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Examiners' Report
June 2015

GCSE Chemistry 5CH3F 01

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Introduction

This paper consists of a mixture of question styles, including objective questions, short answer questions, data analysis questions and extended writing style questions.

Students were assessed on their knowledge and understanding of qualitative analysis, quantitative analysis, electrolysis, equilibria and organic chemistry. There were opportunities for them to demonstrate their knowledge and understanding of writing equations and practical work they have carried out throughout this unit.

The overall impression of the examiners was that the majority of candidates had been well prepared for the examination, with clear evidence of a sound understanding of many of the key concepts across the topic areas.

Successful candidates:

- read the questions carefully and answered the questions as they were set;
- understood and used correct scientific terminology;
- could write the balanced equation for the combustion of methane;
- could carry out a simple calculation of the concentration of a solution;
- could recall the procedures and results for testing for ions;
- could analyse data regarding samples of permanently hard and temporarily hard water;
- could give well communicated descriptions of the procedures for titration reactions and explanations for the electrolysis of copper chloride solution.

Less successful candidates:

- failed to copy accurately the names of species given in the stem of a question when
- writing equations; could not recall the procedures or results for simple tests for ions;
- were unable to recall the conditions required for fermentation;
- confused the explanation for conductivity of ionic solution with that for metals.

In future, some candidates need to revise simple procedures and results for the tests of metal ions and common anions in the specification.

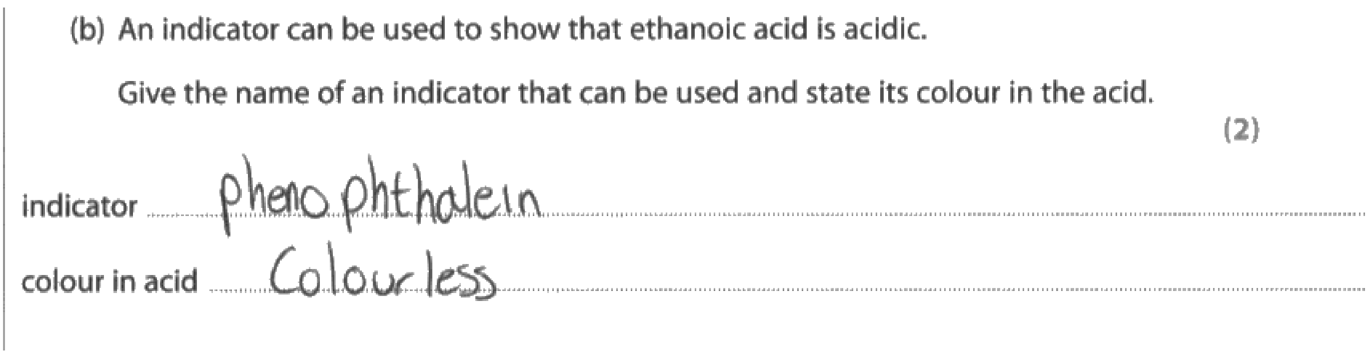
Some candidates would also benefit from working through more questions involving the preparation of salts and electrolysis.

The report provides exemplification of candidates' work, together with tips and/or comments for a selection of the questions.

Question 1 (b)

This question had a good response, with many candidates able to state the name of a suitable indicator for the first marking point, typically for 'universal indicator', 'phenolphthalein', 'methyl orange' or '(red/blue) litmus'. The second marking point, for the correct colour in acid, was less frequently scored.

Common errors were noted by examiners: poor spelling, particularly for phenolphthalein, such as it was often not phonetically spelt and could not score. Occasionally, where a correct indicator gained credit, the mark for the colour in acid was not scored, since candidates incorrectly gave the colour for the indicator in an alkaline or neutral solution. Also, when 'phenolphthalein' was given as a correct indicator, 'clear' was incorrectly referred to instead of 'colourless' as the colour in acid.


(b) An indicator can be used to show that ethanoic acid is acidic.

Give the name of an indicator that can be used and state its colour in the acid.

(2)

indicator Phenophthalein

colour in acid Colourless

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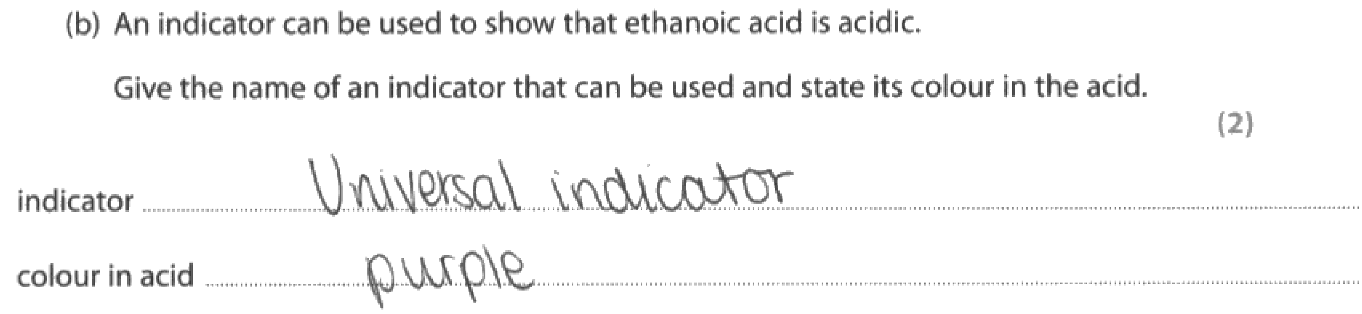
Examiner Comments

In this response, a correct indicator, namely 'phenolphthalein' and the correct colour in acid, namely 'colourless' have been given, so it scored 2 marks. The misspelling of phenolphthalein is a minor error, since it is still easily recognisable.


(b) An indicator can be used to show that ethanoic acid is acidic.

Give the name of an indicator that can be used and state its colour in the acid.

(2)

indicator Universal indicator

colour in acid purple

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Examiner Comments

This response scored 1 mark only for stating a correct indicator, namely 'Universal Indicator'. The colour given for Universal Indicator in acid, 'purple' is incorrect, so the second mark was not scored.

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Examiner Tip

This is a commonly asked question. It is worthwhile learning commonly used indicators and their corresponding colour changes in preparation for the examination.

Question 1 (c) (i)

Most candidates were able to identify 'oxygen' as the correct gas.

Question 1 (c) (ii)

Most candidates were able to identify 'hydrogen' as the correct gas, from result of the pop test given in the question. Occasionally, the gas was confused with carbon dioxide.

Question 1 (c) (iii)

Most candidates were able to identify 'carbon dioxide' as the correct gas formed between an acid and a carbonate.

Question 1 (d)

Many candidates were able to score at least 1 of the 2 marks available, mainly for writing out the correct reactants on the Left Hand Side. Despite having been given so much information in the stem of the question, namely all the names of the reactants and products, many candidates either omitted one of the products or commonly added 'ester' to the products side, not recognising the fact that 'ethyl ethanoate' is the ester. Some candidates misread the question and attempted to give a balanced equation, but frequently could only recall the formula for water.

(d) Ethanoic acid is reacted with ethanol to produce an ester, ethyl ethanoate, and water.

Write the word equation for this reaction.

(2)

Ethanoic acid + ethanol → ester + ethyl ethanoate + water

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Examiner Comments

This was a commonly seen response and scored 1 mark only for correctly showing the reactants. On the products side, the word 'ester' has been included, so the mark for the correct products has not been scored.

Question 2 (a) (ii)

This question is frequently asked on the examination and was poorly answered on the whole, with surprisingly few candidates scoring the 3 marks available. Few candidates were able to recall a correct procedure for flame testing, either by the use of the wire loop or a dampened splint. Of those candidates scoring 2 marks, a large number omitted the cleaning step or used an incorrect reagent e.g. sodium hydroxide, alcohol or disinfectant. It was also evident that the vast majority of candidates did not know where to hold the wire and solid! The most commonly seen in correct descriptions were – 'over' / 'through' / 'under' the flame. Other commonly seen scientific misconceptions relating to the sampling step were: the solid is 'put in boiling water to melt it', 'the solid is broken down into salt ions', 'ion could be put on to splint/wire/loop', 'the solid was put into a solution' when the candidates probably meant 'make a solution of the solid in water'.

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

(3)

You clean a loop of wire in hydrochloric acid, then dip it into your solid and then put the wire into the blue part of the bunsen flame.

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Examiner Comments

This response scored 3 marks. All three marking points have been correctly covered, namely for cleaning, sampling and testing.

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

(3)

a solid is held in the flame (possibly broken down if too big) and the flame will possibly change colour.

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Examiner Comments

This response scored 1 mark only, for a correct reference to the third marking point, namely 'solid held in the flame'.

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

(3)

a ~~hoop are~~ metal rod with a hoop should be pressed against this ~~the~~ solid and then put into a flame near the beginging of the flame and you should see a colour

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Examiner Comments

This response scored 2 marks: for the second marking point, SAMPLE 'pressed against the solid'. The reference to a 'metal rod with a loop' is sufficient here for the test wire/loop and for the third marking point, TEST 'into a flame'The CLEANING mark is not scored since there is no mention of the wire (dipped) in acid.

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

(3)

A damp ~~s~~splint is put on the solid, it is then held over a bunsen burner and will produce a coloured flame. The colour of this flame will tell you the ion.

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Examiner Comments

This response scored 2 marks. The dampened splint method has been described. The use of a 'damp splint', scores marking point one. 'Put (damp splint) on the solid', scores marking point two. The third marking point is not scored since the response incorrectly refers to 'over a Bunsen (flame)' and not specifically 'in' a (Bunsen) flame.

Question 2 (b)

Most responses failed to gain credit, since candidates were unable to recall either the correct colour, 'white', and/or that a 'precipitate' was formed. Of those responses which scored, many gained 1 mark only for mentioning the correct colour, but invariably also mentioning 'solution', or alternatively, correctly mentioned 'precipitate', but gave the wrong colour or a wrong combination of colours. The vast majority of answers referred to 'fizzing'. It was evident that many candidates had confused the test and result for sulfate ions with that for halide ions or with the limewater test for carbon dioxide.

(b) Salt **Y** is a sulfate.
Salt **Y** is dissolved in water.
Dilute hydrochloric acid is added to the solution.
Barium chloride solution is then added to the mixture.

Describe what you would **see** when the barium chloride solution is added.

(2)

a creamy white precipitate.

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Examiner Comments

This response scored 1 mark only for the correct reference to the formation of a 'precipitate'. The colour given, namely 'creamy white' is incorrect. White is the only acceptable colour.

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Examiner Tip

Revise the tests and the results for the common anions, such as the sulfate ion, halide ions and carbonate ions. These are commonly asked for in the examination.

Question 2 (c)

Most responses failed to gain credit, since candidates were unable to recall either the correct colour, 'brown', and/or that a 'precipitate' was formed. Of those responses which scored, many gained 1 mark only for mentioning the correct colour, but also incorrectly referred to a 'solution'. Alternatively, other responses gaining only 1 mark, correctly mentioned 'precipitate', but gave the wrong colour or a wrong combination of colours.

(c) Salt **Z** contains iron(III) ions, Fe^{3+}.

Describe what is **seen** when sodium hydroxide solution is added to a solution of **Z**.

(2)

it ~~woud~~ would turn brown and fizz/bubble.

Examiner Comments

This response scored 1 mark only for the correct colour, 'brown'. There is no mention of a 'precipitate' formed. The reference to 'fizz / bubble' is ignored.

(c) Salt **Z** contains iron(III) ions, Fe^{3+}.

Describe what is **seen** when sodium hydroxide solution is added to a solution of **Z**.

(2)

~~[illegible]~~ green solid.

Examiner Comments

This response scored 1 mark, for a correct reference to a 'solid' formed. Ideally, the use of the word 'precipitate' would be the preferred scientific term, but 'solid' is acceptable. The colour mentioned, namely 'green', is incorrect.

Question 3 (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'.

Question 3 (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 = 17.12 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 = 10.1

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}

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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}

ResultsPlus
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)

17.12g ÷ 7.02g =

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}

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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.

Question 3 (c) (i)

The vast majority of responses were able to score the 1 mark available for recognising either 'calcium' or 'magnesium' (ions) as the ions responsible for hard water. In the few incorrect responses seen, typically, sodium ions, limestone, limescale, calcium carbonate, calcium hydroxide or non-metal ions were given, despite being asked to name a metal ion.

(c) Some tap water is hard.
The hardness is caused by metal ions dissolved in the water.

(i) Give the name of a metal ion that causes tap water to be hard.

(1)

Sodium ions + magnesium ions

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Examiner Comments

This response did not score since both an incorrect alternative answer, 'sodium (ion)', and a correct answer, 'magnesium (ion)', have been given.

Question 3 (c) (ii)

The majority of responses were able to score both marks, by references to the formation of 'scum' and' limescale', or 'limescale' and 'blocks pipes' or 'scum' and 'wastes soap'. In some cases, marks were not gained due to candidates stating that scum and limescale are the same substance. The most common misconception was linking hard water to health issues, such as harmful, poisonous, dirty, bacteria, linked to Alzheimer’s disease, not nice to drink, bad taste, bits floating in it would hurt or damage your skin. In a few cases, there was the misconception that hard water is actually hard, such as 'when putting it into a glass it would break the glass'.

(ii) Describe problems that can be caused by the use of hard water in the home.

(2)

No lather will form and lots of soap will be wasted getting a lather. Limescale will form and bloce pipes.

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Examiner Comments

A typical example of a very good response for 2 marks. Three marking points have actually been covered, namely 'wastes soap', 'forms (lime)scale' and 'blocks pipes'.

(ii) Describe problems that can be caused by the use of hard water in the home.

(2)

it can containg harmfull microorganism or harmful solids it also dosent taste as nice.

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Examiner Comments

This response illustrates the common misconception that hard water is linked to health issues or taste of the water. This response did not score.

(ii) Describe problems that can be caused by the use of hard water in the home.

(2)

more soap would be needed meaning it would be being wasted.

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Examiner Comments

This response scored 1 mark only, for a correct reference to '(soap) being wasted' or 'more soap... needed'. Both are the equivalent marking point.

Question 3 (c) (iii)

This question was well answered, with the vast majority of responses able to score the 3 marks available for interpreting the data from table, namely identifying the types of hardness linked to an explanation.

In cases where just 1 or 2 marks were scored some candidates forgot to write either 'permanent' or 'temporary', when obviously talking about permanently hard or temporarily hard water respectively. There was also confusion about the soap volume not changing, with some candidates thinking that this meant that the water would be soft, even though a lot of soap was necessary.

(iii) The hardness in a water sample can be measured by finding the volume of soap solution needed to form a permanent lather with a known volume of the water.

The hardness in three types of water, **A**, **B** and **C**, was measured. Fresh samples of **A**, **B** and **C** were boiled and allowed to cool. The hardness in the boiled samples was then measured.

The table shows the results.

type of water	volume of soap solution needed / cm^3	
	original sample	boiled sample
A	2	2
B	18	18
C	14	2

- S
- H
- T

Hard water can be temporary hard water or permanent hard water.

Water **A** is soft water.

Explain, using the results in the table, the type of hardness in water **B** and in water **C**.

(3)

The type of water in Water B is Permanent hard water as it wasn't affected when boiled because hard water can only be 'softened'/changed by using an ion exchange resin which exchanges the magnesium & calcium ions in the hard water for sodium and hydrogen ions. Water C is Temporary hardness due to the fact that the volume of soap needed reduced after boiling, and boiling treats temporary hardness, therefore less soap was needed for a lather

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Examiner Comments

A typical example of an excellent response for 3 marks. Both the types of hardness for samples B and C have been correctly identified using the data from the table and linked to a correct explanation, namely changes in the volume of soap required before and after boiling.

(iii) The hardness in a water sample can be measured by finding the volume of soap solution needed to form a permanent lather with a known volume of the water.

The hardness in three types of water, **A**, **B** and **C**, was measured.
Fresh samples of **A**, **B** and **C** were boiled and allowed to cool.
The hardness in the boiled samples was then measured.

The table shows the results.

type of water	volume of soap solution needed / cm^3	
	original sample	boiled sample
A	2	2
B	18	18
C	14	2

Hard water can be temporary hard water or permanent hard water.

Water **A** is soft water.

Explain, using the results in the table, the type of hardness in water **B** and in water **C**.

(3)

Water B is ~~no~~ soft water its volume of soap does not change when boiled. Water C is temporarly hard because it turns soft when boiled.

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Examiner Comments

This response scored 1 mark only for a reference to the third marking point, namely that 'C is temporary hard water'. B has been incorrectly identified (first marking point is not scored). Although the reason given for B, namely 'the volume of soap does not change' might appear correct, it is not linked specifically to permanent hardness of B (second marking point is not scored). The reason given for the temporary softness of C is not linked to the volumes of soap needed (fourth marking point is not scored).

(iii) The hardness in a water sample can be measured by finding the volume of soap solution needed to form a permanent lather with a known volume of the water.

The hardness in three types of water, **A**, **B** and **C**, was measured.
Fresh samples of **A**, **B** and **C** were boiled and allowed to cool.
The hardness in the boiled samples was then measured.

The table shows the results.

type of water	volume of soap solution needed / cm^3	
	original sample	boiled sample
A	2	2
B	18	18
C	14	2

Hard water can be temporary hard water or permanent hard water.

Water **A** is soft water.

Explain, using the results in the table, the type of hardness in water **B** and in water **C**.

(3)

Water B is permanent hard water and therefore Cannot ~~Sample~~ Simply be evaporated in order to make ~~it~~ it Soft water.
Water C is temporary hard water as boiling ~~the~~ water C makes it Soft water.

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Examiner Comments

This response scored 2 marks. This was for correctly identifying the types of hardness in the samples, namely B - permanent and C - temporary (scoring the first and third marking points). The explanations given are not linked to the volumes of soap needed or the fact that boiling has no effect on B (the second and fourth marking points are not scored).

Question 4 (a) (i)

Surprising few candidates were able to recall that 'yeast' is needed for the fermentation of glucose solution. The most commonly seen incorrect answer was 'ethanoic acid', followed by a random selection of substances.

Question 4 (a) (iii)

This was poorly answered by the vast majority of candidates, with few correctly stating that a person's reaction time would increase as an effect of drinking alcohol. The vast majority of responses seen by examiners incorrectly stated that 'the reaction time would slow down'. Occasionally, it was evident that candidates had misread the question, when health problems linked to alcohol consumption were often stated, rather than the effect on reaction time.

(iii) Alcoholic drinks contain ethanol.
State the effect of drinking alcohol on a person's reaction times.

(1)

Drinking alcohol slows down the persons reactions which means it increases their reaction time.

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Examiner Comments

A typical example of a good response which scored the 1 mark available, for a correct reference to 'it increases their reaction time'.

(iii) Alcoholic drinks contain ethanol.
State the effect of drinking alcohol on a person's reaction times.

(1)

It Slows reaction times down.

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Examiner Comments

A very typical example of an incorrect response, which did not score the mark. 'Slows reaction times down' is incorrect. It is not equivalent to 'slower reactions' or 'increases reaction times'.

Question 4 (b) (i)

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

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

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

(2)

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

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Examiner Comments

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

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

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

(2)

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

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Examiner Comments

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

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Examiner Tip

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

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

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

(2)

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

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Examiner Comments

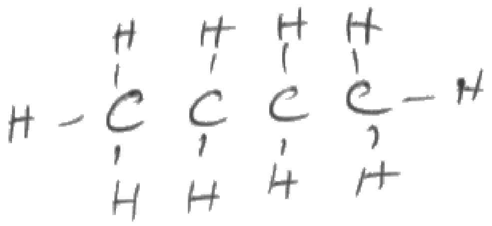
This response scored 2 marks for correct references to 'same general formula' and 'same chemical properties'.

Question 4 (b) (ii)

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

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

(2)



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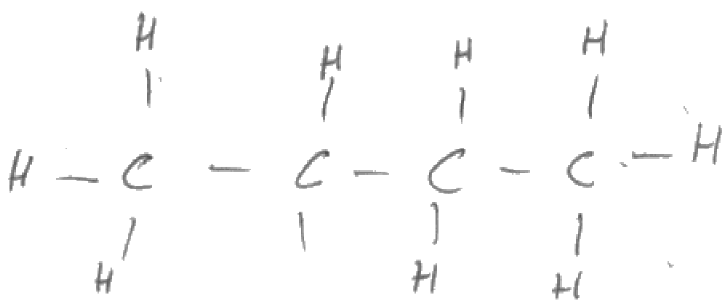
Examiner Comments

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

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

(2)



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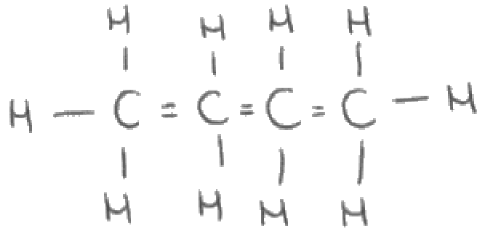
Examiner Comments

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

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

(2)



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Examiner Comments

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

Question 4 (c)

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

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

(3)

$CH_4 + 2O \rightarrow Co_2 + H_2O$

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Examiner Comments

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

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Examiner Tip

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

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

(3)

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

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Examiner Comments

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

Question 5 (a) (ii)

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

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

(1)

Reversible reaction

ResultsPlus

Examiner Comments

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

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

(1)

this is the equals sign in an equation

ResultsPlus

Examiner Comments

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

Question 5(b) (i)

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

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

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

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

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

(2)

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

ResultsPlus

Examiner Comments

A good example of a 2 mark response.

Question 5 (b) (ii)

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

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

Explain how this happens.

(2)

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

ResultsPlus
Examiner Comments

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

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

Explain how this happens.

(2)

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

ResultsPlus
Examiner Comments

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

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

Explain how this happens.

(2)

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

ResultsPlus
Examiner Comments

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

Question 5 (c)

The responses were variable in terms of the quality of descriptions of the stages for the preparation of dry crystals of a soluble salt, namely ammonium sulfate. Most of the marks gained were from detailed descriptions from Stage 2. Only a minority of those responses scoring Level 2 or above made reference to Stage 3. Examiners noted that a surprisingly large number of candidates did not know what either a pipette or a burette was and following on from that a larger number confused a pipette and a burette, and few seemed to realise that a conical flask is a reaction vessel. In many responses which failed to gain credit, candidates simply repeated statements from the Stages in stem of the question.

*(c) A student is told to prepare pure, dry crystals of ammonium sulfate.

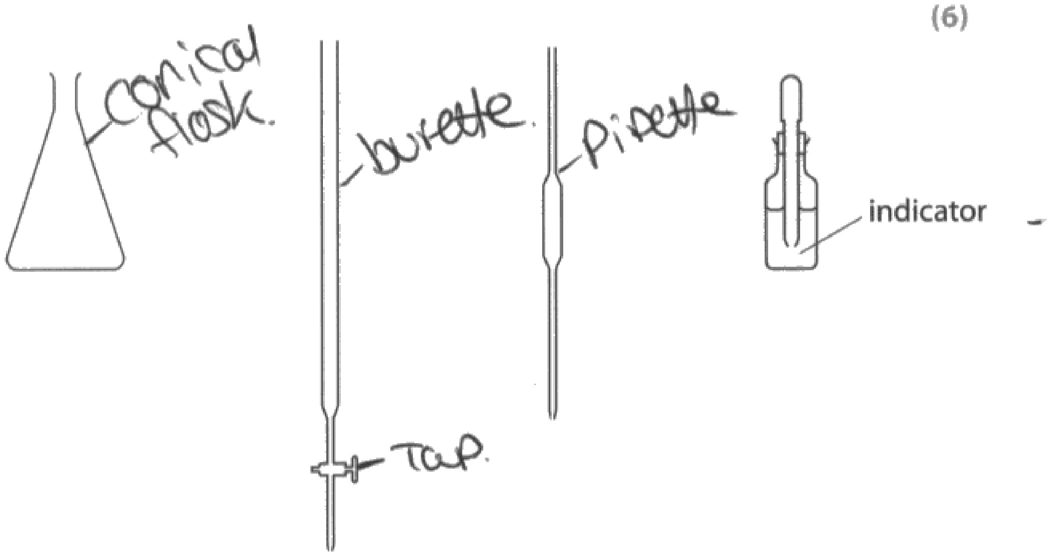
The student is told to carry out the experiment in four stages.

Stage 1: take 25.0 cm^3 of ammonia solution
Stage 2: find the volume of sulfuric acid that is needed to neutralise the ammonia solution
Stage 3: use this result to prepare an ammonium sulfate solution
Stage 4: prepare pure, dry crystals of ammonium sulfate from this solution

Describe how the student should carry out this experiment.

Some of the following apparatus may be used in the experiment.

(6)



First you use a pipette to put the 25.0cm³ of the alkali, ammonia solution, along with a few drops of the indicator into the conical flask. Funnel the acid into the burette. Making sure the tap is closed. Slowly letting the tap open and allowing acid to flow out into the ammonia fully neutralised it should go colourless, producing salt + water. gently heat the salt and waters allowing the water to evaporate and crystallise the salt. Make sure you do a test run first then carry it out two more times, if the result are very similar then you know this test is reliable.

(Total for Question 5 = 12 marks)

14

P 4 4 6 8 5 A 0 1 4 2 0

ResultsPlus

Examiner Comments

This response scored a **Level 3,** 6 marks. Three stages have been described with at least five descriptive points.

Stage 1: use of a pipette to put 25.0 cm^3 of ammonia solution into conical flask (2 creditworthy points).

Stage 2: a few drops of indicator added, sulfuric acid in burette, add acid from burette slowly to ammonia solution, repeat two more times until results are similar (at least 4 creditworthy points).

Stage 3: no detail given.

Stage 4: heat ...to evaporate (until crystals formed) (another descriptive point).

All the pieces of equipment have been identified/labelled in the diagram.

*(c) A student is told to prepare pure, dry crystals of ammonium sulfate.

The student is told to carry out the experiment in four stages.

Stage 1: take 25.0 cm^3 of ammonia solution
Stage 2: find the volume of sulfuric acid that is needed to neutralise the ammonia solution
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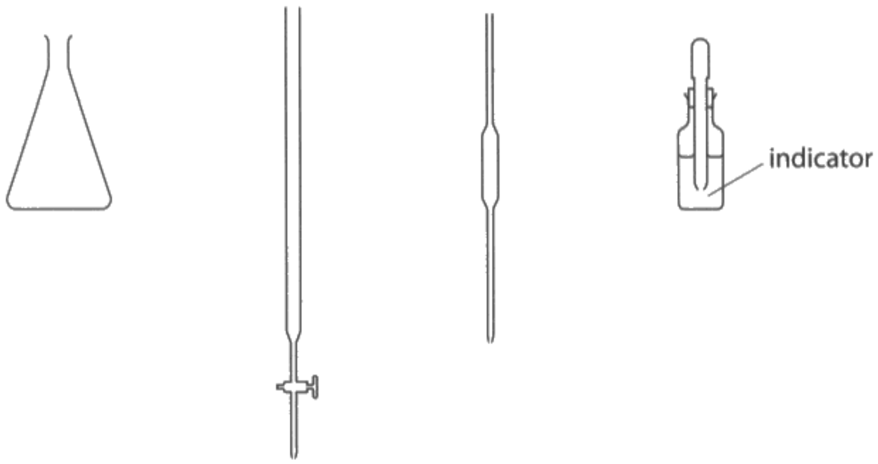
(6)



He needs to use the pippette and measuring cylinder to measure 25cm3 of ammonia solution. He then needs to put the amount of sulfuric acid and also put this into the glass cylinder. He then needs to use the metral rod to create crystals. A bunsen burner is used to heat it up. Once heated, the solution needs to be crystalised.

ResultsPlus
Examiner Comments

This response scored a **Level 1,** 2 marks. Even though two stages of the preparation have been discussed, there is only one descriptive point.

Stage 1: the use of a pipette / measuring cylinder for the ammonia solution (a creditworthy descriptive point).

Stage 2: there is no mention of a burette for acid and the response incorrectly refers to a 'glass cylinder'.

Stage 3: no detail has been given.

Stage 4: 'heat with Bunsen burner .. to crystallize' has been mentioned - but it is not clear as to which solution is being heated.

*(c) A student is told to prepare pure, dry crystals of ammonium sulfate.

The student is told to carry out the experiment in four stages.

Stage 1: take 25.0 cm^3 of ammonia solution
Stage 2: find the volume of sulfuric acid that is needed to neutralise the ammonia solution
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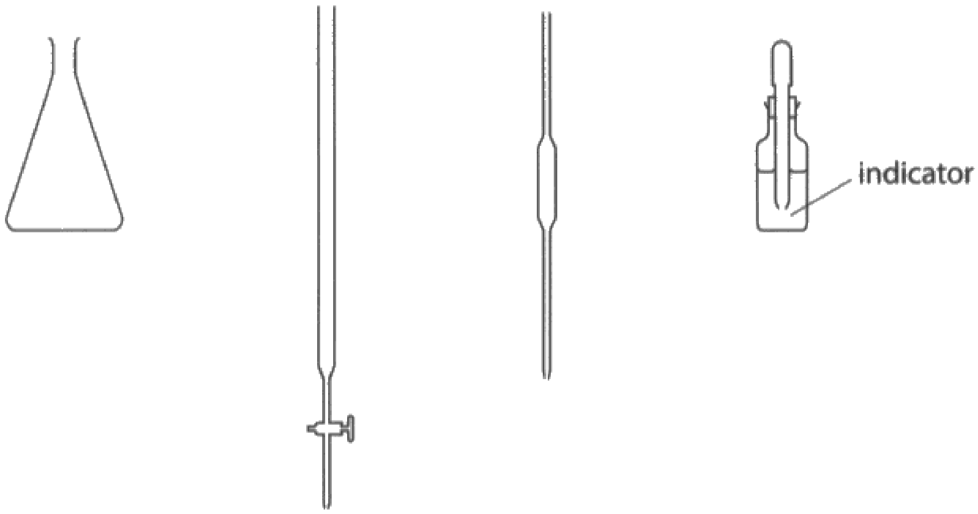
Stage 4: prepare pure, dry crystals of ammonium sulfate from this solution

Describe how the student should carry out this experiment.

Some of the following apparatus may be used in the experiment.

(6)



The student should carry this out by doing the following. Firstly he ~~[illegible]~~ should gather the equipment what he needs then set it all up ready for the experiment. He then should take 25.0 cm^3 of ammonia solution then find the volume of sulfuric acid that is needed to neutralise the ammonia solution. Thirdly use the result of this to prepare an ammonium sulfate solution then finally the student can prepare ~~pure~~ pure, dry crystals of ammonium sulfate from this solution. After ~~those~~ these steps you should have the crystals produced at the end.

ResultsPlus

Examiner Comments

This response scored a **Level 0**. There are no creditworthy descriptive points made, since this is simply a repetition of the stages given in the stem of the question.

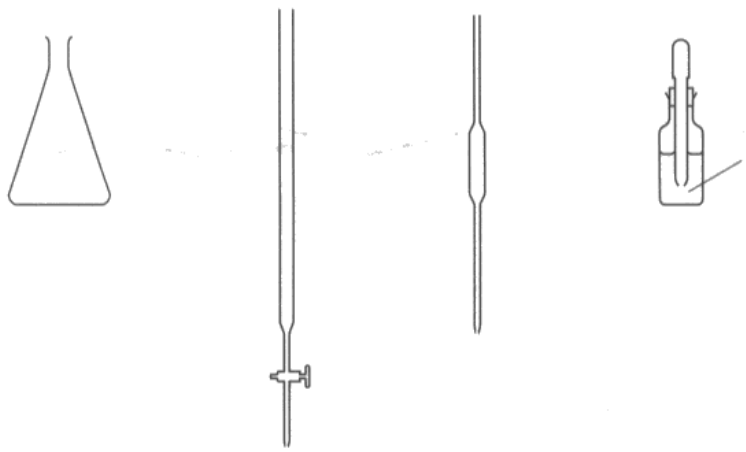
The student is told to carry out the experiment in four stages.

Stage 1: take 25.0 cm^3 of ammonia solution
Stage 2: find the volume of sulfuric acid that is needed to neutralise the ammonia solution
Stage 3: use this result to prepare an ammonium sulfate solution
Stage 4: prepare pure, dry crystals of ammonium sulfate from this solution

Describe how the student should carry out this experiment.

Some of the following apparatus may be used in the experiment.

(6)



1. With a pipette, take 25.0 cm^3 of ammonia solution. This will go into the conical flask.
2. Do a rough titration test to find the volume of sulfuric acid that is needed to neutralise the ammonia solution by using a burette. Sulfuric acid goes into burette. Indicator goes in conical flask with ammonia solution.
3. Use results to prepare ammonium sulfate solution.
4. With this solution, allow it to dry over a period of time to create pure, dry crystals of ammonium sulfate.

ResultsPlus
Examiner Comments

This response scored a **Level 2,** 4 marks. Two stages are described correctly, namely Stages 1 and 2, with four creditworthy descriptive points.

Stage 1: use of a pipette for ammonia solution which goes into the conical flask (2 creditworthy points).

Stage 2: putting sulfuric acid into a burette and indicator into the conical flask containing the ammonia (2 creditworthy points).

Stage 3: no detail has been given.

Stage 4: insufficient detail has been given.

Question 6 (a)

This question had a very good response, with many candidates able to identify the two anions, namely Cl^- and OH^-, from the choice of four ions. In those few responses which failed to gain credit, candidates incorrectly identified the cations, namely Na^+ and H^+, or gave the formula for sodium chloride, namely NaCl.

Question 6 (c)

The majority of responses were able to correctly explain oxidation and reduction in terms of the loss and gain of electrons respectively. In a minority of cases, however, despite being asked in the question to 'explain, in terms of electrons', candidates gave a definition in terms of oxygen and not always stated this correctly. The other commonly seen errors related to responses referring to loss or gain of ions or atoms instead of electrons, or simply getting the redox process the wrong way round, i.e. incorrectly stating that oxidation is the gain and reduction is the loss of electrons (which was credited with 1 mark, as an allowable response in the mark scheme).

(c) During electrolysis, oxidation takes place at the anode and reduction takes place at the cathode.

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

(2)

Oxidation means it gains oxygen and reduction means it loses oxygen.

ResultsPlus
Examiner Comments

The was a typically incorrect response, which did not score. The question specifies 'in terms of electrons', so the definitions stated (although not incorrect) cannot score.

(c) During electrolysis, oxidation takes place at the anode and reduction takes place at the cathode.

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

(2)

Reduction is when something is gained, and oxidation is when something is lost.

ResultsPlus

Examiner Comments

This response did not score. Unfortunately, the key word, namely 'electron(s)' is omitted and 'something' is used by the candidate, which is too vague - insufficient to award any marks.

(c) During electrolysis, oxidation takes place at the anode and reduction takes place at the cathode.

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

(2)

At the anode, oxidation takes place, so the electrons are lost. At the cathode, reduction takes place, so electrons are gained.

ResultsPlus

Examiner Comments

A typically seen response and very good answer - fully correct for '(anode) oxidation... electrons are lost' and '(cathode) reduction... electrons are gained'.

Question 6 (d)

The majority of candidates were able to score at least 1 of the 2 marks available, with references to 'improving the appearance' and/or 'improves resistance to corrosion'. The most common error was to mention 'to prevent rusting' which is clearly only specific to iron and steel. However, this was credited only if rusting, when mentioned, was specifically linked to iron and steel. Several candidates incorrectly referred to 'making the metal stronger'.

(d) Explain why some metal objects are electroplated.

(2)

Some metal objects are electroplated to prevent corrosion (rusting) and also to make them look a lot nicer.

ResultsPlus
Examiner Comments

This response was typical of a good answer for 2 marks. 'To make them look a lot nicer' (marking point 2) and 'prevent corrosion' (marking point 3) are credited. Note that had 'rusting' alone been mentioned this last point would not be credited, unless rusting was linked to iron/steel.

(d) Explain why some metal objects are electroplated.

(2)

So they dont rust and also that electrons are attracted by it.

ResultsPlus
Examiner Comments

This response did not score. 'So they don't rust' is insufficient as it is not linked to iron/steel (so third marking point was not scored).

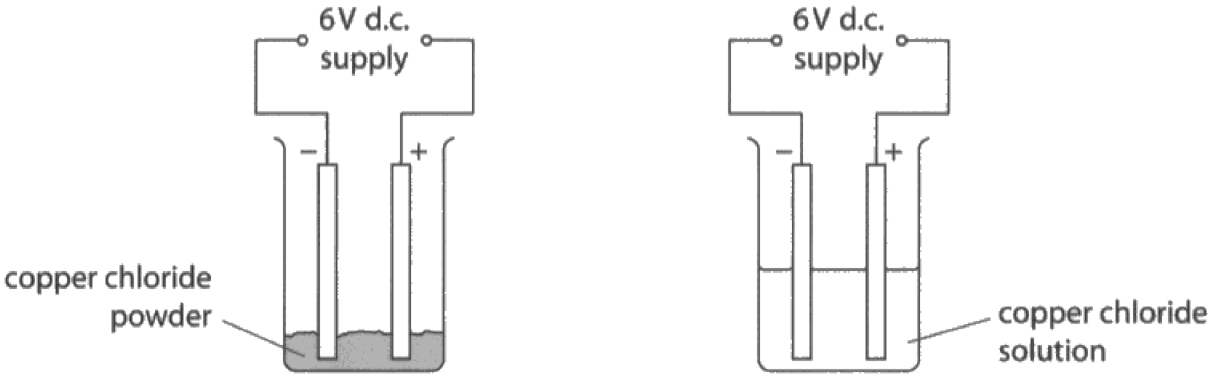
Question 6 (e)

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.

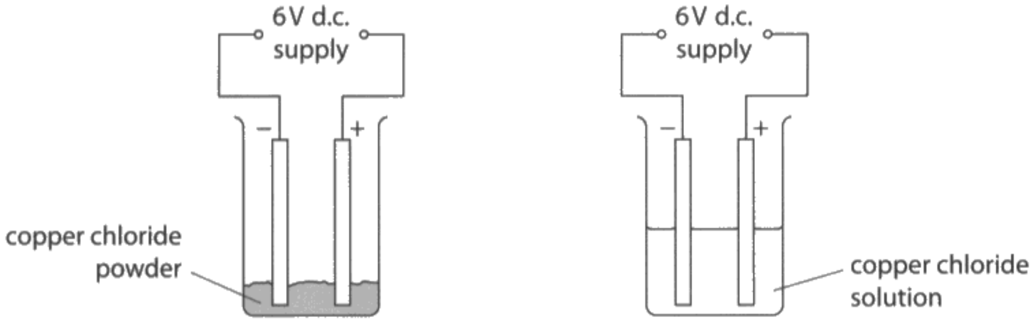
ResultsPlus
Examiner Comments

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.

ResultsPlus

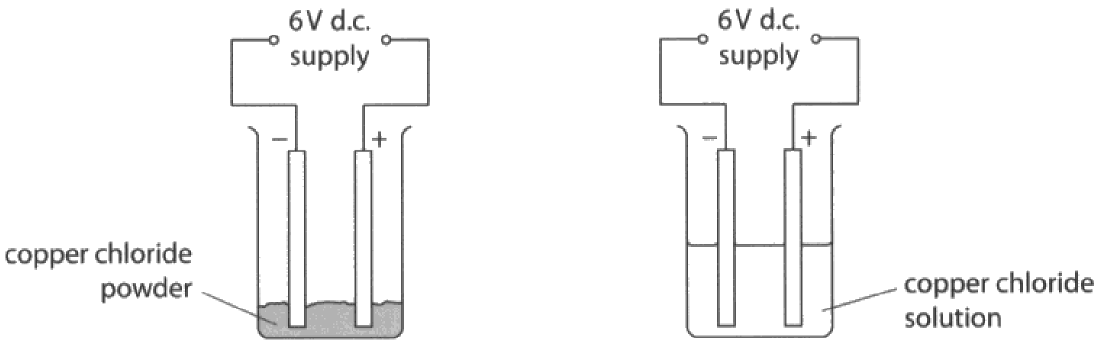
Examiner Comments

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 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 freely.

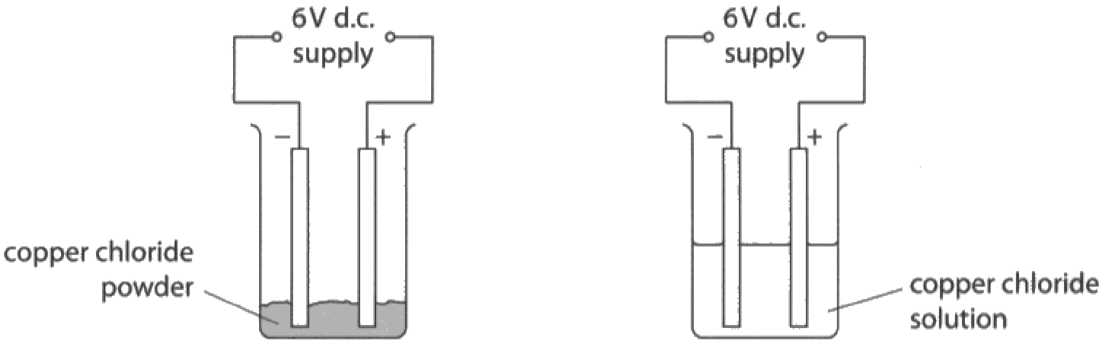
ResultsPlus
Examiner Comments

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.

ResultsPlus
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.

Paper Summary

In order to improve their performance, candidates should:

- read all the information in the question carefully and use this to help them to answer the question;
- revise the correct procedures and results for testing the ions in the specification, particularly the steps for the standard procedure for flame testing of metal ions;
- learn the names of commonly used indicators for titrations and their correct colour in different conditions;
- practise writing out different methods of salt preparation;
- be able to describe the processes occurring in electrolysis reactions in the specification and to explain these in terms of the redox processes occurring, especially for the purification of copper, the electrolysis of molten salts and solutions of salts.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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