) Ammonium sulfate is used as a fertiliser.

State why farmers use fertilisers on their fields.

(1)

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

Results Plus: Examiner Comments

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

(e) (i)

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

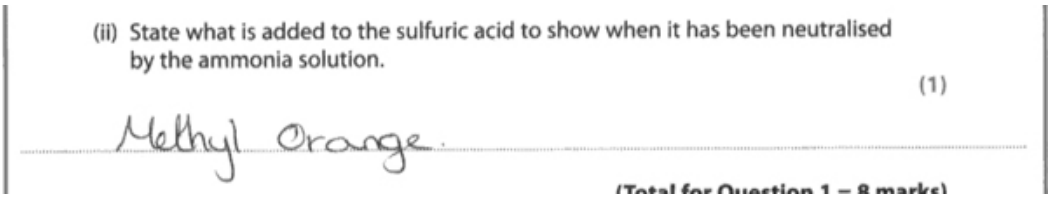
Of those candidates who gained credit for this item, invariably the word was spelled phonetically, this was in most cases sufficient to gain the 1 mark available.

(e) (ii)

Few candidates gained the mark for this question.

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

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


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

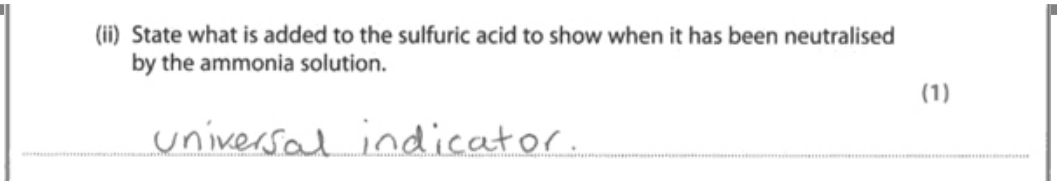
(1)

Methyl Orange.

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

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


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

(1)

universal indicator.

Results Plus: Examiner Comments

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

Q8. No Examiner's Report available for this question

Q9. No Examiner's Report available for this question

Q10.

(i) This part was answered well by most. Equipment to measure volume was well known. It was a little less common to name a balance for the base, with some incorrect responses mentioning pipette or burette, thinking that the base was a liquid.

(ii) Candidates must learn the colours of indicators – many had not.

(iii) A good number of answers explained the increase in pH being due to more OH^- ions or fewer H^+ ions, but a smaller proportion referred to the H^+ ions reacting (with OH^- ions) or being neutralised. A number said there was an excess of OH^- and gave the impression that there was still the same number of H^+ as at the start but they were outnumbered by the hydroxide ions indication a lack of knowledge that neutralisation was taking place. Some did not use 'ions' but referred to hydrogen atoms or particles.

Q11.

(ii)

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

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

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

(2)

1 how much metal we but in the reactivity.

2 and the time.

Results Plus: Examiner Comments

A typical example of response which did not score.

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

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

(2)

1 how much of hydrochloric acid is used

2 And the concentration of the hydrochloric acid.

Results Plus: Examiner Comments

A typical example of a fully correct answer.

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

(iii)

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

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

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

(iv)

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

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

Q12.

(a)

This was very poorly answered on the whole. Most candidates failed to score or had no idea what was required for the 2 marks available. Many simply repeated the stem of the question or confused the reaction for a precipitation reaction and incorrectly suggested filtering the product. The reaction of acids and bases is clearly covered in the specification. However, from the vast

majority of responses seen, it was clear that candidates from most centres may neither have carried out this particular practical nor that of the preparation of a similar soluble salt.

Aqueous Solutions

6 (a) Magnesium sulfate solution can be made by reacting magnesium oxide with dilute sulfuric acid.

The word equation for the reaction is

magnesium oxide + sulfuric acid → magnesium sulfate + water

Describe how solid magnesium oxide and dilute sulfuric acid are used to prepare a sample of pure magnesium sulfate solution.

(2)

Magnesium sulfate solution can be made by reacting magnesium oxide with dilute sulfric acid

Results Plus: Examiner Comments

A typical incorrect response, where the stem of the question has simply been repeated, so this did not score.

Aqueous Solutions

6 (a) Magnesium sulfate solution can be made by reacting magnesium oxide with dilute sulfuric acid.

The word equation for the reaction is

magnesium oxide + sulfuric acid → magnesium sulfate + water

Describe how solid magnesium oxide and dilute sulfuric acid are used to prepare a sample of pure magnesium sulfate solution.

(2)

The magnesium Oxide is mixed with the Sulfuric acid, ace mixed you filter out the exess water and are left with Pure magnesium Sulfate

Results Plus: Examiner Comments

Although filtering is suggested, this did not score since it is clearly implied that the solid, namely magnesium sulfate, is a precipitate and that this is being filtered, as opposed to excess solid reactant, magnesium oxide.

Aqueous Solutions

6 (a) Magnesium sulfate solution can be made by reacting magnesium oxide with dilute sulfuric acid.

The word equation for the reaction is

magnesium oxide + sulfuric acid → magnesium sulfate + water

Describe how solid magnesium oxide and dilute sulfuric acid are used to prepare a sample of pure magnesium sulfate solution.

(2)

They are mixed together and then heated and filtered.

Results Plus: Examiner Comments

A rarely seen response, in which the 'filtered' could be credited, so this scored 1 mark.

(b)

Most candidates were able to score at least 1 of the 2 available marks, typically for stating the correct formulae of the reactants in this balanced equation as given in the stem of the question.

(b) Magnesium carbonate, $MgCO_3$, can be reacted with dilute sulfuric acid, H_2SO_4, to form magnesium sulfate, water and carbon dioxide.

Write the balanced equation for this reaction.

(2)

$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

Mg 1 - 1
C 1 1
O 7 5 - 4
H 2 2
S 1 1 - 1

Results Plus: Examiner Comments

A typical example of a fully correct answer for 2 marks. Although, not necessary, this candidate has clearly checked the balancing beneath.

(b) Magnesium carbonate, $MgCO_3$, can be reacted with dilute sulfuric acid, H_2SO_4, to form magnesium sulfate, water and carbon dioxide.

Write the balanced equation for this reaction.

(2)

$2MgCO_3 + 2H_2SO_4 \rightarrow 2MgSO_4 + H_2O + CO_2$ ~~Magnesium sulfate~~

Results Plus: Examiner Comments

Although the correct formulae of the reactants reactants and products have been shown, the incorrect attempt at balancing, limited the score to 1 mark only.

(c)

This was particularly well answered by candidates, with many fully correct responses seen, gaining the 2 marks available. Most candidates correctly subtracted the correct masses or gained credit simply for the working and pleasingly were able to work out the concentration. Many candidates simply completed the table correctly, as opposed to using the space provided for the answer and working. This was also perfectly acceptable to score full marks.

(d)

Although many candidates knew little about hard water softening, over half of the responses gained at least 2 marks (Level 1), mainly in recognition that temporary hardness can be removed by boiling. In several cases, flawless answers were seen, with excellent descriptions of the methods needed to remove hardness from temporary and/or permanent hardness given by candidates, coupled with detailed explanations, so these scored the full 6 marks (Level 3). Minor errors often seen included simply mentioning 'heating the water' rather than explicitly boiling. In many cases candidates simply misread the question and described methods of testing water hardness, rather than removal, so were unable to receive credit for their responses.

*(d) Some dissolved solids cause hardness in water.
Hard water can be softened.
Water hardness can be temporary hardness or permanent hardness.
Not all softening processes remove both types of hardness.

Describe and explain different methods of softening water, indicating the type of hardness each method removes.

(6)

Some areas of the country ~~conta~~ have dissolved calcium (Ca^{2+}) ions and/or (Mg^{2+}) magnesium ions in their tap water and it is the presence of these ions which determines the hardness of water. Hardness in water can be permanent or temporary; temporary hardness in water is caused by dissolved calcium hydrogencarbonate and/or magnesium hydrogencarbonate. Only temporary hardness in water can be removed or softened by the method of boiling; although this process leaves behind limescale. Permanent hardness in water cannot be softened by the process of boiling - but, it can be softened through the use of an ion exchange resin. Whilst using an ion exchange resin to soften water, the permenantly hardened water is passed through the ion exchange resin and in order to remove the hardness, the dissolved Ca^{2+} and Mg^{2+} ions are swapped or exchanged for sodium ions.

Results Plus: Examiner Comments

An excellent example of a Level 3 response. Both the methods of removal of temporary hardness by boiling and for permanent hardness using an ion exchange resin have been described, but importantly explained to gain the higher Level 3 score.

*(d) Some dissolved solids cause hardness in water.
Hard water can be softened.
Water hardness can be temporary hardness or permanent hardness.
Not all softening processes remove both types of hardness.

Describe and explain different methods of softening water, indicating the type of hardness each method removes.

(6)

Hard water is scum, it can be removed by boiling or fermenting. Permanent ~~hardess~~ hardness is removed by fermenting and temporary hardness is removed by boiling. An example of ~~temporary~~ permanent hardness is limescale. This is found on kettles, even though the kettle gets boiled the limescale stays put.

Results Plus: Examiner Comments

Only lines 4 and 5 of this response are creditworthy for 'temporary hardness... removed by boiling'. This was sufficient for a typical Level 1 answer and was awarded 2 marks.

*(d) Some dissolved solids cause hardness in water.
Hard water can be softened.
Water hardness can be temporary hardness or permanent hardness.
Not all softening processes remove both types of hardness.

Describe and explain different methods of softening water, indicating the type of hardness each method removes.

(6)

If there is temporary hardness it can be removed by using the boiling method which is just where you boil the temporary hardness and it ~~eats~~ will just simply dissolve. For pemanent hardness you must use a oxin resin to remove the permanent hardness because boiling will not be enough to get rid of it.

Results Plus: Examiner Comments

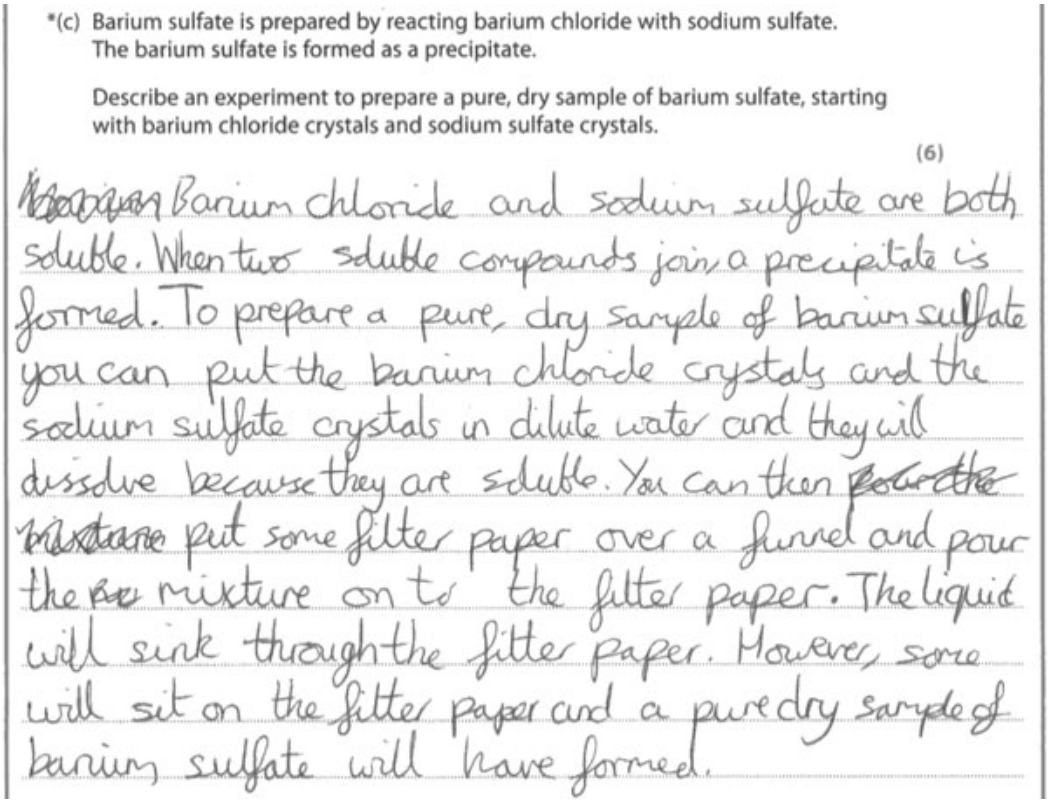
This response makes a reference to the removal of temporary hardness by boiling and the use of ion exchange resin for the removal of permanent hardness, with boiling not being enough for permanent hardness removal. This description is detailed and is sufficient for Level 2, so was awarded 4 marks. There is no explanation given to support a higher Level 3 (5-6 marks) answer.

Q13.

The response to this 6-mark was very disappointing. Over half the candidates could not score a single mark, with the majority of the weaker candidates leaving a blank space. Only a quarter of the candidates produced a level 1 response. Confined to the more able candidates on this paper, very few produced a level 2 answer and a similar number giving a level 3 answer.

A level 1 answer involved making solutions of the reactants and mixing the solutions. Of those that recognised the starting materials were solids, many wanted to dissolve them in hydrochloric acid. For this step we were not sure why this was needed. Many candidates also thought the reactants needed to be heated and melted, rather than simply dissolved in water, before mixing.

A level 2 answer developed this a little further by filtering off the precipitate. Candidates' explanations of filtration and drying were generally good if unsupported by a wider grasp of practical chemistry. A level 3 answer required the idea of drying the precipitate, hopefully having washed it with water before drying.



*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

Barium chloride and sodium sulfate are both soluble. When two soluble compounds join a precipitate is formed. To prepare a pure, dry sample of barium sulfate you can put the barium chloride crystals and the sodium sulfate crystals in dilute water and they will dissolve because they are soluble. You can then put some filter paper over a funnel and pour the mixture on to the filter paper. The liquid will sink through the filter paper. However, some will sit on the filter paper and a pure dry sample of barium sulfate will have formed.

Results Plus: Examiner Comments

This was judged to be a level 2 answer. The candidate had indicated how the precipitate of barium sulfate could be made, but lacked detail. The precipitate was then filtered to obtain a 'pure dry sample', but the washing and drying parts of the process were not detailed. Overall a good answer at this level and 4 marks were given to this answer.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

put barium chloride into a test tube, and fill it with distilled water. Make sure it's dissolved by giving the test tube a shake. Do the same again, this time with sodium sulfate, and give it a shake again. Pour the contents of the two test tubes into a beaker and mix. Put the ~~funnel~~ filter paper into the funnel, and pour the contents of the beaker into the centre of the filter paper. Mix round the filter paper, so all the liquid's gone through. Then scrap the crystals onto a fresh piece of filter paper, and leave to dry.

Results Plus: Examiner Comments

A level 3 answer. This was considered to be a very good answer at this level. It contained the principles of making the solutions, mixing to form the precipitate, filtering and drying the product. Not a perfect answer as the washing process was not present, but a level 3 answer does not have to be perfectly correct answer. There was sufficient for 6 marks to be given.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

Dilute the crystals and mix together the barium chloride and sodium in to either an acidic solution or water, mix well. Then filter the substance formed through a filter paper by using a funnel. Once left with the barium sulphate dry the substance with a paper towel taking out the water creating a dry sample of barium sulphate.

Results Plus: Examiner Comments

Again another level 3 answer. This is not a perfect answer but still has sufficient detail of the steps involved to create a sample of the product. 6 marks were awarded here.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

put the barium sulfate in a test tube, add some hydrochloric acid and mix them together, then drain off the acid.

Results Plus: Examiner Comments

Many answer to this question included the idea of mixing either or both of the reactants with hydrochloric acid, but this step was not explained by the candidates. There was nothing in this answer to credit and so it scored 0 marks.

Results Plus: Examiner Tip

Practice answering the 6-mark questions. To achieve good marks on these questions there has to be a reasonably detailed description or explanation that the question is requiring. Avoid rewriting the question; there is no credit for this.

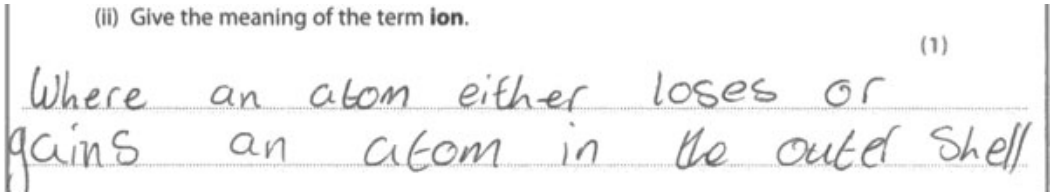
Q14.

(a) (i)

It was clear where candidates had been given practice in working out the formula of ionic compounds from the ions present. About half of the candidates achieved the correct formula; many of those who did not score left it blank presumably because they did not know what to do. Errors seen included multiplying the symbols of the elements by the magnitude of the charge in some way, for example Ba_2SO_4 and $Ba_2S_2O_8$. Also penalised was not giving the 4 as a subscript as in BaSO4.

(a) (ii)

There were some good and valiant attempts at this, but many poor attempts were seen. The majority of candidates missed the point about atoms having lost or gained electrons. There was much confusion with metals and alloy-type descriptions. In addition, many described loss / gain of electrons but lost the mark by putting the answer in terms of 'an element that loses/gains electrons'.

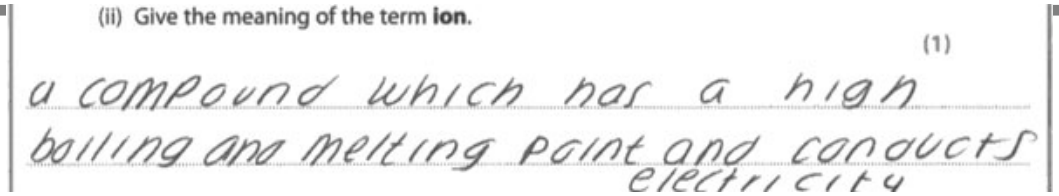

(ii) Give the meaning of the term **ion**.

(1)

Where an atom either loses or gains an atom in the outer shell

Results Plus: Examiner Comments

A careless mistake has cost this candidate the mark. This answer was given 0 marks.

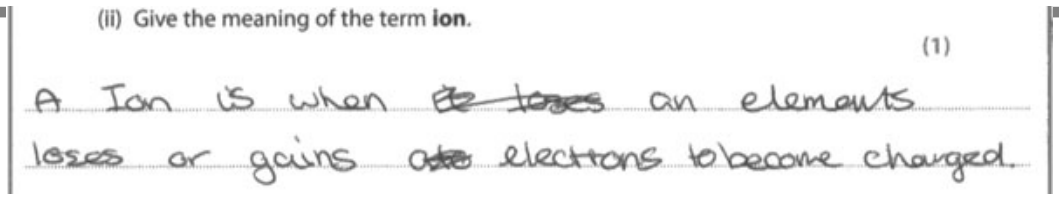

(ii) Give the meaning of the term **ion**.

(1)

a compound which has a high boiling and melting point and conducts electricity

Results Plus: Examiner Comments

It looks like this candidate was trying to describe an ionic compound rather than an ion. 0 marks given.


(ii) Give the meaning of the term **ion**.

(1)

A Ion is when ~~it loses~~ an elements loses or gains ~~ato~~ electrons to become charged.

Results Plus: Examiner Comments

Another careless mistake has cost this candidate the mark. The answer had to be in terms of an atom losing or gaining electrons. 0 marks given.

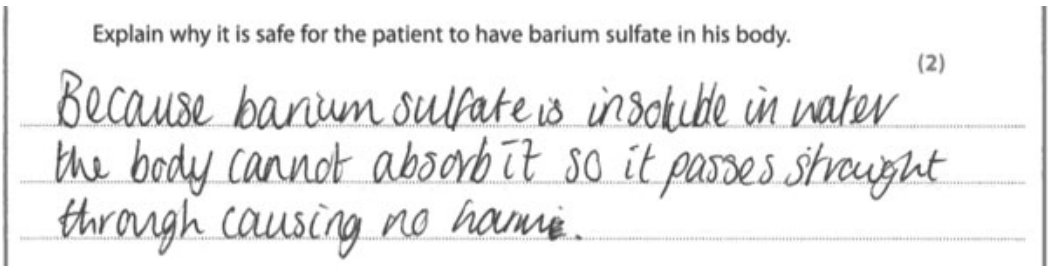
Results Plus: Examiner Tip

Know how ions are formed and know how to use the formulae of ions to be able to work out the formula of an ionic compound.

(b)

There was a pleasing number of 2-mark responses for this stage of the examination paper; the biggest fault lay with the candidates not explaining 'insoluble' and just repeating that part of the question in their answer, for which there was no mark. This question was a good discriminator as it allowed the more able candidates an opportunity to compile a set of linked points. The majority of those that did score a mark here was for indicating that the barium sulfate could not be absorbed into the blood system.

Some candidates tried the argument concerning the percentage of water in our bodies: "about 70-80% water in our bodies and as there's so much it won't be harmful". There was occasional reference made to it reacting with stomach acid and/or being neutralised therefore not harmful or barium sulfate dissolving into water and becoming safe.

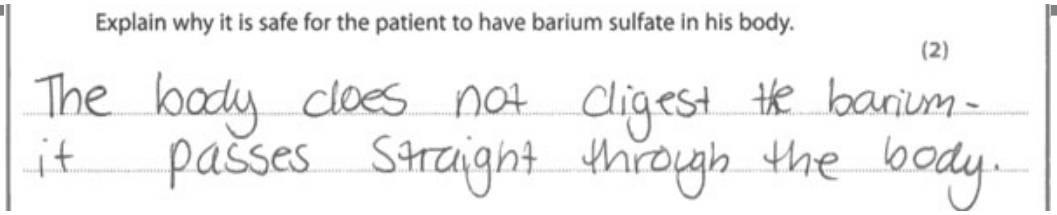

Explain why it is safe for the patient to have barium sulfate in his body.

(2)

Because barium sulfate is insoluble in water the body cannot absorb it so it passes straight through causing no harm.

Results Plus: Examiner Comments

This was a good answer and scored two marks: for the body not able to absorb the barium sulfate and that it passed straight through causing no harm. The first line would not have attracted a mark by itself as this was a repeat of the question.

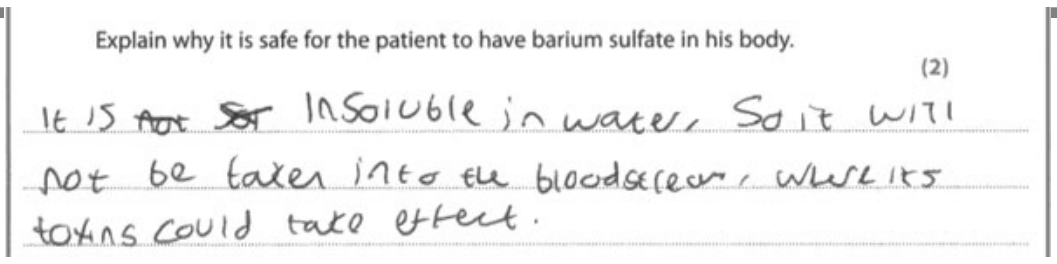

Explain why it is safe for the patient to have barium sulfate in his body.

(2)

The body does not digest the barium - it passes straight through the body.

Results Plus: Examiner Comments

1 mark for stating that the barium sulfate passes straight through the body.


Explain why it is safe for the patient to have barium sulfate in his body.

(2)

It is ~~not~~ ~~so~~ insoluble in water, so it will not be taken into the bloodstream where its toxins could take effect.

Results Plus: Examiner Comments

No marks for the first line, but the second line scored a mark indicating that the barium sulfate would not be taken into the blood stream. The majority of the answers that scored on this question were similar to this.

Results Plus: Examiner Tip

Explanations usually carry two marks, but sometimes three. So 2 linked points need to be made when answering questions of this type.

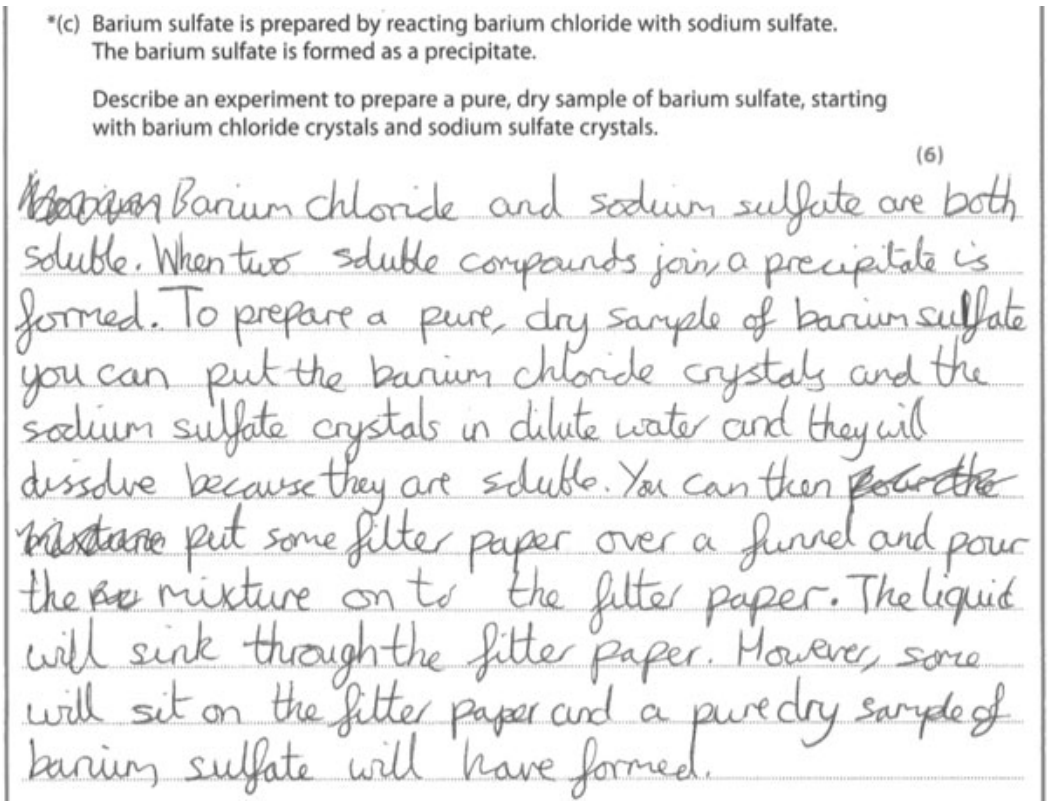
Rewriting part of the question does not gain credit. Take care to use scientific terminology in a correct context.

(c)

The response to this 6-mark was very disappointing. Over half the candidates could not score a single mark, with the majority of the weaker candidates leaving a blank space. Only a quarter of the candidates produced a level 1 response. Confined to the more able candidates on this paper, very few produced a level 2 answer and a similar number giving a level 3 answer.

A level 1 answer involved making solutions of the reactants and mixing the solutions. Of those that recognised the starting materials were solids, many wanted to dissolve them in hydrochloric acid. For this step we were not sure why this was needed. Many candidates also thought the reactants needed to be heated and melted, rather than simply dissolved in water, before mixing.

A level 2 answer developed this a little further by filtering off the precipitate. Candidates' explanations of filtration and drying were generally good if unsupported by a wider grasp of practical chemistry. A level 3 answer required the idea of drying the precipitate, hopefully having washed it with water before drying.



*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

Barium chloride and sodium sulfate are both soluble. When two soluble compounds join, a precipitate is formed. To prepare a pure, dry sample of barium sulfate you can put the barium chloride crystals and the sodium sulfate crystals in dilute water and they will dissolve because they are soluble. You can then put some filter paper over a funnel and pour the mixture on to the filter paper. The liquid will sink through the filter paper. However, some will sit on the filter paper and a pure dry sample of barium sulfate will have formed.

Results Plus: Examiner Comments

This was judged to be a level 2 answer. The candidate had indicated how the precipitate of barium sulfate could be made, but lacked detail. The precipitate was then filtered to obtain a 'pure dry sample', but the washing and drying parts of the process were not detailed. Overall a good answer at this level and 4 marks were given to this answer.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

put barium chloride into a test tube, and fill it with distilled water. Make sure it's dissolved by giving the test tube a shake. Do the same again, this time with sodium sulfate, and give it a shake again. Pour the contents of the two test tubes into a beaker and mix. Put the ~~funnel~~ filter paper into the funnel, and pour the contents of the beaker into the centre of the filter paper. Mix round the filter paper, so all the liquid's gone through. Then scrap the crystals onto a fresh piece of filter paper, and leave to dry.

Results Plus: Examiner Comments

A level 3 answer. This was considered to be a very good answer at this level. It contained the principles of making the solutions, mixing to form the precipitate, filtering and drying the product. Not a perfect answer as the washing process was not present, but a level 3 answer does not have to be perfectly correct answer. There was sufficient for 6 marks to be given.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

Dilute the crystals and mix together the barium chloride and sodium in to either an acidic solution or water, mix well. Then filter the substance formed through a filter paper by using a funnel. Once left with the barium sulphate dry the substance with a paper towel taking out the water creating a dry sample of barium sulphate.

Results Plus: Examiner Comments

Again another level 3 answer. This is not a perfect answer but still has sufficient detail of the steps involved to create a sample of the product. 6 marks were awarded here.

*(c) Barium sulfate is prepared by reacting barium chloride with sodium sulfate. The barium sulfate is formed as a precipitate.

Describe an experiment to prepare a pure, dry sample of barium sulfate, starting with barium chloride crystals and sodium sulfate crystals.

(6)

put the barium sulfate in a test tube, add some hydrochloric acid and mix them together, then drain off the acid.

Results Plus: Examiner Comments

Many answer to this question included the idea of mixing either or both of the reactants with hydrochloric acid, but this step was not explained by the candidates. There was nothing in this answer to credit and so it scored 0 marks.

Results Plus: Examiner Tip

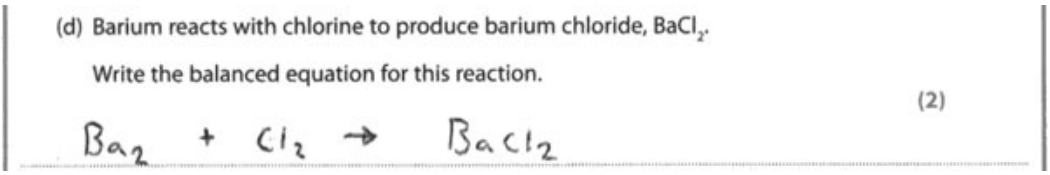
Practice answering the 6-mark questions. To achieve good marks on these questions there has to be a reasonably detailed description or explanation that the question is requiring. Avoid rewriting the question; there is no credit for this.

(d)

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

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

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


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

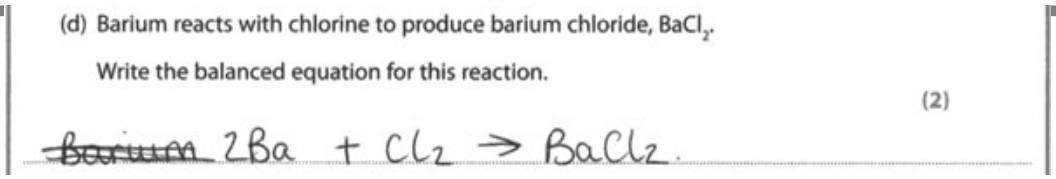
Write the balanced equation for this reaction.

(2)

$Ba_2 + Cl_2 \rightarrow BaCl_2$

Results Plus: Examiner Comments

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


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

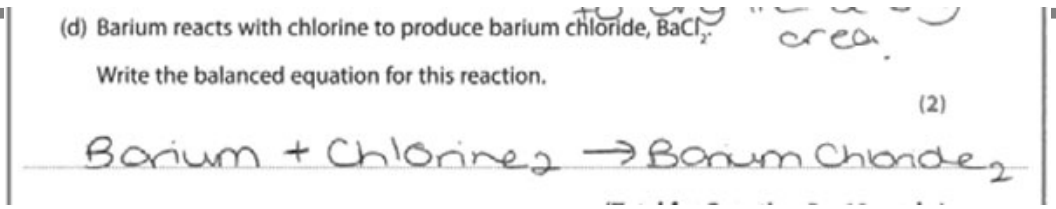
Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

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


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

Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

Word equations do not score when asked for balanced equations.

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

Write the balanced equation for this reaction.

(2)

$Ba + 2Cl \rightarrow BaCl_2$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Spend time making sure you can balance simple equations.

Q15. No Examiner's Report available for this question

Q16.

(a)

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

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

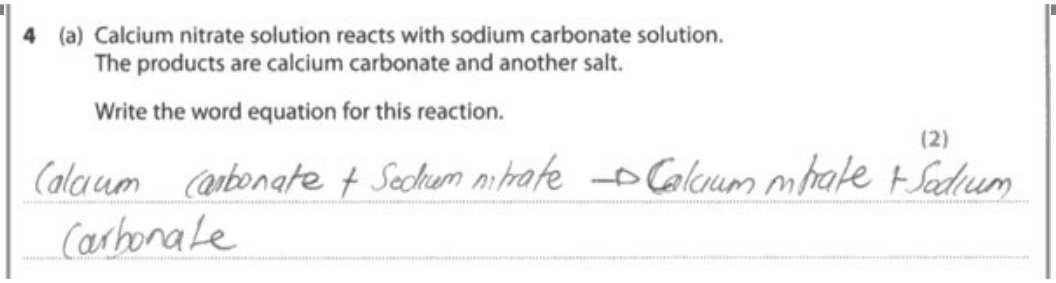
Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

Results Plus: Examiner Comments

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



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

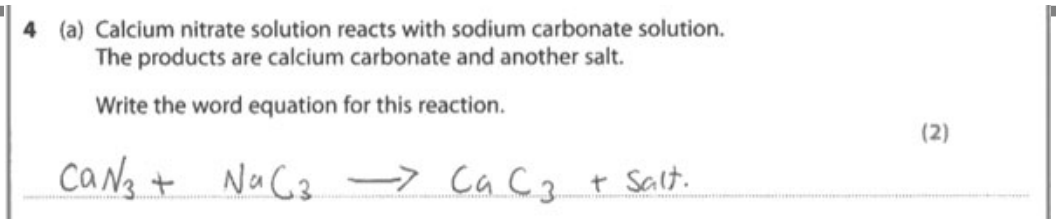
Write the word equation for this reaction.

(2)

Calcium carbonate + Sodium nitrate → Calcium nitrate + Sodium Carbonate

Results Plus: Examiner Comments

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



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

Write the word equation for this reaction.

(2)

$CaN_3 + NaC_3 \longrightarrow CaC_3 + salt.$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(b) (ii)

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

The three steps involved in a flame test are:

1. Clean the flame testing rod with hydrochloric acid.

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

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

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

(c) (i)

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

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

Percentage yield = ~~theoretical~~ Actual yield / ~~Actual~~ ~~theoretical~~ yield × 100 Ans = 90

100% = 40/44 = 0.909 × 100 theoretical

percentage yield of carbon dioxide = 90 %

Results Plus: Examiner Comments

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

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

44/40 x100

actual yield / theoretical yield × 100 44/40 x100 percentage yield of carbon dioxide = 110 %

Results Plus: Examiner Comments

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

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

100g − 40g = 60g

percentage yield of carbon dioxide = 60 %

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(c) (ii)

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

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

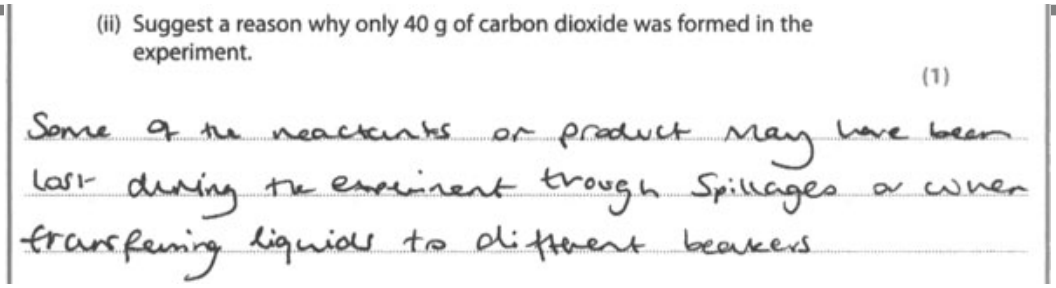
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

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

Results Plus: Examiner Comments

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



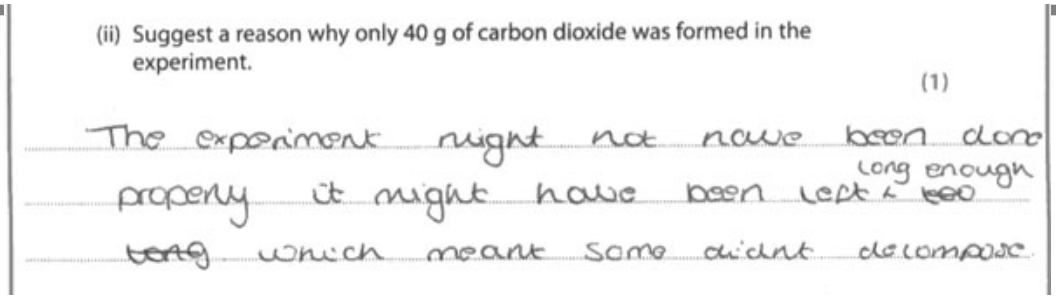
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

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

Results Plus: Examiner Comments

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



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

(1)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

a) Incomplete reaction - not all reactants used up.

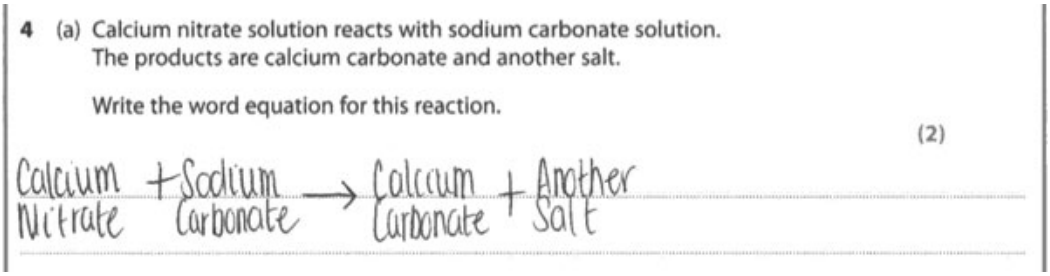
b) Product lost during the reaction - usually when transferring liquids from one container to another.

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

Think about the reaction when applying these ideas.

Q17.

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


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

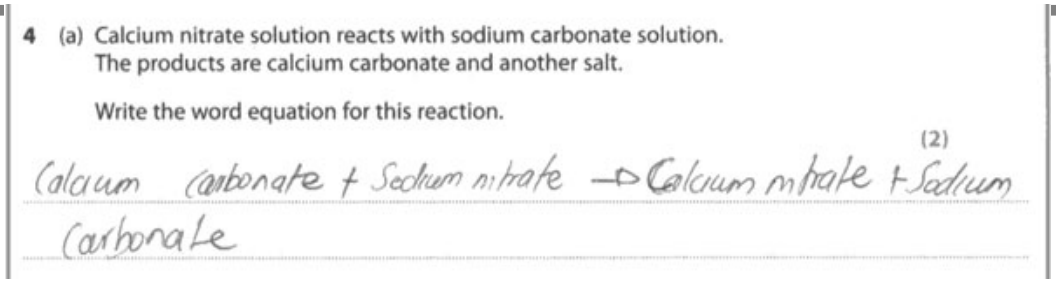
Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

Results Plus: Examiner Comments

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


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

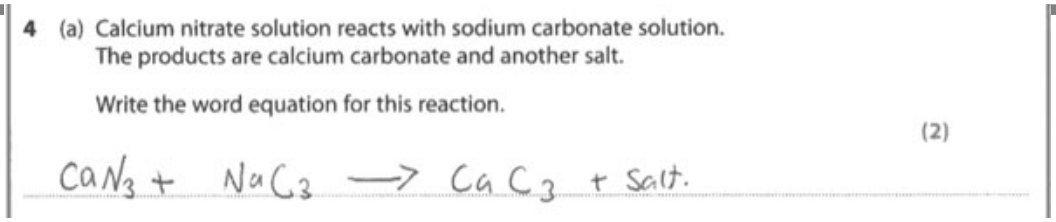
Write the word equation for this reaction.

(2)

Calcium carbonate + Sodium nitrate → Calcium nitrate + Sodium Carbonate

Results Plus: Examiner Comments

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


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

Write the word equation for this reaction.

(2)

$CaN_3 + NaC_3 \longrightarrow CaC_3$ + Salt.

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Q18. No Examiner's Report available for this question

Q19. No Examiner's Report available for this question

Q20.

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

Q21.

(i)

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

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

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

(2)

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

Results Plus: Examiner Comments

The correct answer that scored both marks.

(ii)

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

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

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

(2)

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

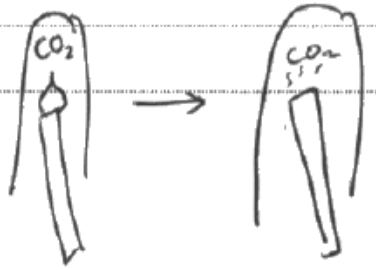
Results Plus: Examiner Comments

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

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

(2)

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

using lime water testing for it to go cloudy

Results Plus: Examiner Comments

A correct answer that gained both marks.

Q22. No Examiner's Report available for this question

Q23. No Examiner's Report available for this question

Q24.

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

Q25. No Examiner's Report available for this question

Q26. No Examiner's Report available for this question

Q27. No Examiner's Report available for this question

Q28.

Candidates found it hard to draw an accurate and labelled diagram of the apparatus used to filter the mixture in part (i). Many candidates lost marks as they did not give a scientific diagram and therefore showed closed funnels or did not draw any filter paper. Of those that did draw a correct diagram, many lost marks as they were vague with their labelling or labelled the funnel as 'filter'. Some candidates tried to label other parts of their diagram such as the filtrate or residue rather than sticking to the apparatus as requested by the question, these additions were ignored. More were able to score well in part (ii) with the majority scoring two marks for understanding that the filtrate should be heated to concentrate and then dried in an oven or between filter papers.

Q29. No Examiner's Report available for this question

Q30. No Examiner's Report available for this question

Q31.

A good proportion of candidates were able to correctly recall the test for hydrogen gas in question (i). In some cases, candidates stated that a glowing splint would be used rather than a lit splint. In these cases, no marks were awarded as the result for the test is dependent on the correct method being used. In part (iii), the definition of electrolysis was well attempted by candidates with around a third being able to give a complete definition. Where candidates did not score both marks, it was often as they had not referred to the use of electricity or an electric

current to decompose the electrolyte.

Q32.

Marks were lost in this question by candidates suggesting that all of the water should be evaporated from the solution rather than heating the solution to concentrate it. Very few responses mentioned leaving the solution to cool or putting the solution somewhere warm for a period of time to allow crystals to form slowly (as tends to be seen more commonly in school).

Q33.

(i) Most candidates scored at least 1 mark on this question, with many of these going on to score the second mark. The quality of the diagrams drawn was very variable – some drawn neatly with a ruler and others showing sketches. It was more difficult to determine whether the freehand sketches were worth both marks. Common reasons for the loss of a mark included: not drawing the solution in the beaker, not adding labels (as asked for in the question), not drawing the power source and wires or showing a chemical cell rather than the set-up of electrolysis.

(ii) Explaining what happens in electrolysis continues to be a weak area for candidates. Very few marks were awarded here with confusion between electrons and ions, and no apparent understanding of why the concentration of the solution does not change during electrolysis with copper electrodes. There was also a misconception that the loss and gain of electrons at the electrodes are the cause of the changes in mass.

Q34.

(b) (ii)

The number of candidates who correctly wrote the formula of carbon dioxide was disappointing. Many candidates simply wrote 'carbon dioxide', indicating a lack of understanding of the term formula. In other cases, candidates lost marks as, although they knew which elements in what proportions are present in carbon dioxide, they had not been successfully taught how to correctly represent this in a formula. The majority of candidates who scored zero marks did so because they wrote the '2' superscript rather than subscript, while others wrote a lower case 'O' for the oxygen rather than a capital.

(ii) Write the formula of a molecule of carbon dioxide.

(1)

CO_2

Results Plus: Examiner Comments

Correct for 1 mark.

(ii) Write the formula of a molecule of carbon dioxide.

(1)

Co2

Results Plus: Examiner Comments

This example scored 0 marks as the oxygen in the formula has been written lower case rather than upper case.

Results Plus: Examiner Tip

When writing formula it is very important that the first letter of each element is capitalised.

(ii) Write the formula of a molecule of carbon dioxide.

(1)

CO^2

Results Plus: Examiner Comments

This very common answer scored zero marks.

(b) (iii)

The majority of candidates were able to explain that trees or plants absorb carbon dioxide from the atmosphere for use in photosynthesis. Fewer candidates explained, using the alternative marking route, that carbon dioxide is soluble in water and that it would be absorbed by oceans. This question was a two mark 'explain' type question, in some cases candidates lost marks as they gave a relevant fact to gain the first mark, but then failed to take this further to explain why this fact made carbon dioxide levels decrease. A common error was that deforestation or the burning of fossil fuels caused the amount of carbon dioxide in the atmosphere to decrease, this was most probably due to candidates misreading the question given.

(iii) The percentage of carbon dioxide in the atmosphere has decreased since the Earth's earliest atmosphere.

Explain what has caused the amount of carbon dioxide in the atmosphere to decrease.

(2)

photosynthesis in plants

Results Plus: Examiner Comments

A short, to the point answer, that scored two marks.

(iii) The percentage of carbon dioxide in the atmosphere has decreased since the Earth's earliest atmosphere.

Explain what has caused the amount of carbon dioxide in the atmosphere to decrease.

(2)

Plants Respiration taking carbon dioxide and replacing that for oxygen.

Results Plus: Examiner Comments

This response scored just 1 mark for showing an understanding that plants caused the decrease of carbon dioxide.

Results Plus: Examiner Tip

Care should be taken when using key scientific terms; respiration is not equivalent to photosynthesis and is rejected even though the correct exchange of gases is given.

(iii) The percentage of carbon dioxide in the atmosphere has decreased since the Earth's earliest atmosphere.

Explain what has caused the amount of carbon dioxide in the atmosphere to decrease.

(2)

The more plants and tree's have been planted.

Results Plus: Examiner Comments

This candidate has gained one mark for stating that the amount of carbon dioxide has decreased due to plants/trees but they have not gone to explain how for the second marking point.

Results Plus: Examiner Tip

When answering questions that ask you to explain, you must give a point, idea or fact and then try to explain the point.

(b) (iv)

The majority of candidates performed well in this question, with the most common correct responses stating that the burning of fossil fuels or deforestation would increase the amount of carbon dioxide in the air. Where candidates lost marks it was because they gave weak non-specific answers such as 'driving cars'.

(iv) State one human activity that increases the amount of carbon dioxide in the atmosphere today.

(1)

Burning of fossil fuels.

Results Plus: Examiner Comments

A good answer which scored 1 mark.

(iv) State one human activity that increases the amount of carbon dioxide in the atmosphere today.

(1)

Travel such as cars.

Results Plus: Examiner Comments

As this response does not give any extra detail it is not worthy of credit. If the candidate had included driving petrol fuelled cars or similar vehicles then credit could have been awarded.

(b) (v)

Candidates seemed to find this question difficult with few being able to give the correct test for carbon dioxide. Some candidates scored 1 mark for showing an understanding that limewater is required, but did not give the result of the test for the second mark. Many candidates confused the test for carbon dioxide with tests for other gases such as hydrogen. Some candidates stated

that carbon dioxide would extinguish a lighted splint. Whilst this is true it would not prove that carbon dioxide was present and therefore would not serve as a test for carbon dioxide.

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

(2)

you do the squeky pop test we put Hydrodgen into a ~~pen~~ test tube then we put the bunsen burner at the top if there is CO_2 then it will make a pop sound.

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

A confused answer. The candidate has obviously confused the test for hydrogen with the test for carbon dioxide.

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

(2)

limewater ~~water~~ which goes cloudy to show that carbon dioxide is present

Results Plus: Examiner Comments

A good answer that scored the two marks available. The candidate has given the reagent for the test and the positive result for the test.

Results Plus: Examiner Tip

When describing the test for a gas, you should always include the test method or reagents such as limewater, followed by the positive result of that test.

Q35. No Examiner's Report available for this question

Q36. No Examiner's Report available for this question

Q37. No Examiner's Report available for this question

Q38.

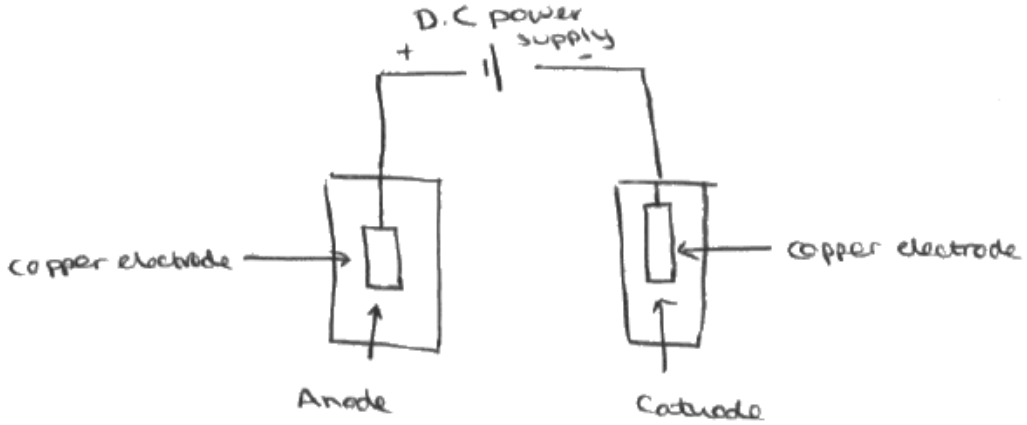
(i)

Diagram drawing is an important skill, and this perhaps has been overlooked by some judging by the quality of those diagrams. However, there were many that were drawn well and clear showing a working diagram with the electrodes sitting in the copper sulfate solution and connected to a power supply. The question asked for the diagram to show the apparatus used to carry out the electrolysis and so the power supply had to be shown. In addition, it was expected to see a complete circuit and any significant break lost one of the marks. Only a few candidates scored 0 marks here.

Copper sulfate solution was electrolysed using copper electrodes.

(i) Draw a labelled diagram to show the apparatus that is used to carry out this electrolysis in the laboratory.

(2)



Results Plus: Examiner Comments

There were 2 errors in this diagram.

The wires were shown to be connected to the electrodes, but not shown as connected to the power supply, so did not score that mark.

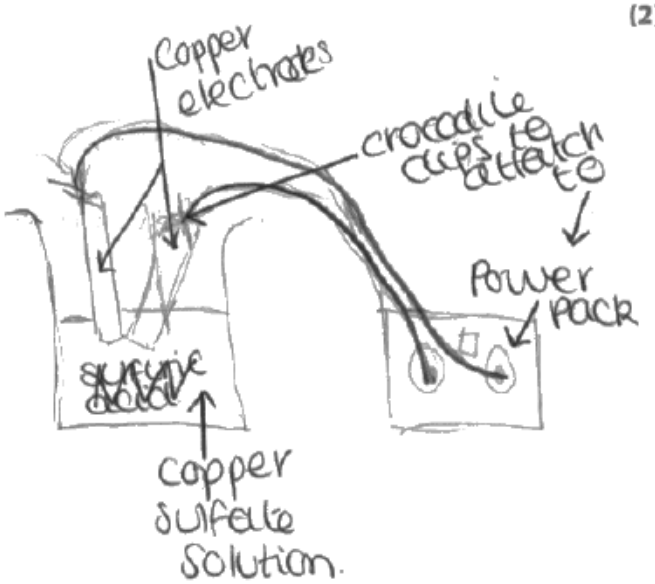
The electrodes were placed in separate containers, which not form a complete circuit. Both electrodes need to be in the same solution for electrolysis to take place.

0 marks for this answer.

Copper sulfate solution was electrolysed using copper electrodes.

(i) Draw a **labelled diagram** to show the apparatus that is used to carry out this electrolysis in the laboratory.

(2)



Results Plus: Examiner Comments

The diagram showed a power pack coonected by 2 wires to electrodes in copper sulfate solution. This scored 1 mark for the power supply, but as the electrodes were shown touching, this did score the 1st marking point. 1 mark overall.

(ii)

Several candidates just restated the contents of the results table in an alternative way for which no credit was given. Several candidates thought that the mass changes were due to the gain/loss of electrons or that negative ions attach to the anode to reduce its mass. Many had missed the point about copper electrodes were used in the electrolysis.

Where marks were being awarded generally this was for candidates writing about copper ions being deposited on the cathode. However, not all of those candidates mentioned the number of electrons that ions needed to form the atoms causing the increase in mass.The idea that particles were attracted to the cathode was evident in many answers, but often copper ions were not identified as those particles. Fewer candidates could explain why the mass of the anode decreased. Where candidates did write about copper atoms forming copper ions, often the number of electrons removed from the copper atom was omitted. It was surprising to see the number of answers that accounted for the decrease in anode mass by the attraction and deposition of negative ions.

Often candidates made correct reference to oxidation at the anode and reduction at the cathode. The stronger candidates made use of correct half equations for what happened at each electrode and included brief detail about copper ions moving from the anode to the cathode.

(ii) Before the electrolysis, the masses of the electrodes were determined.
After the electrolysis, the electrodes were washed and dried and their masses re-determined.

Figure 6 shows these masses and the resulting changes in masses of the electrodes.

	mass of electrode before electrolysis in g	mass of electrode after electrolysis in g	change in mass of electrode in g
anode	11.27	10.42	−0.85
cathode	11.32	12.17	+0.85

Figure 6

Explain these results.

(4)

The cathode is a negative electrode, and there was an increase in mass which means the cathode gained ions., ~~gas~~ This gives it a neutral charge. the anode is a positive electrode, and there was a decrease in mass which means the anode lost ions. This gives it a neutral charge too.

Results Plus: Examiner Comments

The ions that moved in solution were not identified and what was happening at the two electrodes lacked all detail. This scored 0 overall.

(ii) Before the electrolysis, the masses of the electrodes were determined. After the electrolysis, the electrodes were washed and dried and their masses re-determined.

Figure 6 shows these masses and the resulting changes in masses of the electrodes.

	mass of electrode before electrolysis in g	mass of electrode after electrolysis in g	change in mass of electrode in g
anode	11.27	10.42	−0.85
cathode	11.32	12.17	+0.85

Figure 6

Explain these results.

(4)

As the electrons are copper they are non-inert meaning they will take part in the process. The anode loses mass as copper ions leave it during the reaction as it is positive. Cathode gains copper atoms as it is negative so the mass increases.

Half equations: Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$

Anode: $Cu \rightarrow Cu^{2+} + 2e^-$

Results Plus: Examiner Comments

Answers of this quality were a rare sight. The candidate had written about Cu^{2+} moving from the anode to the cathode and written two half equations for the reactions taking place at the electrodes. A maximum of 4 marks for this.

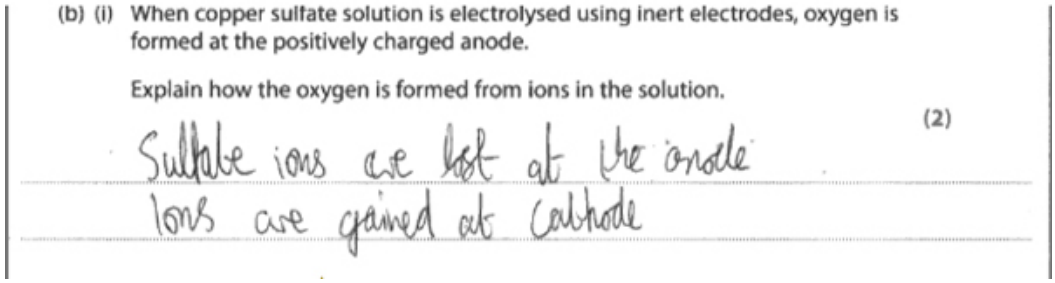
Results Plus: Examiner Tip

Make sure you can write the half equations for the reactions taking place at the anode and cathode in the electrolysis of a variety of electrolyte solutions.

Q39.

(i)

This question was not answered well by many candidates. A lot of candidates thought that there were oxide ions in water or that the oxygen was produced from the sulfate ions. Candidates should be made aware that the ions from water can be discharged at the electrodes during electrolysis of a solution. Some candidates showed an excellent understanding of what was happening and they gave a balanced half-equation for the reaction at the anode.



(b) (i) When copper sulfate solution is electrolysed using inert electrodes, oxygen is formed at the positively charged anode.

Explain how the oxygen is formed from ions in the solution.

(2)

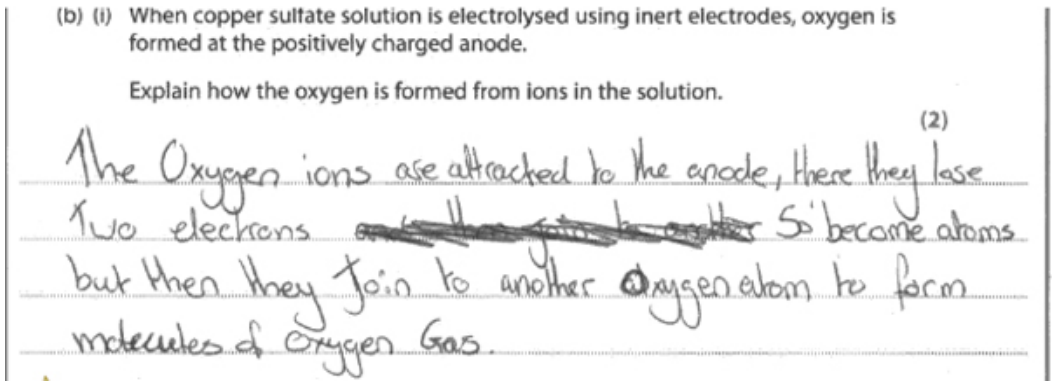
Sulfate ions are lost at the anode
Ions are gained at cathode

Results Plus: Examiner Comments

This candidate did not score any marks.

Results Plus: Examiner Tip

Ions react at the electrodes by gaining or losing electrons.



(b) (i) When copper sulfate solution is electrolysed using inert electrodes, oxygen is formed at the positively charged anode.

Explain how the oxygen is formed from ions in the solution.

(2)

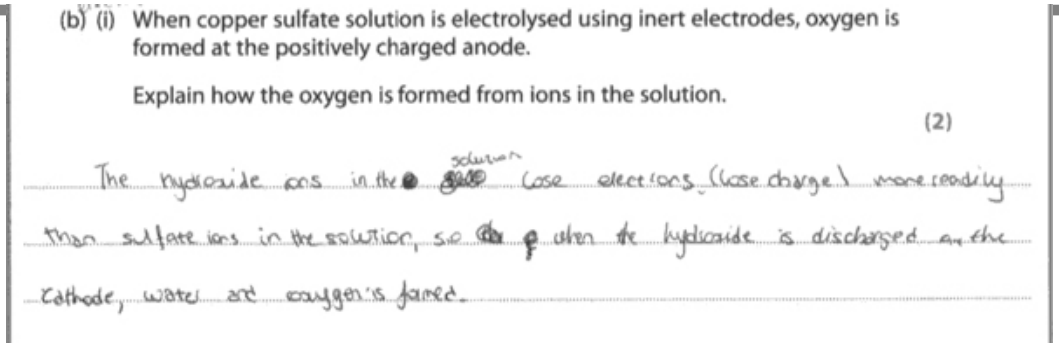
The Oxygen ions are attracted to the anode, there they lose Two electrons [illegible] so become atoms but then they join to another Oxygen atom to form molecules of Oxygen Gas.

Results Plus: Examiner Comments

This candidate thought that there were oxide ions in the solution. However, they do know that the oxygen was formed by loss of electrons at the anode, so scored 1 mark.

Results Plus: Examiner Tip

Remember that water contains a few hydrogen ions, H+, and a few hydroxide ions, OH-. During electrolysis, these ions can gain or lose electrons to form hydrogen gas or oxygen gas.



(b) (i) When copper sulfate solution is electrolysed using inert electrodes, oxygen is formed at the positively charged anode.

Explain how the oxygen is formed from ions in the solution.

(2)

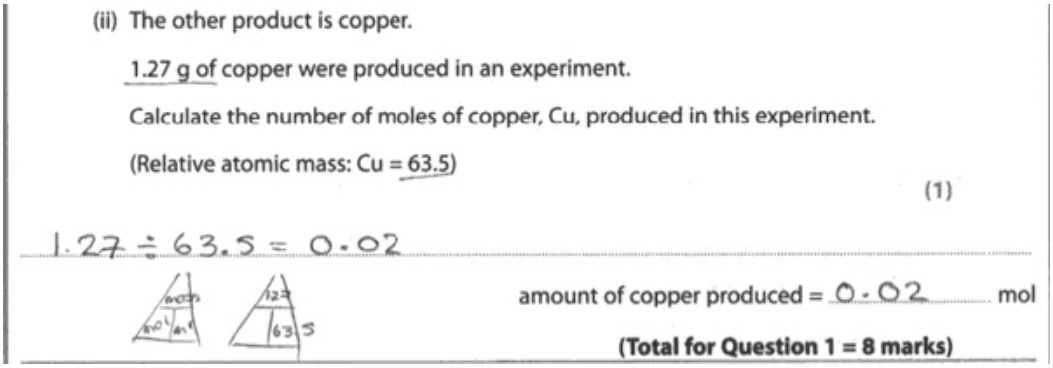
The hydroxide ions in the solution lose electrons (lose charge) more readily than sulfate ions in the solution, so when the hydroxide is discharged at the cathode, water and oxygen is formed.

Results Plus: Examiner Comments

This is a very good answer that identifies the hydroxide ions in the solution and states that they lose electrons to form oxygen. This answer scored both marks.

(ii)

This question was answered correctly by a large number of candidates. Just small numbers of candidates multiplied the mass by the relative atomic mass or divided the relative atomic mass by the mass of copper.



(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

Calculate the number of moles of copper, Cu, produced in this experiment.

(Relative atomic mass: Cu = 63.5)

(1)

1.27 ÷ 63.5 = 0.02

amount of copper produced = 0.02 mol

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

This correct answer scored 1 mark.

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

Calculate the number of moles of copper, Cu, produced in this experiment.

(Relative atomic mass: Cu = 63.5)

(1)

$12.7 \div 63.5 = \frac{1}{5} = 0.2$

amount of copper produced = 0.2 mol

(Total for Question 1 = 8 marks)

$\frac{12.7}{63.5} = \frac{1}{5} = 0.2$

$\frac{\text{mass}}{\text{Ram} \mid \text{moles}}$



Results Plus: Examiner Comments

This candidate has mis-read the question. The mass of copper is 1.27 g not 12.7 g.

Results Plus: Examiner Tip

Avoid making careless errors. Read the question carefully.

Q40. No Examiner's Report available for this question

Q41.

(i)

Candidates did not perform well in this question. In some cases, candidates showed some understanding that the movement of particles was important for electrical conductivity in solution. However, many referred to the movement of electrons rather than the movement of ions.

In other cases, candidates thought that the reason was that you would not be able to get the electrodes into a beaker of solid, this did not gain credit. Some candidates gave vague statements such as the reaction would not work or repeated the stem and said that a solution should be used. Candidates should be taught that no credit will be awarded for repeating the stem of the question.

Solid sodium chloride is dissolved in water.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

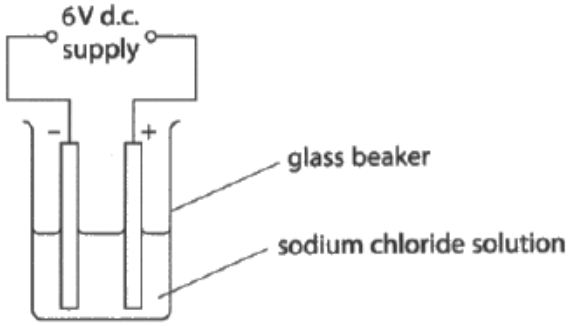


Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

~~So that~~ Because it would not conduct electricity in solid state.

Results Plus: Examiner Comments

Where other candidates gained credit, it was often for stating that the liquid or solution would conduct or for saying that the solid would not conduct electricity.

Solid sodium chloride is dissolved in water.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

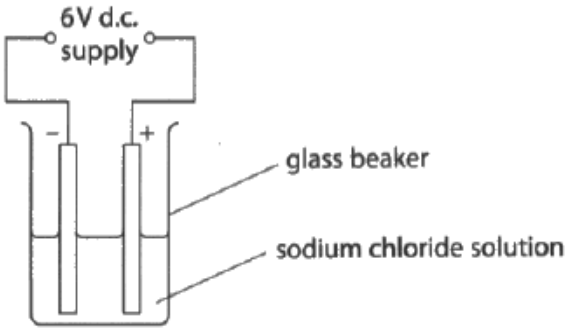


Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

So the electrons can move freely

Results Plus: Examiner Comments

In this case the candidate referred to the movement of electrons rather than the movement of ions and so did not gain the mark.

(iii)

Many candidates found this question hard with the most common incorrect answer being that a lid should be placed on the apparatus.

Few candidates mentioned using a Bunsen burner some discussed using a blow torch which was allowed. Many suggested using a hot water bath, which was not allowed.

Solid sodium chloride is dissolved in water.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

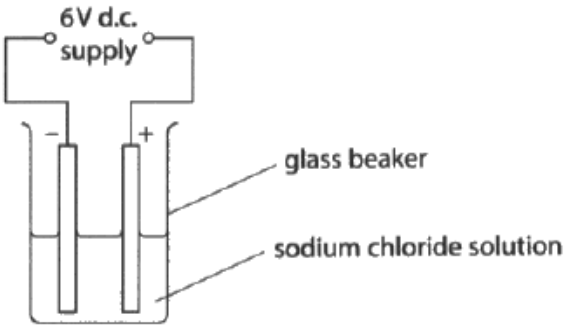


Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

It has to be a liquid to work for electrolysis

(ii) The formulae of the ions present in the sodium chloride solution are

Na^+ Cl^- H^+ OH^-

Circle the ions that would be attracted to the anode.

(1)

(iii) Molten lead bromide can be electrolysed to form molten lead and bromine gas.

Explain how a student could modify the apparatus shown in Figure 8 to carry out this electrolysis.

(2)

They would use the same equipment but would use molten lead bromide instead of sodium chloride solution

Results Plus: Examiner Comments

Some candidates did not read the question carefully and stated that the sodium chloride should be changed to molten lead bromide and did not explain how the apparatus could be modified.

Solid sodium chloride is dissolved in water.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

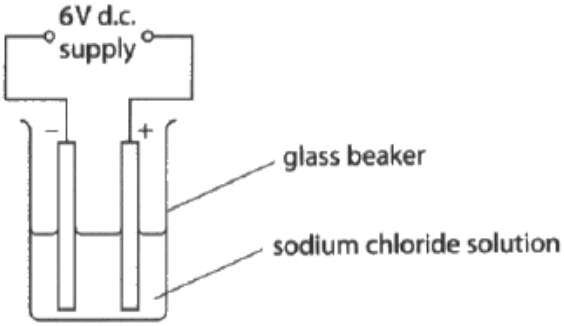


Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

Sodium chloride has no free flowing electrons. Sodium chloride solution does.

(ii) The formulae of the ions present in the sodium chloride solution are

Na^+ Cl^- H^+ OH^-

Circle the ions that would be attracted to the anode.

(1)

(iii) Molten lead bromide can be electrolysed to form molten lead and bromine gas.

Explain how a student could modify the apparatus shown in Figure 8 to carry out this electrolysis.

(2)

Place a lid ontop. This would trap the bromine gas and prevent it from escaping.

Results Plus: Examiner Comments

This common misconception that a lid should be placed on the beaker gained no credit.

Solid sodium chloride is dissolved in water.

The sodium chloride solution is electrolysed in the apparatus shown in Figure 8.

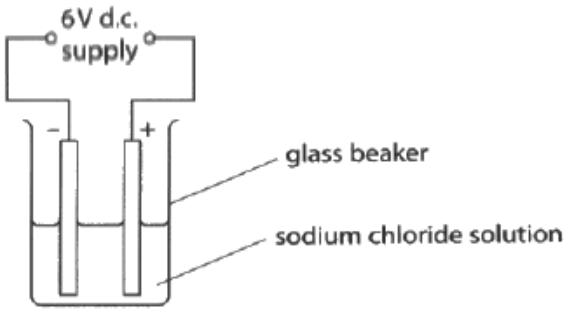


Figure 8

(i) State why sodium chloride solution, rather than solid sodium chloride, must be used in this experiment.

(1)

because sodium chloride solution will have a chemical reaction.

(ii) The formulae of the ions present in the sodium chloride solution are

Na^+ Cl^- H^+ OH^-

Circle the ions that would be attracted to the anode.

(1)

(iii) Molten lead bromide can be electrolysed to form molten lead and bromine gas.

Explain how a student could modify the apparatus shown in Figure 8 to carry out this electrolysis.

(2)

to carry out this electrolysis you need to change the 6v d.c. supply to something more higher.

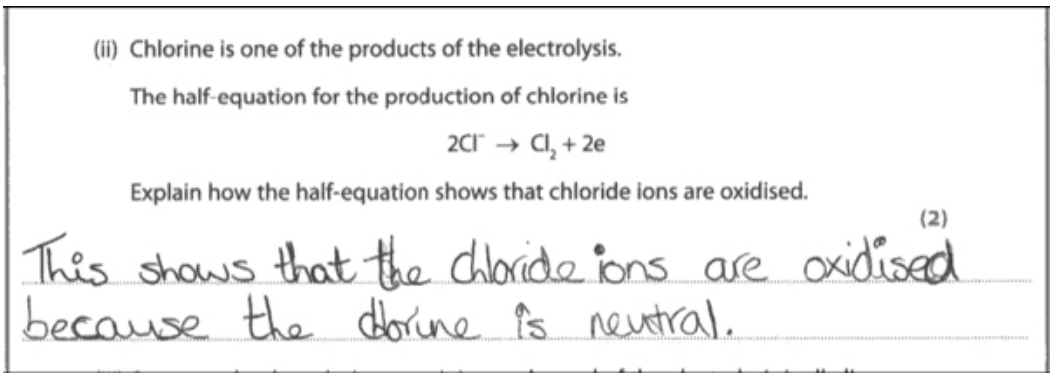
Results Plus: Examiner Comments

Other incorrect answers seen were that to 'catch' the bromine gas or that the voltage should be increased, adding a light bulb/ ammeter or using a bigger beaker.

Q42.

(ii)

Many candidates knew that oxidation is loss of electrons. Some candidates were confused between chloride ions and chlorine and it was not unusual to see that some candidates read the half-equation in reverse and they wrote about chlorine gaining electrons. Some candidates wrote that the chloride ions lost their negative charge but this did not score any marks as they needed to refer to electron loss.



(ii) Chlorine is one of the products of the electrolysis.

The half-equation for the production of chlorine is

$2Cl^- \rightarrow Cl_2 + 2e$

Explain how the half-equation shows that chloride ions are oxidised.

(2)

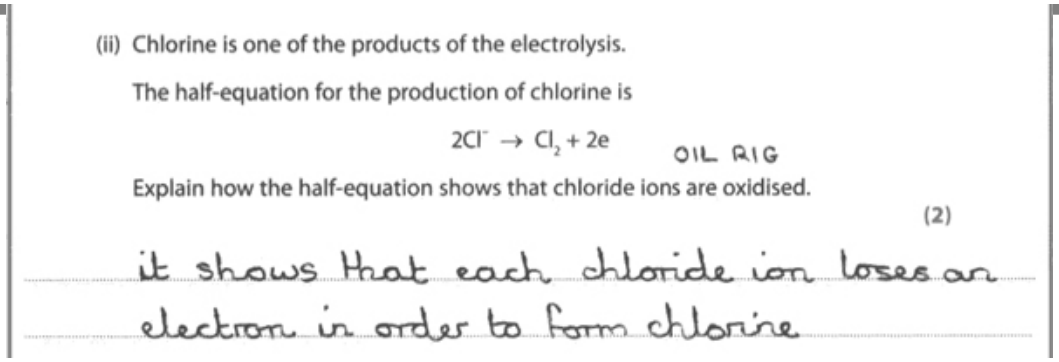
This shows that the chloride ions are oxidised because the chlorine is neutral.

Results Plus: Examiner Comments

This answer did not score any marks as there was no mention of electrons.

Results Plus: Examiner Tip

Use OIL RIG to help you to remember about oxidation and reduction. **O**xidation **I**s **L**oss of electrons. **R**eduction **I**s **G**ain of electrons.



(ii) Chlorine is one of the products of the electrolysis.

The half-equation for the production of chlorine is

$2Cl^- \rightarrow Cl_2 + 2e$ OIL RIG

Explain how the half-equation shows that chloride ions are oxidised.

(2)

it shows that each chloride ion loses an electron in order to form chlorine

Results Plus: Examiner Comments

This is a very good answer, scoring 2 marks.

(iii)

A large number of candidates were able to work out that sodium hydroxide solution was left. However, some candidates thought that sodium was left and as it is an alkali metal, the solution

would be alkaline. A few candidates thought the solution would be alkaline as acidic chlorine is lost.

(iii) Suggest why the solution remaining at the end of the electrolysis is alkaline. (1)

sodium chloride is an alkaline

Results Plus: Examiner Comments

Sodium chloride solution is neutral, so this answer did not score a mark.

Results Plus: Examiner Tip

Remember that acids contain H+ ions and alkalis contain OH- ions.

(iii) Suggest why the solution remaining at the end of the electrolysis is alkaline. (1)

At the end of the electrolysis the sodium and hydroxide ions that were not electrolysed (as they do not lose their charge as easily as H^+ and Cl^- ions) react together.
(all alkalis contain OH^- ions).

Results Plus: Examiner Comments

This is a very good answer and scored 1 mark.

(iv)

Surprisingly few candidates knew that molten sodium chloride is used to produce sodium. Quite a large number did not read the question carefully and they suggested changing an electrode to sodium rather than changing the electrolyte, or increasing the voltage.

(iv) The electrolysis of sodium chloride solution does not produce metallic sodium.

State what change you would make to the electrolyte to obtain metallic sodium. (1)

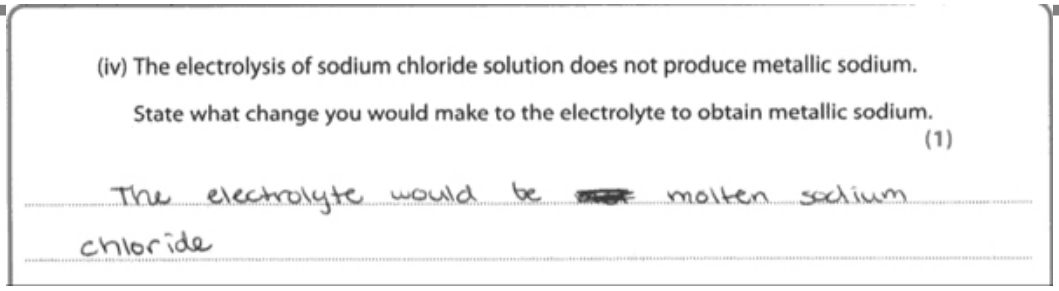
make the cathode and anode sodium so there is something to react with

Results Plus: Examiner Comments

This candidate has suggested a change to the electrodes so has not scored a mark. The question asks for a change to the **electrolyte**.

Results Plus: Examiner Tip

Read the question carefully.



(iv) The electrolysis of sodium chloride solution does not produce metallic sodium.

State what change you would make to the electrolyte to obtain metallic sodium.

(1)

The electrolyte would be molten sodium chloride

Results Plus: Examiner Comments

This is a good answer, scoring 1 mark.

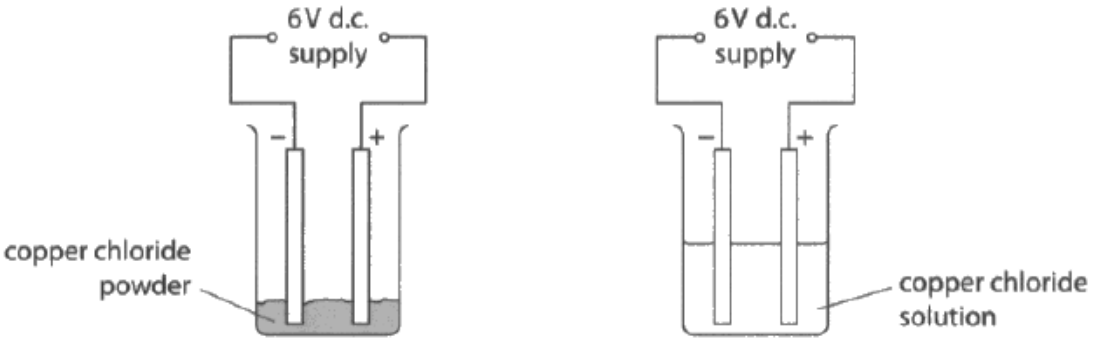
Q43.

Despite some exemplary answers for Level 3 seen by examiners, where candidates had clearly identified the products and explained the observations in terms of the movement of ions to the respective electrode surfaces, many struggled to identify the products or to refer to the movement of ions in their attempted explanations. Consequently, many candidates failed to achieve either a Level 2 or 3. There was a noticeable misconception in most explanations, where candidates had clearly mistaken ions for electrons, confusing the explanation for the conductivity in ionic solutions with that in metals. Most marks, where gained, were from the explanation of the conductivity of the solution rather than the solid. Another point raised by the examining team was the frequent and incorrect use of 'chloride ion' when referring to 'chlorine' and vice versa.

*(e) Carbon electrodes were placed in copper chloride powder.

Some more copper chloride was dissolved in water to make a solution and carbon electrodes were placed in this solution.

In both cases the electrodes were connected to a direct current supply.



The following results were obtained.

substance tested	observation at the cathode (−)	observation at the anode (+)
copper chloride powder	no change	no change
copper chloride solution	red-brown solid formed	bubbles of a yellow-green gas

Explain the results shown in the table for copper chloride powder and the copper chloride solution.

(6)

copper chloride powder will not change as electrolysis needs lots of free moving electrons to work, powder will not conduct electricity. The solution will be much more effective as the electrons can freely pass between the anode and the cathode the red-brown solid formed on the cathode will be copper that has come from the anode and the yellow / green gas will be chlorine gas from the copper chloride.

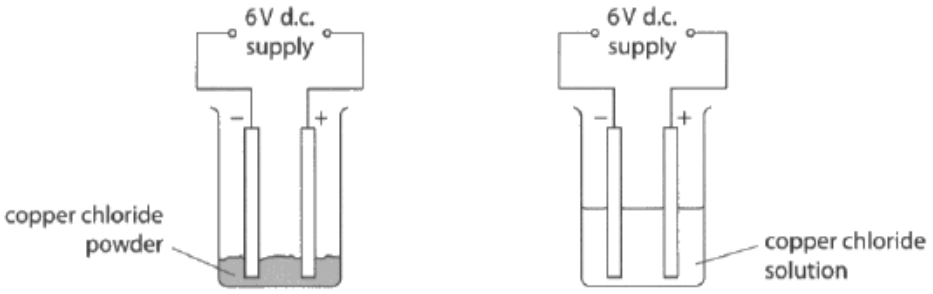
Results Plus: Examiner Comments

This response scored a **Level 2**, 4 marks. The two products from the electrolysis of the copper chloride solution, namely copper and chlorine, have been correctly identified. There is one valid explanatory point, namely that 'the powder does not conduct electricity'.

*(e) Carbon electrodes were placed in copper chloride powder.

Some more copper chloride was dissolved in water to make a solution and carbon electrodes were placed in this solution.

In both cases the electrodes were connected to a direct current supply.



The following results were obtained.

substance tested	observation at the cathode (−)	observation at the anode (+)
copper chloride powder	no change ?	no change ?
copper chloride solution	red-brown solid formed	bubbles of a yellow-green gas

copper. chlorine.

Explain the results shown in the table for copper chloride powder and the copper chloride solution.

(6)

When the substance copper chloride powder was electrolysed there was no change at both the anode and the cathode. This is because it wasn't in solution. However when the copper chloride solution reacted, at the cathode, a red-brown solid was formed. this was copper. Copper was formed at the cathode because the cathode attracts the posotively charged ion. Also, at the anode bubbles of a yellow-green gas occured. This would be chlorine. Chlorine is formed at the anode because the anode attracts the negatively charged ion, therefore chlorine was formed.

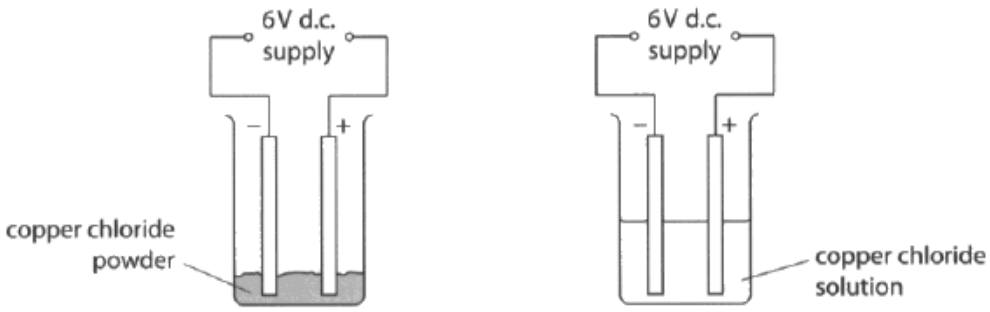
Results Plus: Examiner Comments

This response scored a **Level 3**, 6 marks. The two products from the electrolysis of the copper chloride solution have been correctly identified. There are two explanatory points, both of which relate to the electrode processes occurring in terms of ions.

*(e) Carbon electrodes were placed in copper chloride powder.

Some more copper chloride was dissolved in water to make a solution and carbon electrodes were placed in this solution.

In both cases the electrodes were connected to a direct current supply.



The following results were obtained.

substance tested	observation at the cathode (–)	observation at the anode (+)
copper chloride powder	no change	no change
copper chloride solution	red-brown solid formed	bubbles of a yellow-green gas

Explain the results shown in the table for copper chloride powder and the copper chloride solution.

(6)

- There was no change between the negative cathode and the positive anode for the copper chloride powder.
- This tells us copper chloride cannot be electrolysed.
- For the copper chloride solution, the cathode produced a red-brown solid and bubbles of a yellow-green gas formed at the anode.
- This tells us that the copper chloride solution can be electrolysed to give a product.
- This also proves that electrons cannot pass through

a solid, but can pass through a liquid.

- The electrons can move more freely in the copper chloride solution.
- The negative and positive ions electrons cannot attach to the opposite charge in the powder.
- Only the bottom part of the electrodes for the copper chloride powder were covered, so there wasn't much for the electrons to pass through anyway.
- The particles in a solid are closer together and in a liquid they move more and more free.

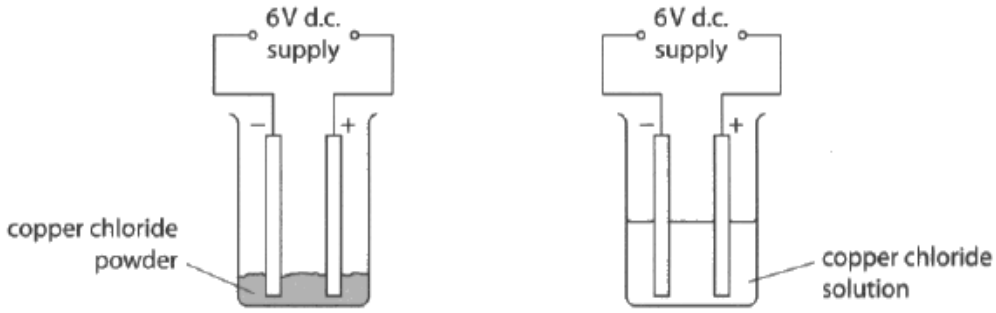
Results Plus: Examiner Comments

This response scored a **Level 0**. The products have not been identified. Although, there has been attempt to compare the powder and solution, namely the idea that the powder cannot be electrolysed/solution can be electrolysed, there is no specific reference to 'conduction'. Also, the explanation in terms of the movement of electrons (as opposed to ions) is incorrect and there is also an incorrect reference to positive and negative electrons!

*(e) Carbon electrodes were placed in copper chloride powder.

Some more copper chloride was dissolved in water to make a solution and carbon electrodes were placed in this solution.

In both cases the electrodes were connected to a direct current supply.



The following results were obtained.

substance tested	observation at the cathode (–)	observation at the anode (+)
copper chloride powder	no change	no change
copper chloride solution	red-brown solid formed	bubbles of a yellow-green gas

Explain the results shown in the table for copper chloride powder and the copper chloride solution.

(6)

As tested the copper powder in a solid there are no electrons free to move so therefore there was no charge on the powder and no change. There was a change in the copper solution because it was dissolved in water so electrons where able to move and carry the charge at the cathode a precipitate was formed which was copper and at the anode a gas was formed which was chlorine.

Results Plus: Examiner Comments

This response scored a **Level 1**, 2 marks. The two products have been correctly identified. The explanations are incorrect, since they relate to the movement of electrons and not ions.

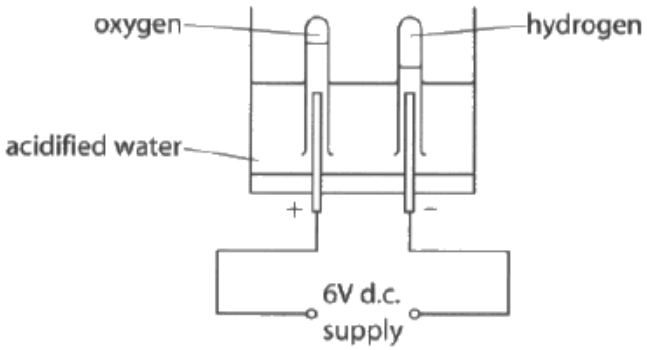
Q44.

(i)

Most candidates scored the mark with 'electricity' (or a variation such as 'electrical'). There were a few giving 'thermal', 'chemical', 'kinetic' as energy sources which did not score, as did those who copied '6V d.c. supply' from the diagram.

Electrolysis and acids

4 (a) Water, acidified with a small amount of dilute sulfuric acid, can be decomposed by electrolysis using the apparatus shown.



squeaky

(i) State the form of energy used to carry out the electrolysis.

(1)

Thermal energy.

Results Plus: Examiner Comments

Most candidates gave a correct answer, but some had an incorrect form of energy as their answer.

(i) State the form of energy used to carry out the electrolysis.

(1)

~~electricity~~ ~~electrical~~ electrical

Results Plus: Examiner Comments

Eventually this candidate decided on a final answer. There was a big clue in the diagram that several either chose not to use or did not understand its significance.

Results Plus: Examiner Tip

Make sure you know the process of electrolysing a solution.

(ii)

This gas test is known by all candidates but there are still some who fail to score for a variety of reasons. Some omitted to state a **lighted** splint or incorrectly tested with a glowing splint. A few just stated 'the squeaky pop test' and did not describe how to carry out the test so did not score any marks. On this specification, candidates need to identify the correct test first and then state the result of that test in order to obtain the marks.

(ii) During the electrolysis, hydrogen is formed at one of the electrodes.

Describe a test to show that this gas is hydrogen.

(2)

put get a test tube that has hydrogen in it and get a lit splint then put the lit splint into the test tube and it should ~~put~~ make a 'squeeky pop' noise.

Results Plus: Examiner Comments

For many candidates this was a straightforward question. Describing a test will always involve the correct test itself and the positive result.

(ii) During the electrolysis, hydrogen is formed at one of the electrodes.

Describe a test to show that this gas is hydrogen.

(2)

When testing to see if a gas is hydrogen. You will have to add a current to the electrolyte which which cause it to decompose. If you hear a squeaky pop (successful) that it means your test for hydrogen gas was

Results Plus: Examiner Comments

The correct test has to be given before a mark is awarded for the positive result.

Results Plus: Examiner Tip

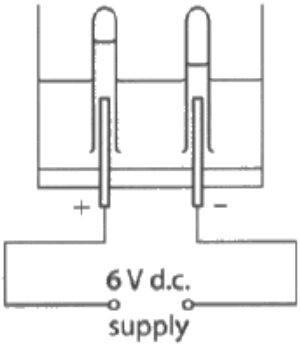
Make sure you know the tests for the gases hydrogen, oxygen and chlorine.

Q45.

Some truly excellent answers were seen with half equations and discussions of preferential discharge. The formation of hydrogen from its ions was well described. The formation of oxygen was sometimes described from oxide ions, understandably, or even hydroxide ions forming oxygen and hydrogen. It is important to realise that in these extended writing questions the 'level' of answer is looked for, and perfection is not required. It is interesting to note the idea of the 'simpler' hydroxide ion being discharged was mentioned by some - an explanation for this is not required by the specification, but many candidates went into pleasing depth. The terms oxidation and reduction were deployed effectively. Candidates should be made aware that in a gas test a (brief) description is required - just 'the squeaky pop test' is not worth a mark.

Candidates should be careful of terminology in questions such as this - being clear to distinguish between hydrogen (gas) and hydrogen ions, for example.

(b) Sodium sulfate solution is electrolysed in the apparatus shown.



Sodium sulfate solution contains sodium ions, Na^+, sulfate ions, SO_4^{2-}, hydrogen ions, H^+, and hydroxide ions, OH^-.

Hydrogen is produced at one electrode and oxygen is produced at the other electrode.

Explain how these products are formed from the ions in the electrolysis process, indicating how you would identify the products.

You may give ionic equations in your answer.

(6)

Because OH^- ions are simpler than SO_4^{2-} ions, the OH^- ion travels to the positive anode as opposite ~~ie~~ charges attract. Here it ~~to~~ is discharged, so it loses its electrons to form oxygen molecules. The hydroxide ion is oxidised $4OH^-_{(aq)} \longrightarrow O_{2(g)} + 2H_2O_{(l)} + 4e^-$

The You can identify that oxygen gas is produced as it will re-light a glowing splint.

Hydrogen ions are discharged at the cathode instead of sodium ions, as sodium is more reactive ~~and so is~~ than hydrogen. H^+ ions gain electrons, and share electron pairs to form hydrogen molecules.

~~$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$~~ $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$

This is a reduction reaction as hydrogen gains electrons. You can test for H_2 gas as it will ~~to~~ extinguish a lighted splint and make a squeaky pop.

Results Plus: Examiner Comments

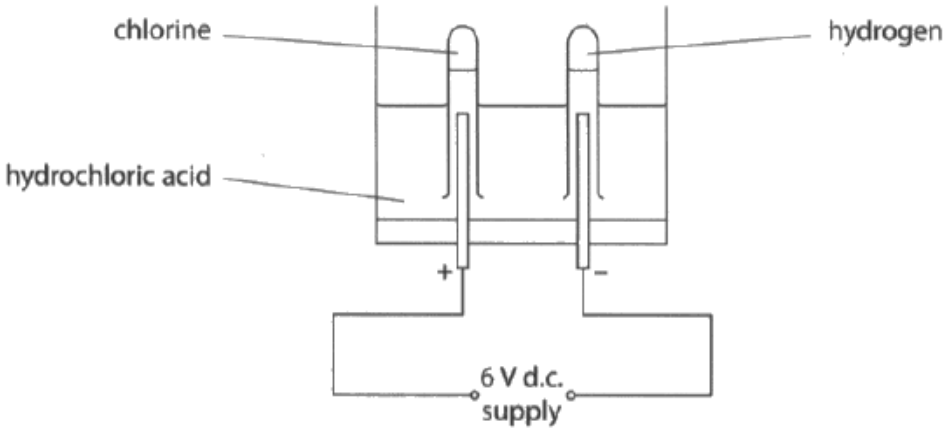
A well-constructed answer.

Q46.

(i)

Very few candidates managed to give a fully correct definition of electrolysis. Some candidates did not read the question correctly and gave a use of electrolysis rather than a definition of the term. Many knew that electricity was used, but could not correctly state for what. Some candidates lost marks as they stated that electrolysis is the separation of compounds rather than the breaking down of compounds. Others thought that it was the elements themselves that were broken down.

(d) Hydrochloric acid can be used to make chlorine in the apparatus shown.



(i) The experiment shown is an example of electrolysis.

Explain the meaning of **electrolysis**.

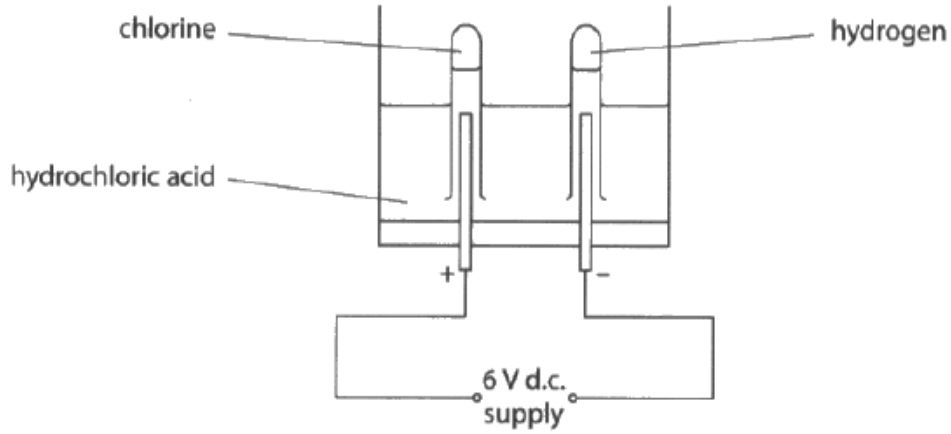
(2)

When you seperate chlorine and hydrogen.

Results Plus: Examiner Comments

The use of the term separate is not an alternative to breaking down or decomposing and so therefore cannot gain credit. There is no reference to using electricity or direct current for the second mark.
This answer therefore scored no marks.

(d) Hydrochloric acid can be used to make chlorine in the apparatus shown.



(i) The experiment shown is an example of electrolysis.

Explain the meaning of **electrolysis**.

(2)

Electrolysis is when electricity is used to break down a compound.

Results Plus: Examiner Comments

A good answer that scored the two marks available.

(ii)

Candidates performed better in this gas test for chlorine than in the previous carbon dioxide gas test. Many candidates gave a good, detailed answer to score both marks. Fewer candidates confused the test for chlorine with tests for other gases such as oxygen or hydrogen.

(ii) Describe the test to show a gas is chlorine.

(2)

Damp blue litmus paper is held in the mouth of the test tube, chlorine is present if the litmus paper turns red then white

Results Plus: Examiner Comments

A very good answer that included correct detail for the litmus paper and the result of the test. 2 marks.

(iii)

Most candidates performed well on this question by showing an understanding that chlorine is toxic and if released could cause death.

(iii) Great care has to be taken when chlorine is manufactured on a large scale.

Explain the potential hazards of storing large volumes of chlorine.

(2)

It could be toxic so could kill you if you breath it in.

Results Plus: Examiner Comments

A good answer that scored both marks.

(iv)

This question was generally poorly answered as candidates were too vague with their responses. The most common answer seen was swimming pools which was not worthy of credit.

(iv) State a large-scale use of chlorine.

(1)

Swimming pools.

Results Plus: Examiner Comments

The most common answer seen was 'swimming pools' but chlorine is not used for swimming in. If the candidate had stated that chlorine is used in swimming pools to sterilize or purify the water then this would have scored the mark.

Results Plus: Examiner Tip

Always use the science that you have learnt to answer the question and try to be as specific with your answer as you can.

(iv) State a large-scale use of chlorine.

(1)

make PVC.

Results Plus: Examiner Comments

To make PVC or bleach was a good answer that scored the mark.

Q47.

(a)

This was well answered on the whole, with most candidates able to correctly identify the two cations, Mg^{2+} and Na^{+}, for the 1 mark available. Occasionally, candidates simply listed all the ions and consequently did not score.

(b)

The majority of responses did not score any of the 2 marks available, since few candidates were able to recall the definition for reduction, namely 'gain of electrons'. Occasionally, a few responses gained just 1 mark for 'the cathode gains electrons'.

(b) During electrolysis, reduction takes place at the cathode.

Explain, in terms of electrons, what is meant by reduction.

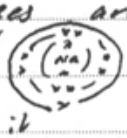
(2)

Reduction is the gain of electrons during a reaction.

Results Plus: Examiner Comments

A good example of a correct, albeit rarely seen, response. This was awarded the 2 marks available.

(2)

A reduction is when it loses an electron. So for example sodium has () an extra one on its last shell. So it loses it to make itself stable.

Results Plus: Examiner Comments

Oxidation has been confused with reduction - a typical error. This was awarded 0 marks.

(2)

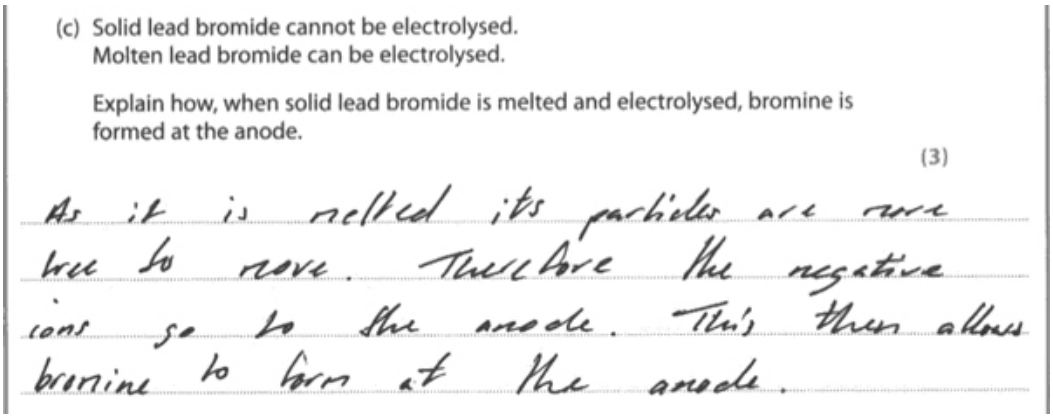
Reduction is loss of oxygen and the gain of electrons.

Results Plus: Examiner Comments

A good 2 marks answer. The first statement alone, referring to 'loss of oxygen', would have secured 1 mark.

(c)

This question was badly answered. Very few correct responses gaining 3 marks were seen. Most responses were able to score just 1 mark, by reference to the third marking point, namely by reference to the idea that bromide ions are attracted to the anode. Occasionally, responses referred to the second marking point, namely to movement of ions in molten liquid. It was evident that few candidates could recall, let alone explain, the electrolysis of molten lead bromide, or recognise that molten ionic substances can conduct electricity.



(c) Solid lead bromide cannot be electrolysed.
Molten lead bromide can be electrolysed.

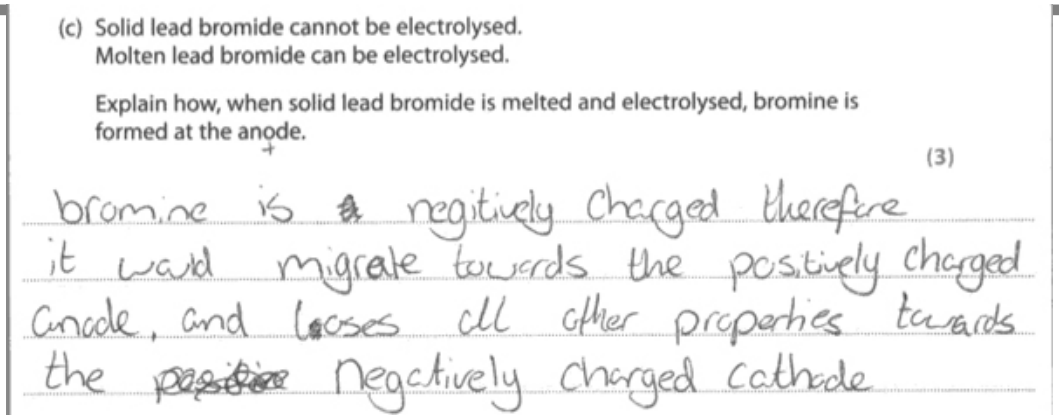
Explain how, when solid lead bromide is melted and electrolysed, bromine is formed at the anode.

(3)

As it is melted its particles are more free to move. Therefore the negative ions go to the anode. This then allows bromine to form at the anode.

Results Plus: Examiner Comments

A typical 2 marks response when seen, awarded 2 out of the 3 marks available. Marking points 2 and 3 have been awarded.



(c) Solid lead bromide cannot be electrolysed.
Molten lead bromide can be electrolysed.

Explain how, when solid lead bromide is melted and electrolysed, bromine is formed at the anode.

(3)

bromine is negitively charged therefore it would migrate towards the positively charged anode, and looses all other properties towards the ~~positive~~ Negatively charged cathode

Results Plus: Examiner Comments

A typical 1 mark response awarded for marking point 3 only. There is no specific mention of particles moving in the molten liquid, so marking point 2 was not scored.

(c) Solid lead bromide cannot be electrolysed.
Molten lead bromide can be electrolysed.

Explain how, when solid lead bromide is melted and electrolysed, bromine is formed at the anode.

(3)

When solid lead bromide is melted, the ions are free to move so it can be electrolysed. The lead is attracted to Positive cathode and bromine is attracted to the opposite electrode which is anode.

Results Plus: Examiner Comments

A typical 1 mark answer awarded for marking point 2 only, namely for the recognition that ions are free to move in the molten lead bromide. The final incorrect sentence can be ignored.

(c) Solid lead bromide cannot be electrolysed.
Molten lead bromide can be electrolysed.

Explain how, when solid lead bromide is melted and electrolysed, bromine is formed at the anode.

(3)

When the molten lead bromide is electrolised, the negatively charged bromine particles move towards the anode as it is positively charged whereas the positively charged lead particles move towards the cathode. Therefore bromine is colected at the anode. This is not possible with ~~the~~ solid lead bromide as the particles are not free to move.

Results Plus: Examiner Comments

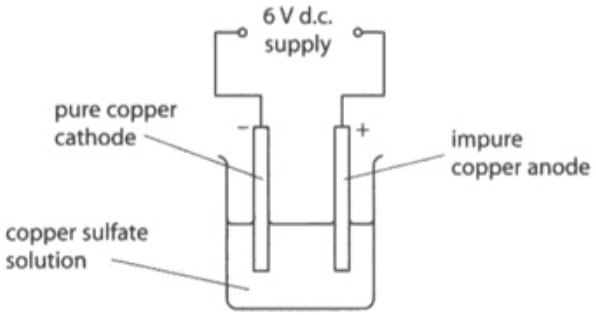
A very rarely seen fully correct response. Marking points 1, 2 and 3 have been mentioned, so 3 marks have been awarded.

(d)

This was a poorly answered question overall. Most candidates failed to give any creditworthy points. Of the correct responses seen, most gained just 2 marks, Level 1, often by a simple description of the deposition of copper at the cathode and a decrease in size of the anode. Few candidates could add further description for Level 2, let alone explain the redox processes, necessary for Level 3.

*(d) Impure copper can be purified using electrolysis.

The impure copper is used as the anode.
A pure copper cathode is used.
The electrodes are placed in copper sulfate solution.
A direct electric current is passed through the solution.



Describe and explain what is seen when this apparatus is used to purify a piece of impure copper.

(6)

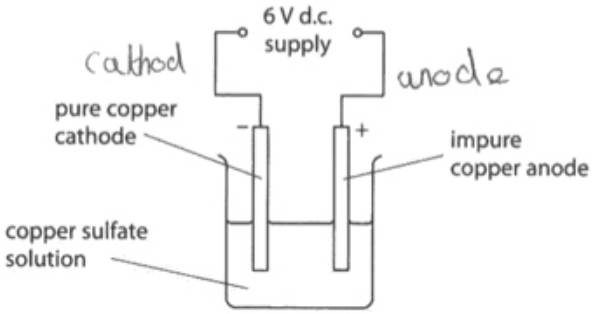
The copper ions from the impure copper anode are released into the copper sulfate solution. The impurities deposit and form sludge at the bottom of the beaker. The pure copper ions attract to the cathode as the pure copper ions are positively charged. The impure copper anode will decrease in mass as oxidation (loss of electrons) occurs and the cathode of pure copper will increase in mass as reduction occurs (gain of electrons). This will leave a pure copper cathode.

Results Plus: Examiner Comments

A typical good quality Level 3 answer. There is a detailed description (3 clear points) and an explanation (3 clear points). This was awarded 6 marks.

*(d) Impure copper can be purified using electrolysis.

The impure copper is used as the anode.
A pure copper cathode is used.
The electrodes are placed in copper sulfate solution.
A direct electric current is passed through the solution.



Describe and explain what is seen when this apparatus is used to purify a piece of impure copper.

(6)

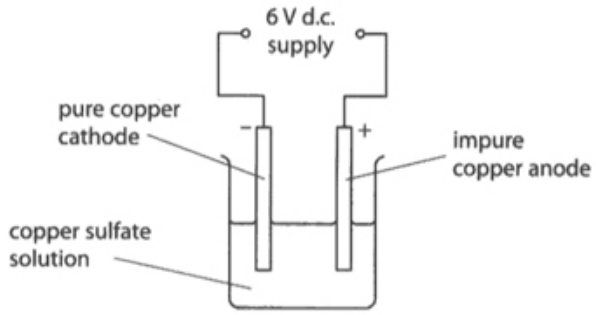
Copper is ~~negatively~~ positively charged so is attracted to the negatively charged cathode. At the cathode a copper coating begings to form, the size of the cathode increases through out the purification. At the anode, since copper atoms are being lost, the size of the anode decreases and impurities form below the anode. ~~Sulfate~~ Sulfur gas is given off also at the anode since ~~it has~~ sulfur is negatively charged. ~~The~~ At the beging of the electrolysis the solution was blue but at the end the blue fades

Results Plus: Examiner Comments

A typical Level 2 response. There is sufficient description of processes occurring at the cathode and anode and of the impurities, so this was awarded 4 marks. There is insufficient explanation to award Level 3.

*(d) Impure copper can be purified using electrolysis.

The impure copper is used as the anode.
A pure copper cathode is used.
The electrodes are placed in copper sulfate solution.
A direct electric current is passed through the solution.



Describe and explain what is seen when this apparatus is used to purify a piece of impure copper.

(6)

The copper Sulfate solution will start to fizz as the electrons move to the anode and cathode through the solution. The pure copper will start to build up around the cathode and a Sludge will start to form in the solution.

Results Plus: Examiner Comments

A typical Level 1 response. Only two valid descriptions have been made, namely the build up of copper on the cathode and the formation of sludge, ignoring the first few lines in the response. This was awarded 2 marks only.

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
	yellow / orange /red (1)	Combinations of yellow/orange/red pink	**(1)**

Q2.

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

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

Q3.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	neutralisation (1)	accept recognisable spelling	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	**D** acid + base → salt + water		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	17.12 – 7.02 (1) (=10.10/10.1) (g)	10.10/10.1 (g)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	$\frac{17.12 - 7.02}{2}$ (1) (=5.05) (g dm^{-3})	5.05 (g dm^{-3}) allow error carried forward from bi	**(1)**

Q4.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	electrolysis	Allow any phonetically correct spelling	**(1)**
(a)(ii)	A description including **two** of the	Ignore references to splint	**(2)**

	following • Burns/ ignites (1) • Squeaky (1) • pop/explodes (1) • water formed (1)		
(b)(i)	**B**hydrochloric acid		**(1)**
(b)(ii)	**C** calcium carbonate		**(1)**
(b)(iii)	An explanation linking **two** of the following • alkali/ base (1) • (remedy) reacts with/ reduces/ removes (acid) (1) • (that is in) excess (1) • neutralises (acid) / pH raised/ forms water (1) • pain {removed/relieved} (1)		**(2)**
(c)	magnesium nitrate / $Mg(NO_3)_2$ (1) water /H_2O (1)	Reject hydrogen oxide	**(2)**

Q5.

Question Number	Answer	Acceptable answers	Mark
(a)	magnesium nitrate water carbon dioxide all three correct (2) magnesium nitrate + one other correct (1)	allow correct formulae	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	C – neutralisation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$ (3) LHS (1) RHS (1) balancing of correct formula (1)	correct multiples ignore state symbols	**(3)**

Question Number		Indicative Content	Mark
QWC	* **(c)**	A description including some of the following points experiment set up • hydrochloric acid in container • carbon rods in acid • attach rods to electrical supply • d.c. supply(or reference to positive and negative) • test tubes to collect gases test hydrogen • lighted splint • squeaky pop (with air)/burns test chlorine • (damp blue) litmus paper • (turns red then) bleaches/white	**(6)**
Level	**0**	No rewardable content	
1	**1 – 2**	• a limited description e.g. simple description/diagram of electrolysis set up OR description of test for one of the gases. • 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. a full description of electrolysis OR test for both gases OR simple description of electrolysis and the test for one of the gases. • 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. description of electrolysis and test for both gases OR a full description of electrolysis and of one gas test. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q6.

Question Number	Answer	Acceptable answers	Mark
(i)	**D** salt and water only		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description to include two from • (green) solid {disappears / dissolves} (1) • effervesces / bubbles (of colourless gas) given off (1) • blue (solution) forms (1)	 ignore references to names of products fizz goes blue ignore incorrect colours of solution ignore temperature rise	**(2)**

Q7.

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

Q8.

Question Number	Answer	Mark
(i)	**B** a decomposition reaction	**(1)**

Question Number	Answer	Mark
(ii)	An answer that combines the following points to provide a logical description of the experiment • leave the solution (in a warm place) (1) • until crystals form then pat with dry filter paper (1) OR • partially evaporate the water (1) • leave to crystallise and pat dry with filter paper (1)	**(2)**

Q9.

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

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

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

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

Q10.

Question number	Answer	Additional guidance	Mark
(i)	ACID use measuring cylinder / pipette / burette (1) BASE balance / scales / weigh out amount (1)	must name apparatus ignore weigh the liquid allow use portion of known mass / use measured amount **in g** / specific mass given [from 0.1 to 10g] allow weight for mass	**(2)**
(ii)	START colourless END pink / magenta	**both** START **and** END required for mark ignore clear	**(1)**
(iii)	An explanation linking • {hydrogen **ions**/ H^+} {reacted / neutralised} (1) • {concentration falls/ fewer} H^+ / {concentration rises/ more} OH^- (1)	allow $H^+ + OH^- \; H_2O$ (1) for MP1	**(2)**

Q11.

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

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

Q12.

	Answer	Acceptable answers	Mark
(a)	A description including excess magnesium oxide (1) filter (to remove excess solid / magnesium oxide) (1)		**(2)**
(b)	$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$ (2) left hand side (1) right hand side (1)	max 1 if incorrect balancing	**(2)**
(c)	A calculation involving mass of solid = 258.515 – 258.450 (1) (= 0.065 g)		**(2)**

	concentration = $0.065 \times {}^{1000}/_{500}$ (1) (= 0.130 (g dm^{-3}))	allow TE from mass of solid for second mark	

		Indicative Content	
QWC	***(d)**	A description including some of the following points • hardness caused by dissolved calcium and/or ions • boiling water • removes temporary hardness only / not perma hardness • ions removed • by formation of limescale / calcium carbonate • ion exchange resin • run tap water through resin • calcium and / or magnesium ions are exchang ions • which do not cause hardness allow full credit for use of other correct methods such washing soda	

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. temporary hardness by boiling water / permanent hardness (& temporary hardness) by ion exchange • 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. use of ion exchange and boiling water removes ions causing hardness • 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 simple description and explanation e.g. boiling water removes only temporary hardness, ion exchange resin removes both types of hardness, by removing calcium and/or magnesium ions from hard water • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q13.

		Indicative Content	
QWC	*	A description including some of the following points	

		reactants • dissolve reactants (in water) • mix reactants / solutions • use of appropriate apparatus • stir **separate product** • filter • use of filter funnel and paper **making pure dry salt** • solid on filter paper • wash with water • dry in oven / leave to dry / in a warm place	

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • 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. mix solutions of the reactants in a beaker and then filter. • 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. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q14.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	$BaSO_4$	SO_4Ba ignore charges unless incorrect	**(1)**
(a)(ii)	charged particle	charged atom / {particle/atom(s)} that has gained or lost electrons ignore any stated charges	**(1)**
(b)	An explanation linking two of the following points: • barium sulfate does not dissolve (in water) (1)	 ignore barium sulfate is insoluble in water {mix with / enter} blood allow 'barium sulfate does not dissolve	**(2)**

	• is not absorbed into blood / body (1) • passes through body (unchanged) (1)	into the bloodstream' for 2 marks allow 'it is insoluble so it is nontoxic' for one mark	

		Indicative Content	
QWC	***(c)**	A description including some of the following points **reactants** • dissolve reactants (in water) • mix reactants / solutions • use of appropriate apparatus • stir **separate product** • filter • use of filter funnel and paper **making pure dry salt** • solid on filter paper • wash with water • dry in oven / leave to dry / in a warm place	

Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • 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. mix solutions of the reactants in a beaker and then filter. • 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. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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

Q15.

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

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

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

Q16.

	Answer	Acceptable answers	Mark
(a)	sodium carbonate + calcium nitrate → sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	ignore solution / state symbols ignore incorrect attempts at balanced equation ignore mixtures of words and formulae	**(2)**
(b)(i)	C orange-red		**(1)**
(b)(ii)	A description including two points from CLEAN • clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• moisten splint • put splint into solid • hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1	**(2)**

(c)(i)	40/44 (1) (= 0.909) (any fraction) x 100 (1) (= 90.9 / 90.91 / 91(%))	correct answer (2) Ignore 90(%)	**(2)**
(c)(ii)	reaction is incomplete / not hot enough / not heated for long enough / use of impure calcium carbonate	ignore {gas escaping / not all collected / incorrect measurement}	**(1)**
(d)	D have high melting points		**(1)**

Q17.

	Answer	**Acceptable answers**	**Mark**
	sodium carbonate + calcium nitrate → sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	ignore solution / state symbols ignore incorrect attempts at balanced equation ignore mixtures of words and formulae	**(2)**

Q18.

Question Number	Answer	Mark
	An answer that combines knowledge (1 mark) and understanding (2 marks) to provide a logical description • use of a pH (probe and) meter / suitable universal indicator paper (1) • (after each addition of calcium oxide) stir (1) • record pH after each addition (1)	**(3)**

Q19.

Question number	Answer	Mark
	D potassium and bromine **D** is the only correct answer. **A** is incorrect since neither hydrogen nor oxygen are products of this electrolysis. **B** is incorrect because only bromine is a product and hydrogen is not a product of this electrolysis. **C** is incorrect since only potassium is a product and oxygen is not a product of this electrolysis.	**(1)** **AO1**

Q20.

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

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

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

Q21.

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

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

Q22.

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

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

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

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

Q23.

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

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

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

Q24.

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

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

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

Q25.

Question number	Answer	Mark
	C lead and bromine is the only correct answer **A** is incorrect because lead is produced at the cathode **B** is incorrect because lead and bromine are produced **D** is incorrect because bromine is produced at the anode	**(1)**

Q26.

Question number	Answer	Mark
	C lead and bromine is the only correct answer **A** is incorrect because lead is produced at the cathode **B** is incorrect because lead and bromine are produced **D** is incorrect because bromine is produced at the anode	**(1)**

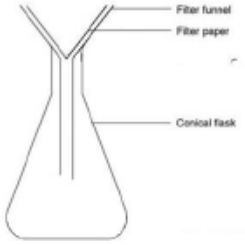
Q27.

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

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

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

Q28.

Question number	Answer	Additional guidance	Mark
(i)	 (2) OR diagram: funnel with separate filter paper and (conical) flask (1) labels: (filter) **funnel and filter paper and** (conical) flask (1)	reject diagram with funnel 'closed' at bottom/top but can score MP2 allow 'closed' filter paper allow any suitable apparatus for conical flask e.g. beaker 'flask' label should be appropriate to apparatus drawn ignore labelling of filtrate/residue etc	(2)

Question number	Answer	Additional guidance	Mark
(ii)	a description including any three from: • heat solution (to concentrate) (1) then either • leave solution {in warm place / to crystallise} (1) • scrape crystals (from container) / pat dry between filter papers (1) OR • leave solution {to crystallise / to cool} (1) • filter off crystals / decant liquid from the crystals / pat dry between filter papers / dry in oven (1)	if no other marks are scored , allow max 1 for crystallisation (1)	(3)

Q29.

Question number	Answer	Additional guidance	Mark
(i)	Any TWO from • no more bubbles / fizzing (1) • no further change in colour (1) • {solid / copper carbonate} remains at bottom of flask / no more {solid / copper carbonate} dissolves (1)	ignore references to pH allow cloudy/opaque liquid ignore no more copper carbonate will react	(2)

Question number	Indicative content	Mark
(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 and A03 (6 marks)** • filter mixture • using filter funnel and paper • collect filtrate / copper sulfate solution • in conical flask / suitable (named) container • pour into an evaporating basin • heat on water bath / on tripod over Bunsen • until half volume / concentrated / partially evaporated / crystals start to appear around the edge • remove from heat and cover with filter paper • allow to cool • and crystallise • separate crystals using a suitable method • put/place crystals onto absorbent/filter paper • dry in a warm place	**(6)**

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by planning detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Identifies relevant practical operations	Possible candidate responses • filter the mixture (alone) • allow solution to crystallise (alone) • filter mixture using filter paper - upper part of level
Level 2	3–4	Additional guidance Some correct sequencing of correct operations	Possible candidate responses • filter mixture and collect solution/liquid • evaporate solution and leave to cool • sequence with detail – upper part of level
Level 3	5–6	Additional guidance Sequence of operations to include two from filter to remove excess copper carbonate, crystallise (includes heating & cooling), separate crystals & dry	Possible candidate responses • filter mixture then cool and crystallise • evaporate/heat solution then allow to cool and crystallise • sequence with detail – upper part of level

Q30.

Question number	Answer	Additional guidance	Mark
(i)	A description including • apply lighted splint (1) • gas burns / (squeaky) pop (1)	 allow flame / ignite gas ignore 'squeaky pop test' / glowing splint second mark is dependent on first	(2)

Question number	Answer	Mark
(ii)	**B** oxygen **The only correct answer is B** **A, C & D** these gases are not produced in the electrolysis of sodium sulfate solution	(1)

Question number	Answer	Additional guidance	Mark
(iii)	• electrical energy / electricity (1) • {decomposes / breaks down / splits} {electrolytes / (ionic) compounds / substances} (1)	allow electric current allow **separates** ions reject decomposing elements for MP2	(2)

Q31.

Question number	Answer	Additional guidance	Mark
(i)	A description including • apply lighted splint (1) • gas burns / (squeaky) pop (1)	 allow flame / ignite gas ignore 'squeaky pop test' / glowing splint second mark is dependent on first	(2)

Question number	Answer	Mark
(ii)	**B** oxygen **The only correct answer is B** **A, C & D** these gases are not produced in the electrolysis of sodium sulfate solution	(1)

Question number	Answer	Additional guidance	Mark
(iii)	• electrical energy / electricity (1) • {decomposes / breaks down / splits} {electrolytes / (ionic) compounds / substances} (1)	allow electric current allow **separates** ions reject decomposing elements for MP2	(2)

Q32.

Question number	Answer	Additional guidance	Mark
	A description to include • heat solution (to evaporate water and concentrate the salt solution) (1) • leave to cool (1)	evaporating all water loses MP1 allow leave {in warm place/on window sill} (for water to evaporate slowly) (1) for several days (1)	(2) AO1

Q33.

Question number	Answer	Additional guidance	Mark
(i)	Diagram to show • electrodes in solution (1) • wires and power supply connected to give a complete circuit (1)	max 1 mark if no labelling Ignore any charges on the diagram	(2) AO1

Question number	Answer	Additional guidance	Mark
(ii)	• anode: smaller because copper atoms form ions (and go into solution) / oxidation of Cu atoms (1) • cathode: larger because copper atoms are formed (from ions in the solution) / reduction of Cu^{2+} (1) • solution: the same number of ions enter and leave solution (1)		(3) AO1

Q34.

Question Number	Answer	Acceptable answers	Mark
(a)	**D** gases from volcanoes		(1)

Question Number	Answer	Acceptable answers	Mark
(b) (i)	**A** less than 1%		(1)

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	CO_2	CO must be capitals Reject Co 2 must be subscript	(1)

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	An explanation linking any two from **EITHER** • photosynthesis(1) • in (green) plants (1) • (carbon dioxide) absorbed (1) **OR** • (carbon dioxide) is soluble (in water) / dissolves (1) • in oceans (1)	Reject respiration Ignore breathe in (carbon dioxide) reference to formation of skeletons / carbonate rock	(2)

Question Number	Answer	Acceptable answers	Mark
(b)(iv)	burning fossil fuels / burning {petrol / fossil fuel} (in vehicles) /deforestation	ignore cars/driving unqualified allow breathing / respiration	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(v)	a description linking second marking point is dependent on first • limewater • (turning) cloudy/milky/white ppt		**(2)**

Q35.

Question Number	Indicative content	Mark
*	An answer that combines knowledge (3 marks) and understanding (3 marks) to provide a logical description: • place zinc chloride in crucible • heat to melt zinc chloride • use inert electrodes • connect to d.c. supply • zinc chloride is ionic • contains zinc ions and chloride ions • ions can move in liquid • positive zinc ions move to cathode • zinc ions gain electrons • zinc metal forms • as silver shiny solid formed • negative chloride ions move to anode • chloride ions lose electrons • chlorine forms • as (yellow-) green gas	**(6)**

Level	Mark	Descriptor
	0	No awardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Q36.

Question Number	Answer	Mark
(i)	chlorine (1)	(1)

Question Number	Answer	Mark
(ii)	A description to include • lighted splint / ignite gas (1) • gas burns / (squeaky) pop (if air is present) (1)	(2)

Q37.

Question Number	Answer	Mark
(i)	chlorine (1)	(1)

Question Number	Answer	Mark
(ii)	A description to include • lighted splint / ignite gas (1) • gas burns / (squeaky) pop (if air is present) (1)	(2)

Q38.

Question Number	Answer	Additional guidance	Mark
(i)	A diagram of a workable apparatus showing a complete circuit including • electrodes labelled in (copper sulfate) solution (1) • {power supply / power pack / battery} connected (1)	max 1 if circuit not complete allow labelling as 'electrodes' or 'anode' and 'cathode' or 'copper' ignore 'connected to mains' allow symbol for cell/battery even if wrong way round	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking the following point to a maximum of four • anode lost copper **and** cathode gained copper / reaction at cathode is reverse of reaction at anode / copper ions move into solution at anode AND copper ions move out of solution at cathode (1) and any three from • at anode copper atoms become copper ions (1) and lose **two** electrons (1) OR (at anode) $Cu \rightarrow Cu^{2+} + 2e$ (2) • at cathode copper ions become copper atoms (1) and gain **two** electrons (1) OR (at cathode) $Cu^{2+} + 2e \rightarrow Cu$ (2)	ignore references to zinc, chlorine and zinc chloride allow copper atoms are oxidised (1) marking points independently allow copper ions are reduced (1) marking points independently penalise wrong use of atom / ion once only penalise wrong use of reduced / oxidised once only	(4) AO 2 1

Q39.

	Answer	Acceptable answers	Mark
(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	 half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	**(2)**
(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

Q40.

Question Number	Answer	Mark
(i)	**C** chlorine zinc **The only correct answer is C** ***A*** *is not correct because oxygen cannot be produced by the electrolysis of this molten salt* ***B*** *is not correct because hydrogen cannot be produced by the electrolysis of this molten salt* ***D*** *is not correct because hydrogen and oxygen cannot be produced by the electrolysis of this molten salt*	**(1)** AO 2 1

Question Number	Answer	Mark
(ii)	**D** it contains ions that can move **The only correct answer is D** ***A*** *is not correct because molten zinc chloride does not contain molecules* ***B*** *is not correct because molten zinc chloride does not have a giant structure* ***C*** *is not correct because delocalised electrons are not present*	**(1)** AO 1 1

Q41.

Question Number	Answer	Additional guidance	Mark
(i)	so that the ions can move	allow the solid does not conduct allow conducts when {in solution/liquid} ignore conducts when molten allow so cations / anions can move ignore so particles can move reject electrons move	(1) AO 2 2

Question Number	Answer	Mark
(ii)	OH^- and Cl^- only circled	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation linking one of the following pairs of points • use a crucible/metal container (instead of a beaker) (1) • which will not break/melt (when heated strongly) (1) OR • add a Bunsen burner (under the container) (1) • because heat needed to melt the lead bromide / to make the lead bromide a liquid (1)	allow blow torch ignore hot water bath	(2) AO 3 3b

Q42.

	Answer	Acceptable answers	Mark
(i)	B H^+ and Na^+ ions		(1)
(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	(2)
(iii)	Any one from • it contains (excess)	ignore solution has pH greater than 7	(1)

	{hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	allow no hydrogen ions left/acidic **ions**removed	
(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**

Q43.

Question Number		Indicative Content	Mark
QWC	*	An explanation including some of the following points **copper chloride powder** • does not conduct • solid ionic compounds do not conduct • ions not free to move **copper chloride solution** • conducts • (ionic) solutions conduct • ions are free to move • red-brown solid is copper/copper produced at cathode • yellow green gas is chlorine/chlorine produced at anode **explanation in terms of ions for copper chloride solution** • negatively charged ions/chloride ions attracted to the anode • positively charged ions/copper ions attracted to the cathode More detailed explanation of electrode reactions/half equations not required but must be credited	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited explanation e.g. products are identified • 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 explanation e.g. identifies the products and limited explanation of either powder or solution • 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 explanation e.g. a detailed explanation of copper chloride solution identifying the products • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q44.

Question Number	Answer	Acceptable answers	Mark
(i)	electrical (energy) / electricity / direct (electric) current		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description including • {light / ignite} gas / lighted splint (1) • gas burns / (squeaky) pop (if air is present) (1)	 reject glowing splint second mark conditional on first	**(2)**

Q45.

Question Number		Indicative Content	Mark
QWC	*	A description / explanation including some of the following points marks can be scored from diagrams incorrectly balanced equations can be used as evidence of reaction occurring but po not otherwise credited **electrolysis process** • ions move when current passed • negative ions move to anode • overall decomposition of water • $2H_2O \rightarrow 2H_2+O_2$ **Anode/ positive electrode** • sulphate ions move to anode • hydroxide ions move to anode • hydroxide ions lose electrons/oxidation • hydroxide ions form oxygen • half equation: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ • half volume gas at this electrode • oxygen test: glowing splint in gas relights **cathode/ negative electrode** • sodium ions move to cathode • hydrogen ions move to cathode • hydrogen ions gain electrons / reduction • hydrogen ions form hydrogen • half equation: $2H^+ + 2e^- \rightarrow H_2$ • double volume gas at this electrode • hydrogen test: lit splint in gas burns/ pops • hence double volume of hydrogen gas	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. states which ions go to which electrode • 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 explanation e.g. explain formation of one product • 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 explanation e.g. explaining formation of BOTH products at electrodes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q46.

Question Number	Answer	Acceptable answers	Mark
(i)	An explanation including • decomposing / breaking down of (compounds) (1) • using electrical energy / electricity /direct current /d.c. supply (1)	 allow 'splitting up' ignore 'separate' reject breaking down of elements	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description including • (damp blue) litmus • turns (red then) white / bleached	use of any suitable indicator (1) with correct result (1) eg universal indicator paper is bleached (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	An explanation including any two of • (chlorine) could escape/leak (1) • (chlorine is) toxic / corrosive / poisonous (1) • an effect on people eg death / injury / damage lungs /damage eye	 Ignore 'chlorine is dangerous' Allow harmful to people	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iv)	Any one of • (to make) plastics / PVC / bleach • to purify / sterilise water	 Ignore '(cleans) swimming pools'	**(1)**

Q47.

	Answer	**Acceptable answers**	**Mark**
(a)	Na^+ **and** Mg^{2+}	reject if any other ions are given	**(1)**

		allow names	
(b)	An explanation linking (reduction is) gain of electrons(2)	if cathode gains electrons – 1 mark loss of oxygen – 1 mark	**(2)**
(c)	An explanation linking three of the following {ions / particles} cannot move in solid (1) {ions / particles} move **in molten liquid**/ lattice structure is **broken on melting**(1) {bromide (ions) / negatively charged (ions /bromine)} {move / attracted} to anode (1) bromide (ions) lose electrons / (bromide ions) are oxidised(1) to form bromine atoms (1) bromine molecules / Br_2 formed (1)	Half equation, even unbalanced, showing bromide ions losing electrons (2)	**(3)**

		Indicative Content	
QWC	***(d)**	A description / explanation including some of the follo anode • the anode decreases in mass / size • copper atoms form ions by losing electrons • copper ions pass into electrolyte • oxidation takes place at the anode • (anode) sludge forms as • impurities {are left behind / fall to the bottom electrode) cathode • the cathode increases in mass / size • copper ions gain electrons to form copper • pure copper deposits on the cathode • reduction takes place at the cathode electrolyte • copper sulfate solution does not change in col • no change in concentration of copper ions • copper ions in the electrolyte move toward the	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. copper leaves the anode and deposits on the cathode.	

		• 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. copper leaves the anode and deposits on the cathode and impurities fall to the bottom of the beaker. • 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 and explanation e.g. copper atoms from the anode lose electrons to form copper ions; copper ions are attracted to the cathode where they gain electrons to form pure copper. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors