PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 0: FORMULAE, EQUATIONS AND HAZARDS (PACK 3)

SCORE	PERCENTAGE
/175	%

STEMUP

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Q1.

(b)

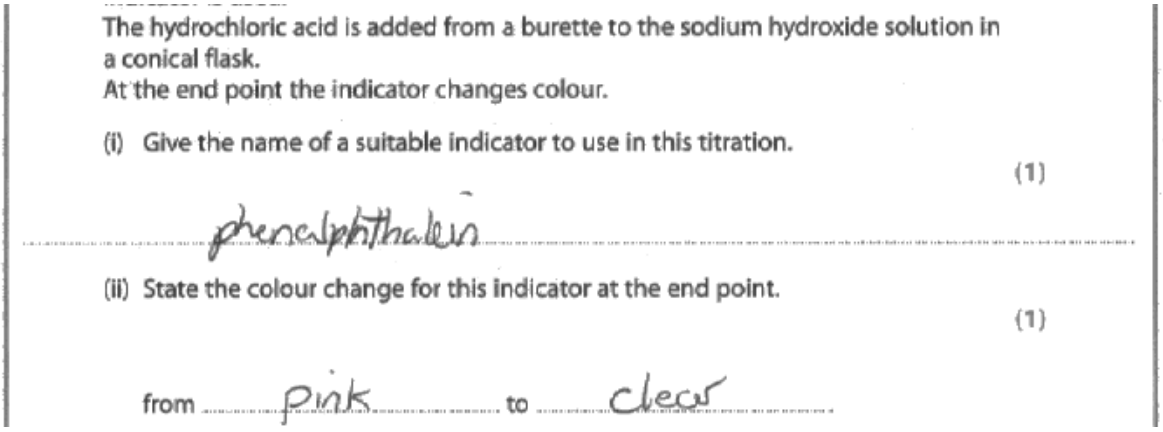
This question was very poorly answered. Most candidates struggled with writing the ionic equation for neutralisation. It was apparent that very few candidates knew what is meant by an ionic equation, let alone how to write one.

Many wrote the full symbol equation, and in few cases, word equation. Some candidates were able to score 1 mark for the inclusion of the spectator ions, sodium and chloride ions, on both sides of the equation.

(c)

Although there were many correct responses seen by examiners, typically for 'phenolphthalein' or 'methyl orange' coupled with their correct colour changes, many candidates incorrectly suggested indicator paper or 'universal indicator' as a suitable indicator. Centres need to stress to candidates that universal indicator solution is not acceptable for titrations.

Common errors were noted by examiners: extremely poor spelling, particularly for phenolphthalein, such that it was not phonetic and could not score. Occasionally, where a correct indicator had gained credit, the mark for the colour change was not scored, since the change was the incorrect way round or 'clear' was incorrectly used instead of 'colourless' when referring to phenolphthalein.


The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask.
At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

phenolphthalein

(ii) State the colour change for this indicator at the end point.

(1)

from pink to clear

Results Plus: Examiner Comments

This response mentions 'phenolphthalein' which scored 1 mark for part (i). Unfortunately, the second marking point (pink to colourless) for part (ii) was not awarded, since 'clear' is not equivalent to colourless.

Results Plus: Examiner Tip

This is a commonly asked question. It is worthwhile learning key indicators and their correct corresponding colour changes. Remember, universal indicator solution should never be used as

an indicator for titration experiments.

The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask.
At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

Phenolphthalein

(ii) State the colour change for this indicator at the end point.

(1)

from Colourless to Pink

Results Plus: Examiner Comments

This response scored 1 mark only for correct indicator (and spelled correctly) in part (i), but the colour change is the wrong way round, so the second marking point was not scored.

(d)

The majority of candidates correctly calculated the correct concentration for the 2 marks available, or at least 1 mark for correctly calculating the Relative Formula Mass for sodium hydroxide. Commonly seen errors included: dividing the Relative Formula Mass (40 g) by the mass (20 g), namely 40/20, as opposed to the other way round, 20/40. Some calculated the mass concentration, 20 g dm^{-3}, which gained 1 mark only.

(e)

Examiners were impressed by the high quality of responses seen, many scoring the full 3 marks available. It was evident that many candidates were able to use the formulae for calculating moles and concentrations competently. Occasionally, candidates inverted arithmetic or lost marks with powers of ten errors, so were limited to 1 or 2 marks. A few answers gained credit for clearly stating that the reactants were in a ratio 1:1.

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid.
The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

(3)

Formula	Ratio	Concentration	volume	moles
HCL	1	1.25	0.03	0.0375
NaOH	1	1.5	0.025	0.0375



concentration = 1.25 mol dm^{-3}

Results Plus: Examiner Comments

A typical example of a fully correct response, 3 marks. This candidate has used the correct formula triangle and shown all the quantities in a table (correctly calculated the number of moles of sodium hydroxide, and recognised that the reaction is in a 1:1 ratio, and has then calculated the concentration of the hydrochloric acid).

Q2.

The majority of candidates were able to state the correct meaning of the hazard symbol.

Two compounds of barium are barium sulfide and barium chloride.

The hazard symbol shown in Figure 5 is on bottles containing barium metal.



Figure 5

State the meaning of this hazard symbol.

(1)

flammable

Results Plus: Examiner Comments

A correct answer that scored the mark.

Q3.

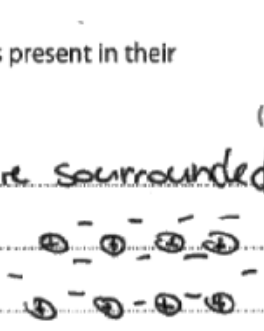
(b)(i)

The concept of delocalised electrons was quite common but a considerable numbers of candidates failed to mention cations or positive ions when answering this question. Some candidates thought metals contained positive and negative ions. Others mentioned protons instead of positive ions. Many candidates described the arrangement of particles in a metal and went on to describe how the arrangement explained the physical properties of a metal, but without mentioning that the particles are positive ions.

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

(2)

within metals there are protons which are sourrounded by a sea of delocalised electrons



Results Plus: Examiner Comments

This candidate gained one mark for a correct reference to delocalised electrons but, like many others, wrote protons rather than cations/positive ions.

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

(2)

metals are made up of positive ions surrounded by a 'sea' of delocalised electrons

Results Plus: Examiner Comments

This is the type of answer which earned two marks.

(b)(ii)

Most students were able to identify electrons as being involved in metals conducting electricity. Many were also able to explain that this was because the electrons were free to move and so gained both marks. However a proportion of candidates referred to "charged particles" instead of electrons.

Others confused the conductivity of metals with that of ionic substances with references made to ions or that the metal had to be molten to conduct.

(ii) Explain how metals conduct electricity.

(2)

Metals conduct electricity through the delocalised electrons which create a "sea" around the metal, meaning a current can be carried.

Results Plus: Examiner Comments

This gained one mark for correctly identifying the involvement of electrons, but unfortunately did not mention the idea of them moving so did not gain the second mark.

(ii) Explain how metals conduct electricity.

(2)

There is space between the positively charged ions for the electrons to move about, and due to the fact they are free to move, they conduct electricity.

Results Plus: Examiner Comments

An example of a response indicating that electrons are free to move and so worth both marks.

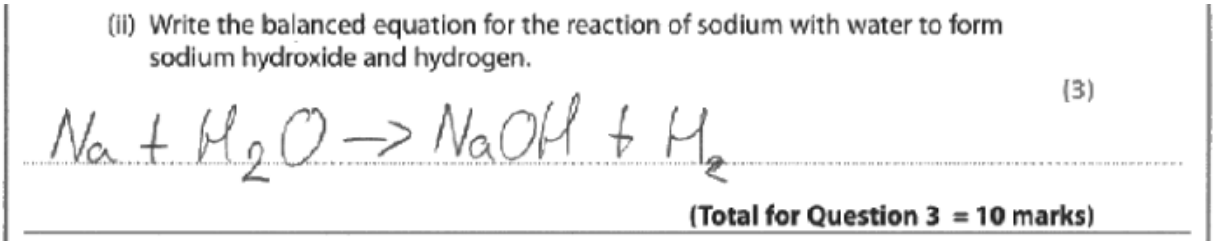
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The reaction between sodium and water was very well described by most candidates indicating the value of teacher demonstrations, however some candidates did not appreciate that the question was asking for things that can be seen during the reaction. Comments on the reactivity of sodium or explaining its reactivity in terms of electron arrangement are not required. Candidates should realise that "fizzing" and "bubbling" are really the same observation and that "hydrogen is given off" is not an observation. A few candidates included observations made after adding universal indicator, which were not credited.

(c)(ii)

About 30% of candidates produced a fully correct balanced equation. Most commonly candidates scored just one mark for the formulae on the left hand side of the equation, which was meant to be a straightforward mark. Given that the products were also named in the question, it was very disappointing that so few candidates were able to score the second mark. H for hydrogen was common as was sodium hydroxide being given as $Na(OH)_2$

It was also very surprising to see the introduction of substances not mentioned in the question.


(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

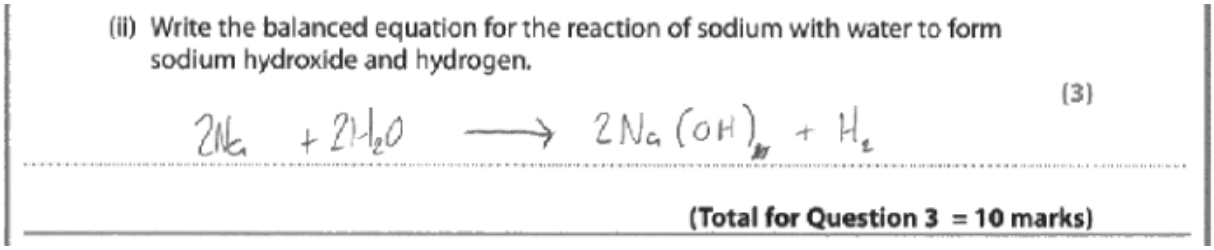
(3)

$Na + H_2O \rightarrow NaOH + H_2$

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

This candidate was awarded two marks as the symbols and formulae are correct on both sides of the equation but the equation has not been balanced.


(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

$2Na + 2H_2O \longrightarrow 2Na(OH)_2 + H_2$

(Total for Question 3 = 10 marks)

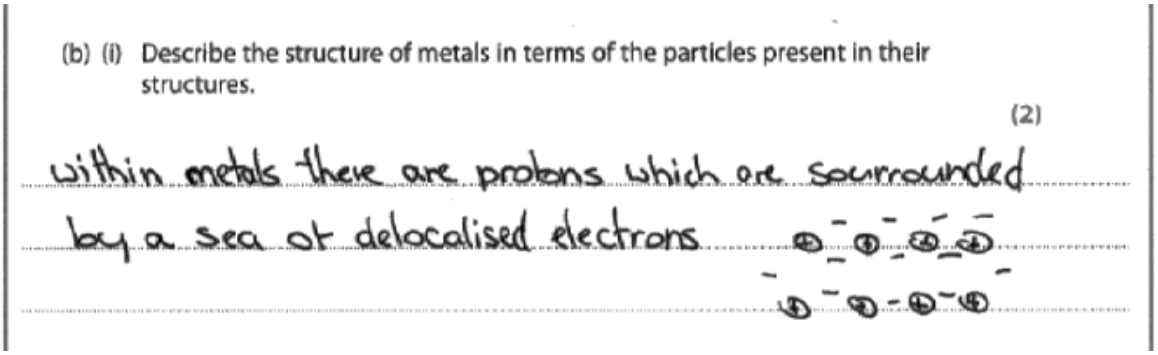
Results Plus: Examiner Comments

Although it should obviously not be encouraged the use of brackets around OH was not penalised. Candidates who wrote NaHO were treated in a similar way.

Q4.

(b)(i)

The concept of delocalised electrons was quite common but a considerable numbers of candidates failed to mention cations or positive ions when answering this question. Some candidates thought metals contained positive and negative ions. Others mentioned protons instead of positive ions. Many candidates described the arrangement of particles in a metal and went on to describe how the arrangement explained the physical properties of a metal, but without mentioning that the particles are positive ions.

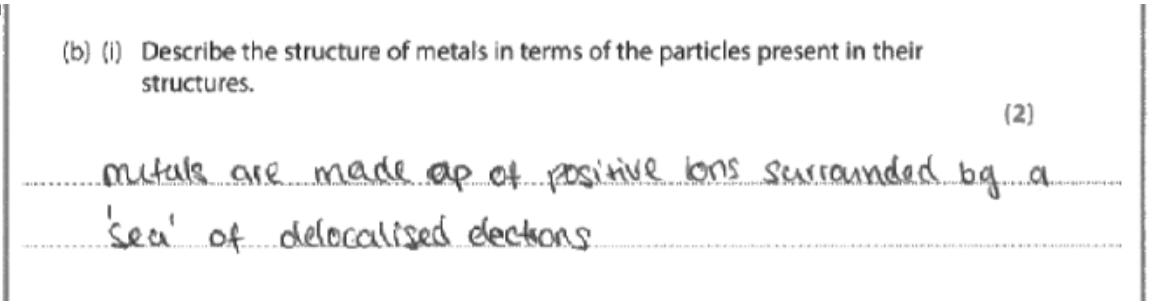

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

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Results Plus: Examiner Comments

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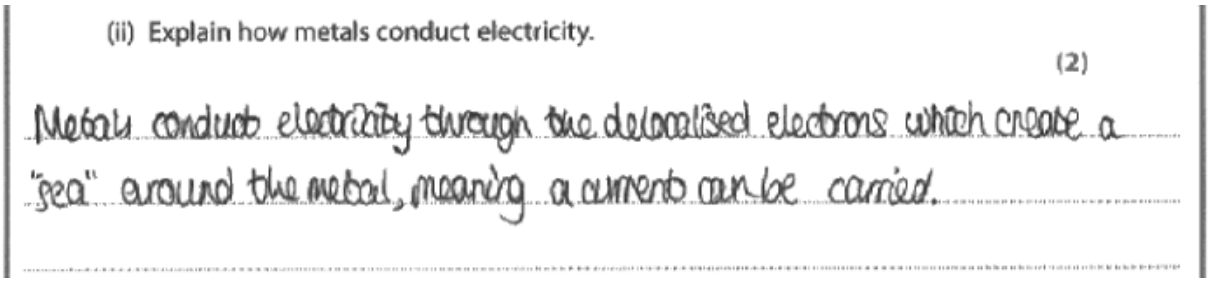
Results Plus: Examiner Comments

This is the type of answer which earned two marks.

(b)(ii)

Most students were able to identify electrons as being involved in metals conducting electricity. Many were also able to explain that this was because the electrons were free to move and so gained both marks. However a proportion of candidates referred to "charged particles" instead of electrons.

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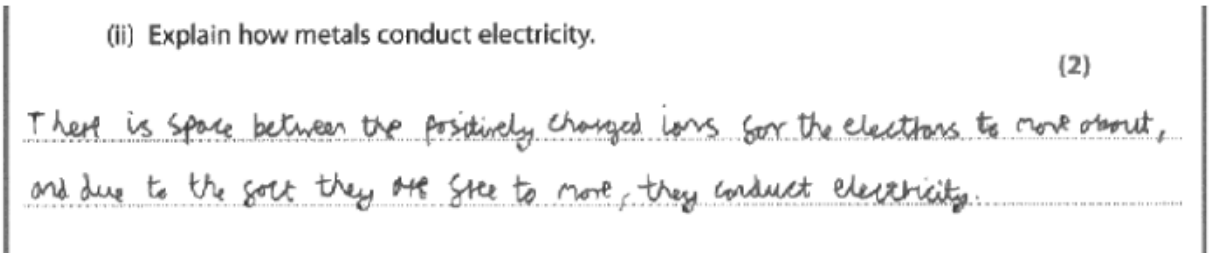
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Results Plus: Examiner Comments

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An example of a response indicating that electrons are free to move and so worth both marks.

(c)(i)

The reaction between sodium and water was very well described by most candidates indicating the value of teacher demonstrations, however some candidates did not appreciate that the question was asking for things that can be seen during the reaction. Comments on the reactivity of sodium or explaining its reactivity in terms of electron arrangement are not required. Candidates should realise that "fizzing" and "bubbling" are really the same observation and that "hydrogen is given off" is not an observation. A few candidates included observations made after adding universal indicator, which were not credited.

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It was also very surprising to see the introduction of substances not mentioned in the question.

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

$Na + H_2O \rightarrow NaOH + H_2$

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

This candidate was awarded two marks as the symbols and formulae are correct on both sides of the equation but the equation has not been balanced.

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

$2Na + 2H_2O \longrightarrow 2Na(OH)_2 + H_2$

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

Although it should obviously not be encouraged the use of brackets around OH was not penalised. Candidates who wrote NaHO were treated in a similar way.

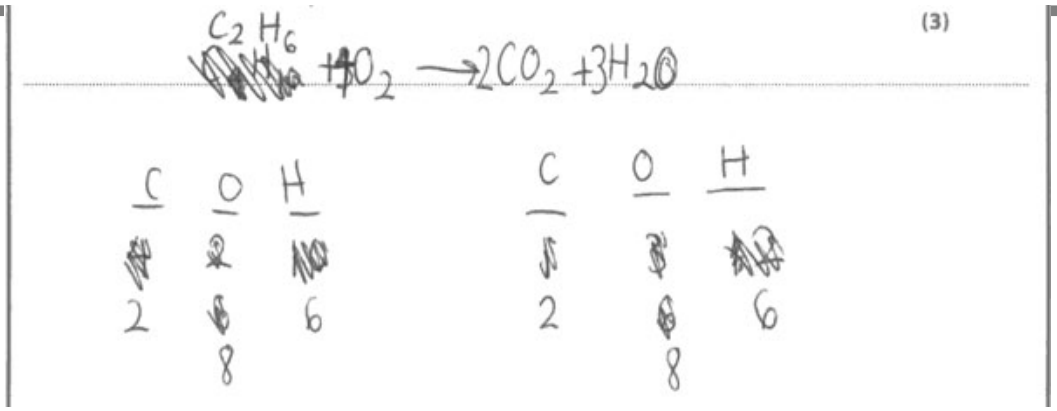
Q5.

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

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

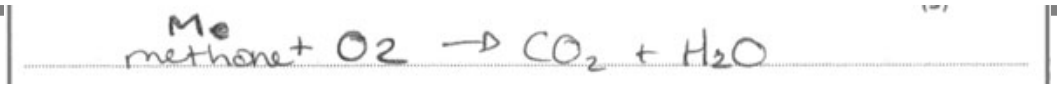
Results Plus: Examiner Comments

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



Results Plus: Examiner Comments

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

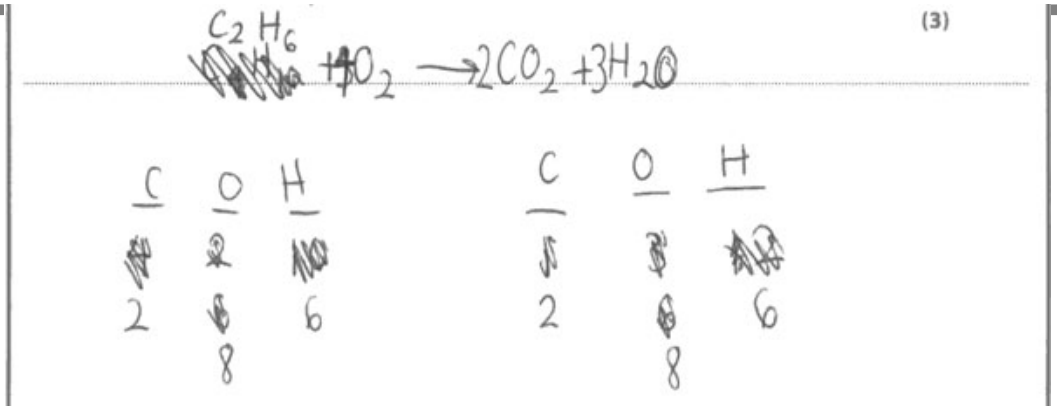
Q6.

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



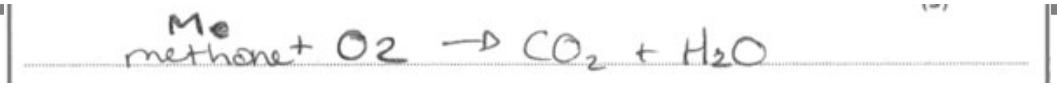
Results Plus: Examiner Comments

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



Results Plus: Examiner Comments

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Q7. No Examiner's Report available for this question

Q8.

(a) (i)

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

Organic chemistry

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

(i) Describe how this fermentation is carried out.

(2)

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

Results Plus: Examiner Comments

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

Organic chemistry

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

(i) Describe how this fermentation is carried out.

(2)

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

Results Plus: Examiner Comments

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

(a) (ii)

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

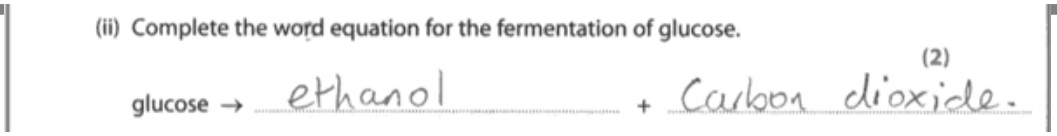
(ii) Complete the word equation for the fermentation of glucose.

(2)

glucose → Ethanol + water

Results Plus: Examiner Comments

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

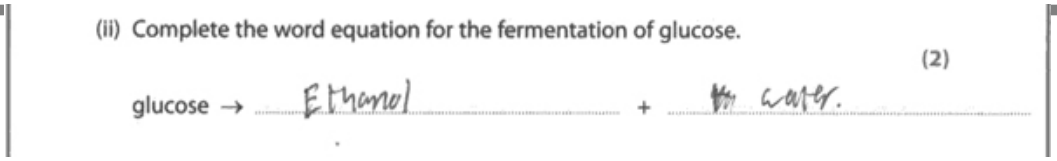

(ii) Complete the word equation for the fermentation of glucose.

(2)

glucose → ethanol + Carbon dioxide.

Results Plus: Examiner Comments

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


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

(2)

glucose → Ethanol + water.

Results Plus: Examiner Comments

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

(a) (iv)

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

(b) (i)

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

(b) (ii)

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

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

(1)

the boiling point increases.

Results Plus: Examiner Comments

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

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

(1)

because more carbon atoms need to be broken

Results Plus: Examiner Comments

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

Q9.

(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

Results Plus: 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

Results Plus: 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.

Results Plus: 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.

(c) (i)

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

(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.

(c) (iii)

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

(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

Results Plus: 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.

Q10.

(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.

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Results Plus: 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.

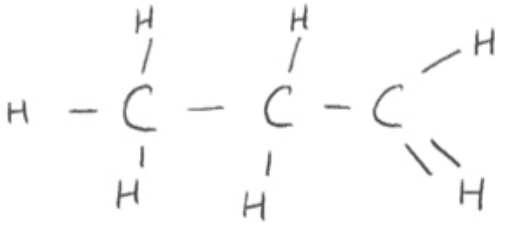
Q11.

(a) (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) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

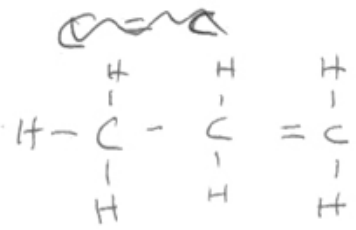
This candidate knew that propene has three carbon atoms and a double dond, but they have shown the double bond between a carbon atom and a hydrogen atom so did not score a mark.

Results Plus: Examiner Tip

Remember that hydrogen atoms only form 1 bond.

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

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Results Plus: Examiner Comments

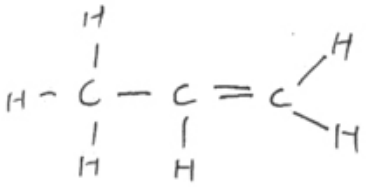
This candidate knew that there should be three carbon atoms and one double bond, so scored 1 mark. However, there are too many hydrogen atoms on the central carbon atom.

Results Plus: Examiner Tip

Remember that carbon atoms only form 4 bonds.

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

This was a clear, correct answer scoring two marks.

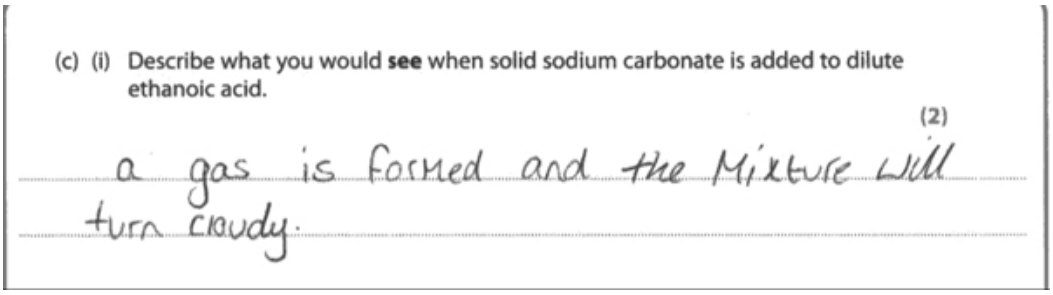
Results Plus: Examiner Tip

Learn that all alkenes contain a double bond between two carbon atoms.

Learn that the prefixes of the names give the number of carbon atoms in the molecules.
meth- shows 1 carbon atom.
eth- shows 2 carbon atoms.
prop- shows 3 carbon atoms.
but- shows 4 carbon atoms.

(c) (i)

Many candidates were able to describe one observation for the reaction between sodium carbonate and dilute ethanoic acid, but far fewer could describe two observations. Some candidates stated that carbon dioxide is produced but did not state what they would **see**as a gas is formed.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

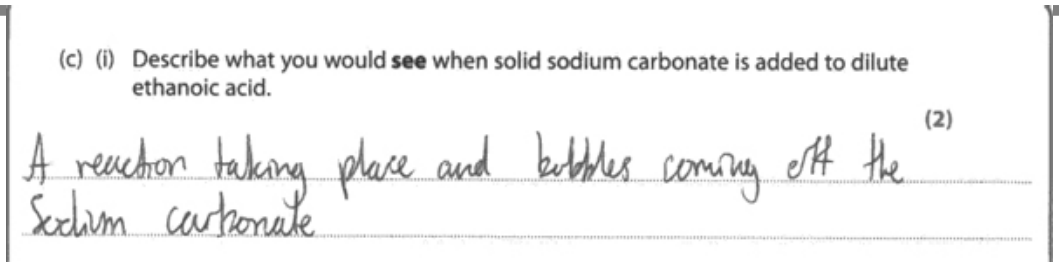
a gas is formed and the Mixture will turn cloudy.

Results Plus: Examiner Comments

This candidate knows that a gas is formed but has not stated what they would **see**during the reaction.

Results Plus: Examiner Tip

When a gas is formed from a reaction involving a solid and a solution, you will always see the gas as fizzing or effervescence.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

A reaction taking place and bubbles coming off the Sodium carbonate

Results Plus: Examiner Comments

This candidate scored 1 mark for knowing that bubbles would be seen.

Results Plus: Examiner Tip

When you see 2 marks for a question, try to include more detail in your answer.

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

There would be fizzing or bubbling as carbon dioxide is produced. The solid ~~of~~ sodium carbonate would dissolve into solution

Results Plus: Examiner Comments

This is an excellent answer scoring both marks.

(c) (ii)

Although there were some excellent answers to this question, many candidates struggled to write the correct formula for an ester and it was not uncommon to see COO or COOH at the end of the formula. Many candidates did realise that water is formed and gained 1 mark for the formula but some candidates thought that carbon dioxide is produced when a carboxylic acid reacts with an alcohol.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ C_2H_8OH + CO_2

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This candidate has been unable to work out the formula for the ester and has carbon dioxide as the other product, which is incorrect. This answer did not score any marks.

Results Plus: Examiner Tip

Remember that a carboxylic acid reacts with an alcohol to produce and ester and water.

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$CH_3COOH + C_2H_5OH \rightarrow$ C_4H_7OOH + H_2O

Results Plus: Examiner Comments

This candidate did not know the formula for the ester, but they did know that water is also formed, so scored 1 mark.

Results Plus: Examiner Tip

Learn how to write the formula for an ester.

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Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

Results Plus: Examiner Comments

This is an example of a perfect answer, scoring both marks.

Results Plus: Examiner Tip

Notice how this candidate has crossed through the end H in the ethanoic acid and the OH in the ethanol. They know that water is formed so were able to combine the remaining parts of the molecules to write the correct formula for the ester.

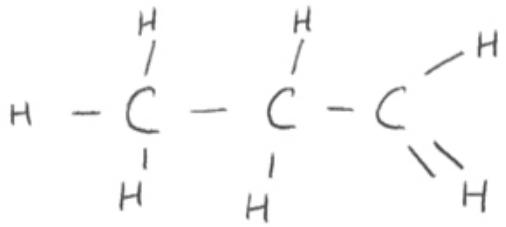
Q12.

(a) (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) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)



Results Plus: Examiner Comments

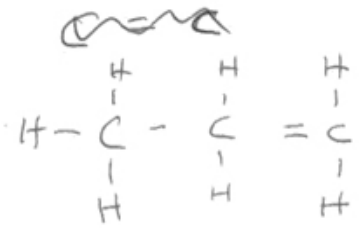
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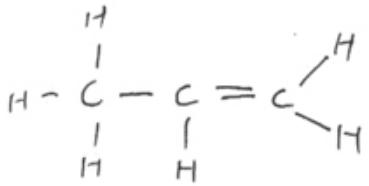
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(2)



Results Plus: Examiner Comments

This was a clear, correct answer scoring two marks.

Results Plus: Examiner Tip

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(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

a gas is formed and the mixture will turn cloudy.

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This candidate knows that a gas is formed but has not stated what they would **see**during the reaction.

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When a gas is formed from a reaction involving a solid and a solution, you will always see the gas as fizzing or effervescence.

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

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A reaction taking place and bubbles coming off the Sodium carbonate

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There would be fizzing or bubbling as carbon dioxide is produced. The solid ~~of~~ sodium carbonate would dissolve into solution

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Although there were some excellent answers to this question, many candidates struggled to write the correct formula for an ester and it was not uncommon to see COO or COOH at the end of the formula. Many candidates did realise that water is formed and gained 1 mark for the formula but some candidates thought that carbon dioxide is produced when a carboxylic acid reacts with an alcohol.

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Complete the balanced equation for this reaction.

(2)

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(Total for Question 2 = 8 marks)

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Results Plus: Examiner Tip

Notice how this candidate has crossed through the end H in the ethanoic acid and the OH in the ethanol. They know that water is formed so were able to combine the remaining parts of the molecules to write the correct formula for the ester.

Q13.

(i)

Generally well answered with most candidates able to score 1 or 2 of the 2 marks available.

Common errors, omissions, misconceptions:

In some cases candidates attempted balanced equations, many of which were correct, even though the question simply required a word equation. Some candidates incorrectly opted for the reaction leading to carbon dioxide and water. Others started with propanol and went on to produce ethanoic acid. Others incorrectly wrote 'air' as a reactant species.

Ethanol can oxidise when exposed to air to produce ethanoic acid and water.
Propanol can also oxidise in a similar reaction when it is exposed to air.

(i) Write the word equation for the reaction when **propanol** oxidises when it is exposed to air.

(2)



Results Plus: Examiner Comments

This response was not creditworthy.

There are two incorrect substances, namely 'propanoate' and 'hydrogen' shown as products on the right hand side of this equation.

Ethanol can oxidise when exposed to air to produce ethanoic acid and water.
Propanol can also oxidise in a similar reaction when it is exposed to air.

(i) Write the word equation for the reaction when **propanol** oxidises when it is exposed to air.

(2)

propanol + air → propanoic acid + water

Results Plus: Examiner Comments

This response only scored 1 of the 2 marks available.

There are three correct substances. 'Air' is not acceptable.

Results Plus: Examiner Tip

In word equations involving oxidation, 'air' is not a correct species.

Q14.

(i)

It was pleasing to see a good number of correct interpretations here. Common errors were air instead of oxygen, missing water, and ethanoic acid/ propane oxide/ propanol oxide as a product. Some added extra products, such as carbon dioxide.

Q15.

(a)

As anticipated this opening question on protons, neutrons and electrons provided a good start for most candidates with over 90% gaining 2 or more marks. The most common error was in the mass of the electron whilst some others included charges on the relative mass.

1 (a) Atoms contain protons, neutrons and electrons.

Complete the table to show the relative mass and relative charge of each particle and its position in an atom.

(3)

	relative mass	relative charge	position in atom
proton	1	+1	shells
neutron	1	0	in nucleus
electron	0	-1	shells

Results Plus: Examiner Comments

The relative mass of the electron was the most common incorrect aspect but this was a surprising incorrect answer. Also the position of the proton was incorrect but four correct responses earned 2 marks.

Results Plus: Examiner Tip

This is obviously just a matter of factual recall and should always be a good source of marks.

(c)(i)

Most candidates gave the correct answer of Ca but a few did not follow the instructions and gave the name rather than the symbol.

(c)(ii)

Over a third of candidates gave incorrect answers showing a lack of knowledge of the connection between groups and the charge on ions. Instead of the correct answer of O it was common to see K and Cl, with Ne also sometimes being given.

(d)(i)

Many candidates seemed generally confused about different types of atoms and the total number of atoms. There were a wide range of incorrect answers – 3, 9, 10 and 12 all seemed popular. Some even went into the hundreds, perhaps multiplying rather than adding, whilst others were obviously working out a value of the relative formula mass.

(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

(1)

27 [(14+48)]3
24 + 186 = 213

213

Results Plus: Examiner Comments

This candidate was one of quite a few who tried to work out a relative formula mass.

(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

(1)

3

Results Plus: Examiner Comments

Many, as this candidate did, gave the number of different elements present.

Q16.

(a)

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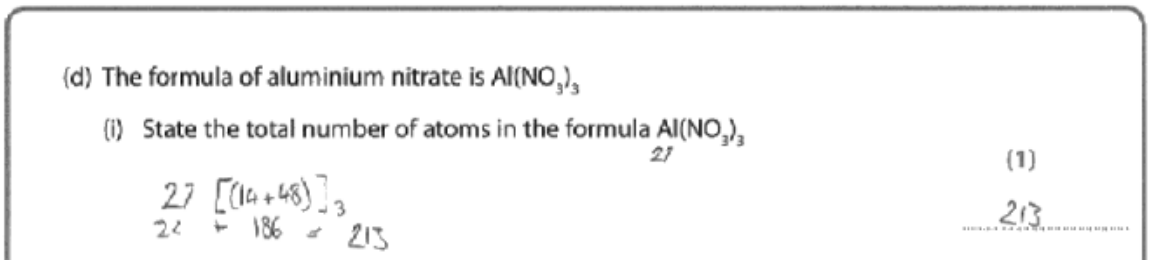
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Many, as this candidate did, gave the number of different elements present.

Q17.

(i)

Very few candidates could write a correct formula for sulphuric acid. SO4 was often seen even though hydrogen still appeared on the right-hand side of the equation. More candidates gained the mark for correct products as the formula for zinc sulphate was given but some even lost this mark as they wrote hydrogen as H.

6 (a) A student investigated the rate of a reaction.
The student investigated the reaction between zinc and dilute sulfuric acid.
The products are zinc sulfate, $ZnSO_4$, and hydrogen.

(i) Write the balanced equation for this reaction.

(2)

$Zn + SO_4 = ZnSO_4$

Results Plus: Examiner Comments

A common incorrect attempt for the formula of sulfuric acid.

(ii)

This proved to be a very accessible and hence well answered question, with the large majority of candidates producing a level 2 or 3 answer. Most candidates demonstrated a good understanding of the collision theory. The effect of the changed conditions was often well described, with the best answers containing separate considerations of the effect of concentration and temperature. However many candidates did not distinguish between their explanations for temperature and concentration and gave a combined answer rather than explaining each factor in turn. As a result these candidates often referred to an increase in concentration making the particles move faster or having more energy. Sometimes candidates lost marks because they only referred to concentration effects or temperature effects, rather than both. Many candidates omitted the need for successful collisions, simply stating that

collision frequency would be increased.

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

The rate of reaction is higer in experiment 2 because the temprature is higer. This is because higher tempratures give the particles more energy, this means the particles will be moving at a greater speed. If they are moving at a greater speed it increases the chance of a sucsessful collishion. If their are more sucsessful collishions happening at a faster rate this means the reaction will happen quicker.

Results Plus: Examiner Comments

This answer contains a good description of the effect of increasing temperature but does not mention concentration and so is unable to access level 3.

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The rate of reaction was alot faster due to the difference between the tempurature that was use in experiment 1+2. In experiment 1 the temp was 20 and 2 the temp was 40. this proves that the higher the temp the quicker the reaction is. Also using different amounts of concentrated Sulfuric acid helps to increase the rate of reaction. This is because the peiece of zinc would have more to react with making the reation stronger.

Results Plus: Examiner Comments

This answer just gives a limited description and so is a level 1 response.

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In your answer you should refer to the frequency and energy of collisions between particles.

(6)

As the concentration of sulfuric acid and the temperature increases, the rate of the reaction also increases. When the concentration increases, there are more particles per cm^3 which means there are more frequent collisions between the particles. More frequent collisions means more successful collisions. When the temperature is increased, the particles move a lot faster. When the particles move faster, they move with a lot more energy which means there are more frequent collisions. The more frequent the collisions are, the more successful the collisions are and therefore the [redacted] rate of the reaction increases.

Results Plus: Examiner Comments

A detailed description of the effect of increasing the concentration and temperature and worthy of six marks.

Q18.

(i)

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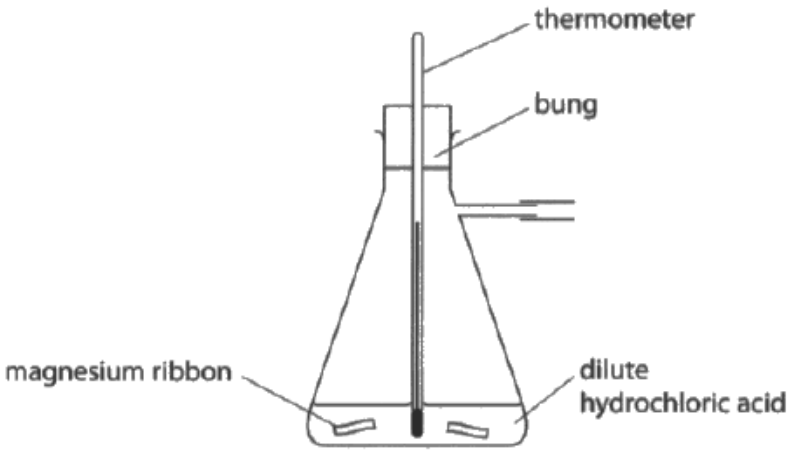
Q19.

(a)

There were many misconceptions and misunderstanding of the meanings of the state symbols. There were many who did not understand the meaning of (aq) and several different alternatives were suggested. Surprisingly, some who gave correct meanings of (aq) then proceeded to say (l) meant either a solid or a gas. It was not unusual to see statements such as 'aq is more reactive'.

Chemical reactions

4 The apparatus shown was used by a student to investigate the reaction between strips of magnesium ribbon and **excess** dilute hydrochloric acid.



The word equation for the reaction is

$$\text{magnesium(s)} + \text{hydrochloric acid(aq)} \rightarrow \text{magnesium chloride(aq)} + \text{hydrogen(g)}$$

(a) States of substances in reactions can be shown by state symbols.

Explain the difference between magnesium chloride(aq) and magnesium chloride(l).

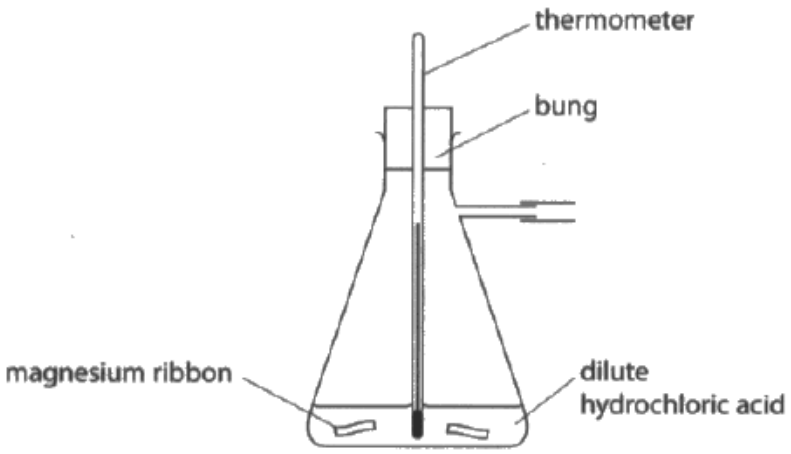
(2)

(aq) is a solid and magnesium chloride (l) is a liquid.

Results Plus: Examiner Comments

This type of response was surprisingly common.

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The word equation for the reaction is

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(a) States of substances in reactions can be shown by state symbols.

Explain the difference between magnesium chloride(aq) and magnesium chloride(l).

(2)

Magnesium chloride (aq) is a gas and Magnesium chloride (l) is a Liquide

Results Plus: Examiner Comments

Another common incorrect explanation of (aq)

(b)

Many candidates correctly suggested fizzing or bubbling. Temperature rise was common too. This was an acceptable answer as a thermometer was shown in the diagram.
However, many candidates then lost the mark by also giving an incorrect observation such as a white flame or suggesting would be seen.

(b) Describe what you would **see** when magnesium ribbon reacts with dilute hydrochloric acid.

(1)

Bubbles, a gas is being released

Results Plus: Examiner Comments

The mark was awarded for reference to bubbles but other candidates simply gave the second

part of the response - "a gas/hydrogen being produced/released" which was not sufficient to gain a mark.

(b) Describe what you would **see** when magnesium ribbon reacts with dilute hydrochloric acid.

It sets on fire with a bright light. (1)

Results Plus: Examiner Comments

This candidate, like many others, incorrectly thought the magnesium would set alight.

(c) (i)

The mark was most frequently awarded for a gas syringe but a measuring cylinder was also commonly seen. A variety of incorrect responses were given, some quite surprising such as thermometer, stop watch and ruler.

(c) Every 20 seconds, the student recorded the total volume of hydrogen produced in the reaction.

(i) Name a piece of apparatus the student should use to measure the volume of hydrogen produced. (1)

a gas ~~Fire~~ syringe

Results Plus: Examiner Comments

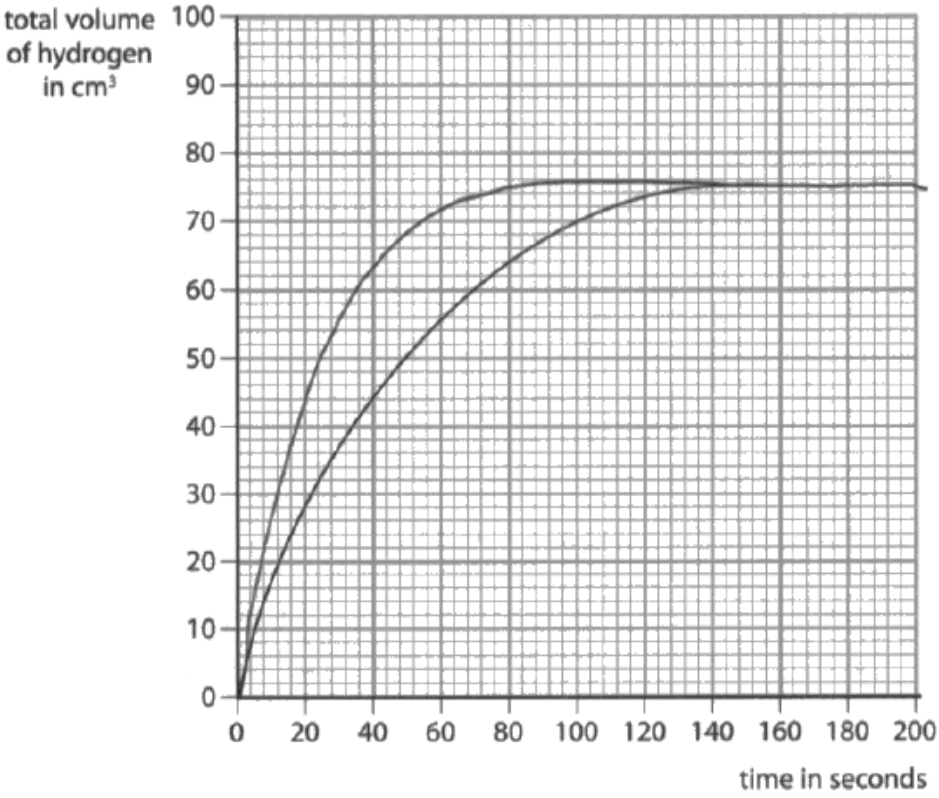
This was the most common correct answer.

(c) (ii)-(iii)

(ii) The majority of candidates did not appreciate when the reaction ended and gave an incorrect answer of 180cm^3.

(iii) Many candidates scored 1 mark for drawing a line above the original, but many fewer realised the curve should end at the same volume as the original.

The results are shown on the graph.



(ii) After how many seconds had all the magnesium reacted?

(1)

140 seconds

(iii) The experiment is repeated using the same volume of a more concentrated hydrochloric acid solution.
All other conditions were kept the same.

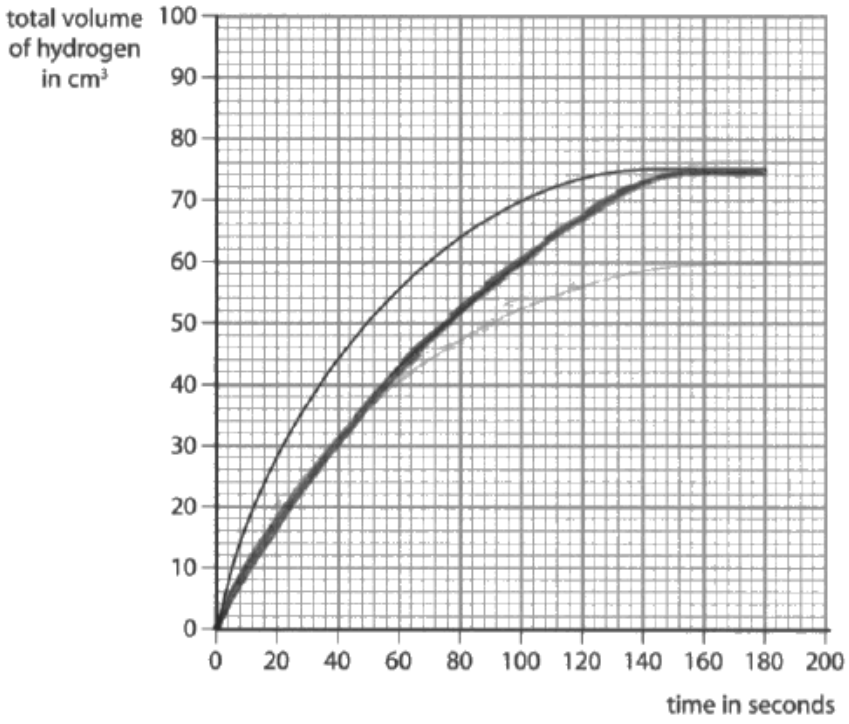
On the graph draw a curve to show how the volume of hydrogen changes with time during this experiment.

(2)

Results Plus: Examiner Comments

This is an example of a response worth all 3 marks.

The results are shown on the graph.



(ii) After how many seconds had all the magnesium reacted?

(1)

180 seconds

(iii) The experiment is repeated using the same volume of a more concentrated hydrochloric acid solution.
All other conditions were kept the same.

On the graph draw a curve to show how the volume of hydrogen changes with time during this experiment.

(2)

Results Plus: Examiner Comments

180 is incorrect and does not score a mark.

The curve is below the original one and so did not score the first mark but it finishes at the correct volume and so was awarded 1 mark.

(d)

The majority of candidates correctly stated that the rate of reaction increased or that the reaction was quicker, and many also gave a correct explanation. However it was common for candidates to mistakenly suggest that the reason for the increased rate was that the powder had a smaller surface area. A small but significant number gave an incorrect relationship stating that the reaction would be slower.

(d) A student repeated the original experiment using the same mass of magnesium as a powder instead of as ribbon.
All other conditions were the same as in the first experiment.

Explain the effect on the rate of reaction of using magnesium powder instead of magnesium ribbon.

(2)

It will React Quicker because there IS more Surface Area

Results Plus: Examiner Comments

A response worth two marks.

(d) A student repeated the original experiment using the same mass of magnesium as a powder instead of as ribbon.
All other conditions were the same as in the first experiment.

Explain the effect on the rate of reaction of using magnesium powder instead of magnesium ribbon.

(2)

The surface area has change so the rate of reaction will increase.

Results Plus: Examiner Comments

This scored a mark for stating the rate of reaction will increase but has stated the surface area changes not *increases* so was not worth the second mark.

(e)

Most candidates indicated the increase in temperature. However it then proved more difficult to gain the second mark with many suggesting the reaction was endothermic or contradicting themselves by saying it was an exothermic reaction as heat was taken in. Some candidates thought the temperature had risen due to various external factors and then explained the effect of raising the temperature on the rate of reaction.

(e) When magnesium reacts with dilute hydrochloric acid there is a change in temperature.

In an experiment the results were
temperature at start = 21 °C
temperature at end = 62 °C

Explain what conclusion can be made about the type of reaction, from these results.

(2)

There was an endothermic reaction as the temperature had increased from the beginning to the end. There was more temperature recorded at the end than there was at the beginning

(Total for Question 4 = 11 marks)



Results Plus: Examiner Comments

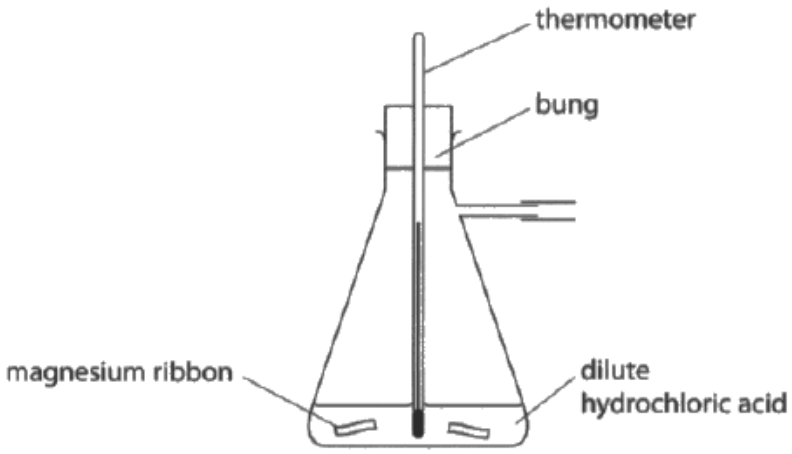
This was a common occurrence as the candidate scores a mark for stating the temperature had increased but then incorrectly states this meant it was an endothermic reaction.

Q20.

(a)

There were many misconceptions and misunderstanding of the meanings of the state symbols. There were many who did not understand the meaning of (aq) and several different alternatives were suggested. Surprisingly, some who gave correct meanings of (aq) then proceeded to say (l) meant either a solid or a gas. It was not unusual to see statements such as 'aq is more reactive'.

4 The apparatus shown was used by a student to investigate the reaction between strips of magnesium ribbon and **excess** dilute hydrochloric acid.



The word equation for the reaction is

$$\text{magnesium(s)} + \underset{\text{acid}}{\text{hydrochloric}}\text{(aq)} \rightarrow \underset{\text{chloride}}{\text{magnesium}}\text{(aq)} + \text{hydrogen(g)}$$

(a) States of substances in reactions can be shown by state symbols.

Explain the difference between magnesium chloride(aq) and magnesium chloride(l).

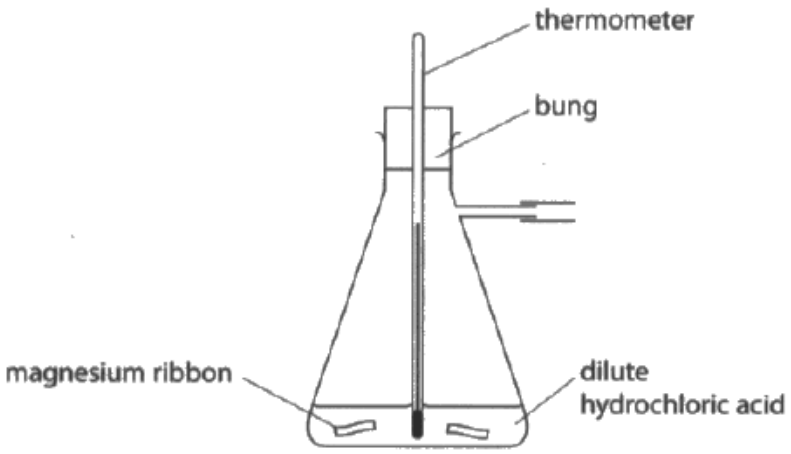
(2)

(aq) is a solid and magnesium chloride (l) is a liquid.

Results Plus: Examiner Comments

This type of response was surprisingly common.

4 The apparatus shown was used by a student to investigate the reaction between strips of magnesium ribbon and **excess** dilute hydrochloric acid.



The word equation for the reaction is

$$\text{magnesium(s)} + \underset{\text{acid}}{\text{hydrochloric}}\text{(aq)} \rightarrow \underset{\text{chloride}}{\text{magnesium}}\text{(aq)} + \text{hydrogen(g)}$$

(a) States of substances in reactions can be shown by state symbols.

Explain the difference between magnesium chloride(aq) and magnesium chloride(l).

(2)

Magnesium chloride (aq) is a gas and Magnesium chloride (l) is a Liquide

Results Plus: Examiner Comments

Another common incorrect explanation of (aq)

(b)

Many candidates correctly suggested fizzing or bubbling. Temperature rise was common too. This was an acceptable answer as a thermometer was shown in the diagram.
However, many candidates then lost the mark by also giving an incorrect observation such as a white flame or suggesting would be seen.

(b) Describe what you would **see** when magnesium ribbon reacts with dilute hydrochloric acid.

(1)

Bubbles, a gas is being released

Results Plus: Examiner Comments

The mark was awarded for reference to bubbles but other candidates simply gave the second

part of the response - "a gas/hydrogen being produced/released" which was not sufficient to gain a mark.

(b) Describe what you would **see** when magnesium ribbon reacts with dilute hydrochloric acid.

It sets on fire with a bright light. (1)

Results Plus: Examiner Comments

This candidate, like many others, incorrectly thought the magnesium would set alight.

(c) (i)

The mark was most frequently awarded for a gas syringe but a measuring cylinder was also commonly seen. A variety of incorrect responses were given, some quite surprising such as thermometer, stop watch and ruler.

(c) Every 20 seconds, the student recorded the total volume of hydrogen produced in the reaction.

(i) Name a piece of apparatus the student should use to measure the volume of hydrogen produced. (1)

a gas ~~Fire~~ syringe

Results Plus: Examiner Comments

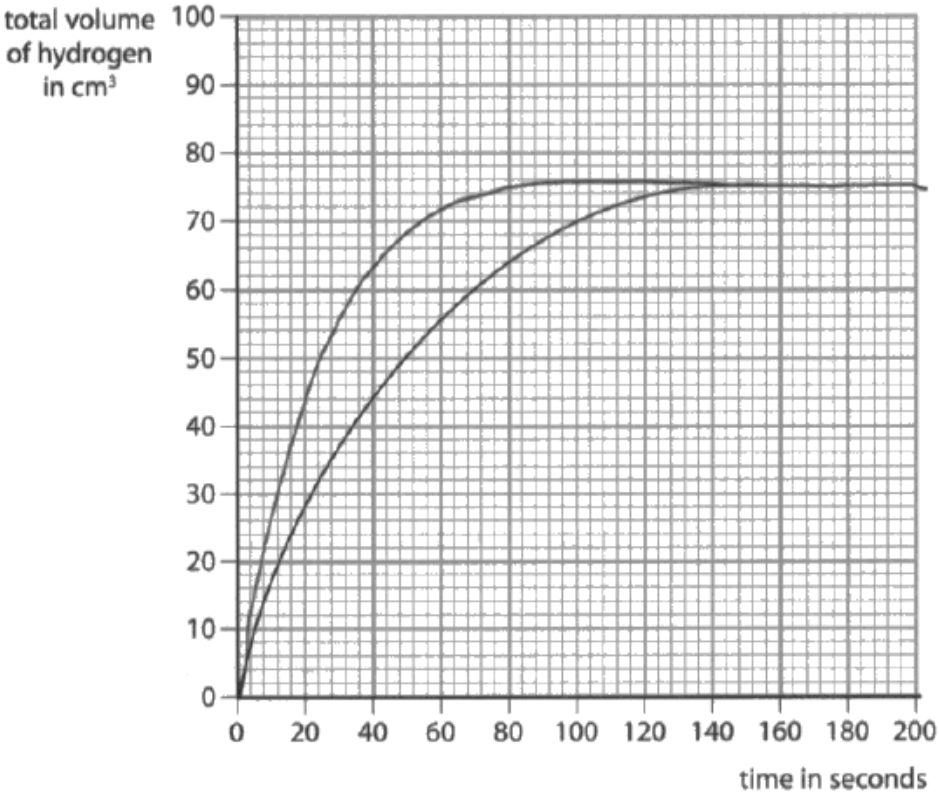
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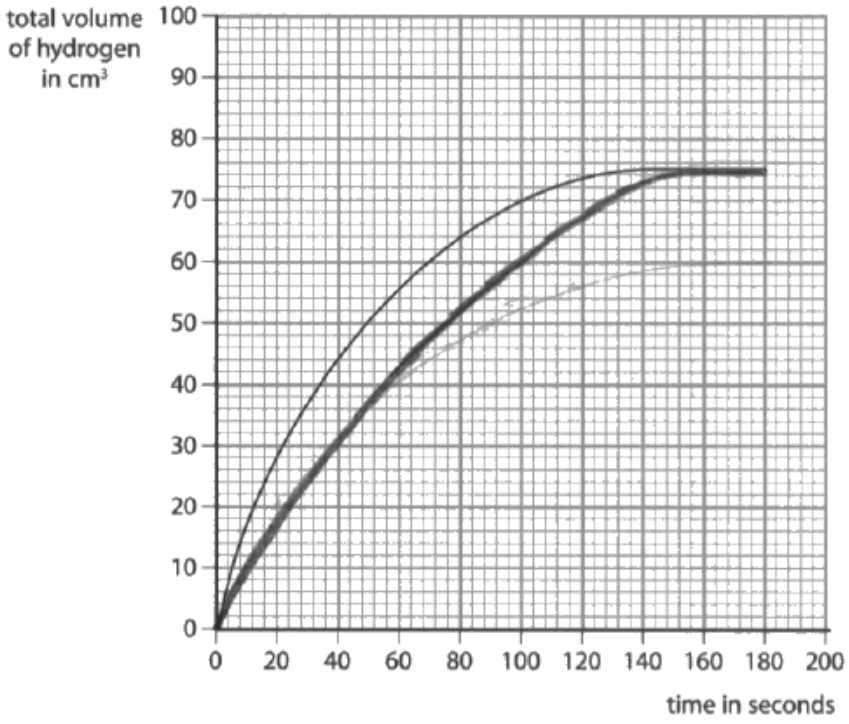
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(2)

Results Plus: Examiner Comments

This is an example of a response worth all 3 marks.

The results are shown on the graph.



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180 is incorrect and does not score a mark.

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This scored a mark for stating the rate of reaction will increase but has stated the surface area changes not *increases* so was not worth the second mark.

(e)

Most candidates indicated the increase in temperature. However it then proved more difficult to gain the second mark with many suggesting the reaction was endothermic or contradicting themselves by saying it was an exothermic reaction as heat was taken in. Some candidates thought the temperature had risen due to various external factors and then explained the effect of raising the temperature on the rate of reaction.

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(2)

There was an endothermic reaction as the temperature had increased from the beginning to the end. There was more temperature recorded at the end than there was at the beginning

(Total for Question 4 = 11 marks)



Results Plus: Examiner Comments

This was a common occurrence as the candidate scores a mark for stating the temperature had increased but then incorrectly states this meant it was an endothermic reaction.

Q21.

(b)

The majority of candidates gained a mark for stating that at a higher temperature the particles will have more energy or alternatively move faster. However, only about a third then gained a second mark by mentioning more *frequent* collisions or *more* successful collisions. Usually they did not gain the second mark because they simply mentioned more collisions without the key reference to a time factor. Another acceptable idea was a correct reference to activation energy

but these types of answers were not often seen.

(b) Explain why increasing the temperature of a reaction increases the rate of the reaction.

(2)

This gives the particles more energy. As a result they move faster and collide more frequently, with higher energy collisions. The more collision between particles, the higher the rate of reaction.

Results Plus: Examiner Comments

A good response which refers to both the idea of the particles having more energy and colliding more frequently, and so was awarded two marks.

(b) Explain why increasing the temperature of a reaction increases the rate of the reaction.

(2)

Increasing the temperature of a reaction increases the rate of the reaction because it makes the particles in the reaction move faster.

Results Plus: Examiner Comments

The candidate was awarded one mark for stating that the particles would move faster but there is no reference to more frequent or more successful collisions.

(b) Explain why increasing the temperature of a reaction increases the rate of the reaction.

(2)

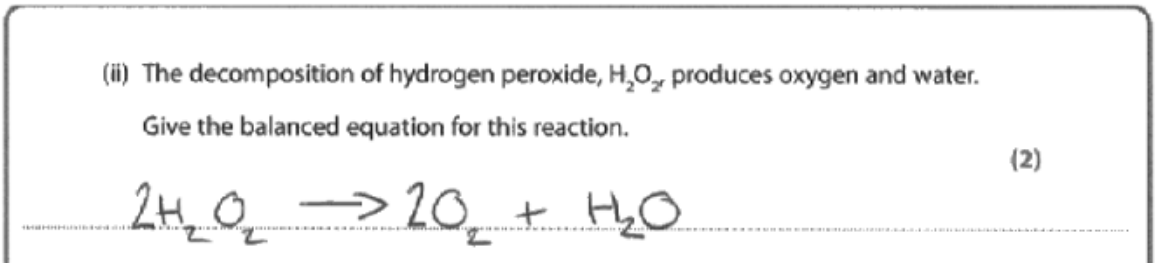
Increasing the temperature of a reaction increases the rate of reaction because it makes the particles move ~~quicker~~ faster, causing more collisions, speeding up the rate of reaction.

Results Plus: Examiner Comments

One mark was awarded for the particles moving faster but "more collisions" was not sufficient for a second mark which required a reference to "more frequent" or "more successful" collisions.

(c)(ii)

Almost half the candidates gave a fully correct answer and others gained a mark for giving three correct formulae. However it was disappointing to see oxygen gas often being shown as O, rather than O_2. Even more disappointingly, the formula for water was sometimes incorrect as was the formula of hydrogen peroxide despite it being given in the question.


(ii) The decomposition of hydrogen peroxide, H_2O_2, produces oxygen and water.

Give the balanced equation for this reaction.

(2)

$2H_2O_2 \rightarrow 2O_2 + H_2O$

Results Plus: Examiner Comments

This response gained one mark for all the correct formulae, but not the second mark, as it was not correctly balanced.

(d)

This question proved very challenging with only just over a third of candidates gaining any credit for their answers. Most either simply did not appreciate that bond breaking requires energy and bond formation releases energy or, as was often the case, they made contradictory statements such as "the energy needed to break the bonds is less than the energy needed to make the bonds".

Some students failed to make the link between bond making and bond breaking in their answers, and just gave simple statements such as "in exothermic reactions heat is given out".

(d) Explain, in terms of the energy involved in the breaking of bonds and in the making of bonds, why some reactions are exothermic.

(2)

When bonds are being made in a reaction and heat is given off then this is an exothermic reaction.

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This response gained one mark for a correct reference to bond making involving heat being given off.

(d) Explain, in terms of the energy involved in the breaking of bonds and in the making of bonds, why some reactions are exothermic.

(2)

Some reactions are exothermic (they give off heat). As there is more energy released when new bonds are formed than the energy taken in to break the old bond so more energy is given out overall making it exothermic.

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This answer was worth both marks.

(d) Explain, in terms of the energy involved in the breaking of bonds and in the making of bonds, why some reactions are exothermic.

(2)

Making bonds are endothermic
This is because alot of heat energy is released in making bonds where as breaking bond is exothermic and requires less energy and energy is releaved when breaking bonds

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

Unfortunately incorrect responses similar to this, in which the ideas were completely mixed up, were quite common.

Q22.

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

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

Write the balanced equation for this reaction.

(2)

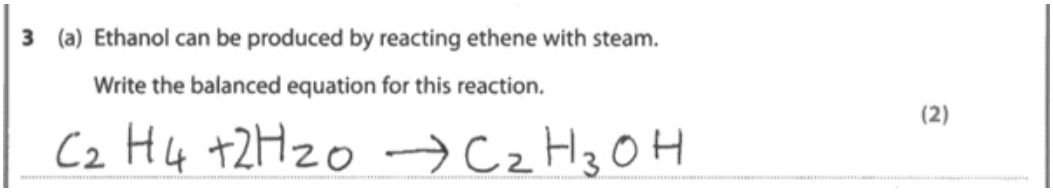
$C_2H_5OH + H_2O \rightarrow C_2H_4$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

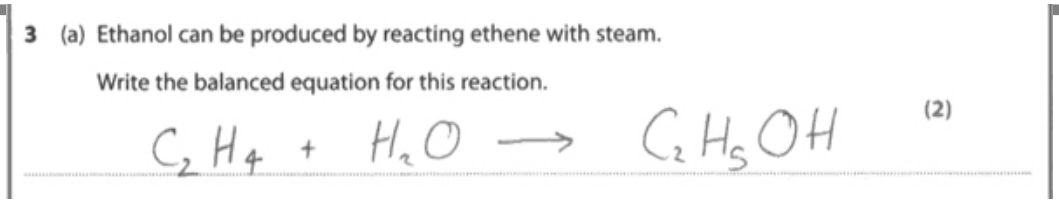


Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Use the correct formulae given on the examination paper.

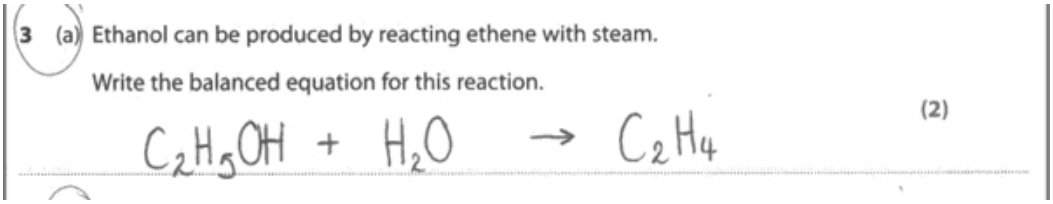


Results Plus: Examiner Comments

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

Q23.

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

Write the balanced equation for this reaction. (2)

$C_2H_4 + 2H_2O \rightarrow C_2H_3OH$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Use the correct formulae given on the examination paper.

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

Write the balanced equation for this reaction. (2)

$C_2H_4 + H_2O \rightarrow C_2H_5OH$

Results Plus: Examiner Comments

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

Q24.

(ii)

The marks here were for the formulae of both nitrogen and hydrogen, and for the balancing of

the equation. Many candidates scored both marks with slightly more scoring 0 marks for this question. Only a few candidates wrote an unbalanced equation. A common mistake was the formula of nitrogen given as 2N in the equation. Candidates do need to know the formulae of the elements and simple compounds given in the specification.

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

(2)

$2N + 3H_2 \rightarrow 2NH_3$

Results Plus: Examiner Comments

Incorrect formula on left hand side (2N) - 0 marks. Balancing was dependent on correct formulae being used. 0 marks.

(ii) Ammonia, NH_3, is made by reacting nitrogen with hydrogen.

Write the balanced equation for this reaction.

(2)

$N_2 + H_2 \longrightarrow NH_3$

Results Plus: Examiner Comments

1 mark for the correct formulae, but no balancing.
1 mark overall.

Results Plus: Examiner Tip

Practice writing and balancing equations from word equations.

Q25.

(i)

Generally very poorly answered, with very few responses scoring any of the 3 marks available for ionic equation for the formation of iron(II) hydroxide.

Common errors, omissions, misconceptions:

Far too many candidates simply did not give an ionic equation. Many included spectator ions or gave full formulae. Others included charges in the formula of $Fe(OH)_2$.

Iron(II) sulfate solution reacts with sodium hydroxide solution to form a pale green precipitate of iron(II) hydroxide, $Fe(OH)_2$.

(i) Write the ionic equation for this reaction. (3)

$Fe^{2+} + 2OH^- \rightarrow Fe^{2+}(OH)_2^+$

Results Plus: Examiner Comments

This is a typical response which scored only 1 of the 3 marks available.

The ions on the left hand side of the equation, Fe^{2+}, and OH^-, are correctly written and score the first marking point. The formula for iron(II) hydroxide shown on the right hand side of the equation is incorrect since charges are still on ions and they are also incorrect. The third marking point for balancing cannot be scored since not all the species in this equation are correct.

Results Plus: Examiner Tip

Remember when writing the formula for an ionic compound in ionic equations, such as the iron(II) hydroxide in this question, do not include charges on the formula.

Iron(II) sulfate solution reacts with sodium hydroxide solution to form a pale green precipitate of iron(II) hydroxide, $Fe(OH)_2$.

(i) Write the ionic equation for this reaction. (3)

~~$FeSO_4$~~ $Fe^{2+} + 2\ OH^- \rightarrow 2\ Fe(OH)_2$

Results Plus: Examiner Comments

This response scored 2 of the 3 marks available.

The species on both sides of the equation are correctly written, which scores the first two marking points. However, the extra balancing coefficient, 2, in front of the iron(II) hydroxide on the right hand side means the balancing is incorrect, so the third marking point cannot be scored.

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(ii)

This was poorly answered with only half the candidates able to score 1 or 2 of the 2 marks available.

The most commonly seen correct response was for mentioning that iron (III) hydroxide was produced, for the second marking point.

Most responses for this item were simply too vague, with many mentioning about iron rusting and consequently did not score.

(ii) The green iron(II) (aq) hydroxide precipitate gradually turns brown when exposed to air.

Explain this observation.

(2)

The iron is oxidised, which means that the iron will lose one more electron to form Iron (III). Iron (III) hydroxide is a brown precipitate.

Results Plus: Examiner Comments

This response scored 1 of the 2 marks available.

The product, iron(III) hydroxide, is correct and scores on marking point 2. However, the first marking point is not awarded since 'iron' alone is not specific and not acceptable for iron(II).

(ii) The green iron(II) hydroxide precipitate gradually turns brown when exposed to air.

Explain this observation.

(2)

The iron (II) ~~hydroxide~~ may oxidise to form iron (III) hydroxide, and Fe^{3+} forms a brown precipitate, which is likely what occurred during the observation.

$Na^+ + OH^- \rightarrow 2OH^- + 2Na^+$

SO_4^{2-}

$Fe^{2+} + SO_4^{2-} + Na^+ + OH^- \rightarrow Fe^{3+} + 2OH^- + 2Na^- + SO_4^{2-}$

$FeSO_4 + NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$

$SO_4^{2-} + Na^+ \rightarrow Fe(OH)_2$

Results Plus: Examiner Comments

This response scored the 2 marks available.

The response mentions that iron((II) hydroxide may oxidise to form iron(III) hydroxide which scores both marking points. Although not perfectly worded, in respect of the term 'may oxidise', rather than 'is oxidised', the correct idea is sufficient to gain credit, since at this level, students will unfamiliar with 'oxidising agents'.

Q26.

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

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

ethanoic acid + sodium hydroxide → sodium ethanoate + water

Complete the balanced equation for this reaction.

(2)

CH_3COOH + NaOH → CH_3COONa + H_2O

Results Plus: Examiner Comments

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

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

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Complete the balanced equation for this reaction.

(2)

CH_3COOH + NaH_2 → CH_3COONa + H_2O

Results Plus: Examiner Comments

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

Q27.

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

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Results Plus: Examiner Comments

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

Q28.

ii

Many candidates did not score here. Candidates that did not get the mark, did so as they thought that a gas was produced and so the mass decreased. They did not read the question fully and did not take on board that no gases were produced in the reaction and that a bung was in the top of the apparatus. There was also evidence of some fundamental misunderstandings such as the magnesium oxide condensing or water vapour being produced, condensed and therefore increasing the water level.

It will stay the same

Results Plus: Examiner Comments

Fine, scores one mark.

would be lighter because some is now a gas.

Results Plus: Examiner Comments

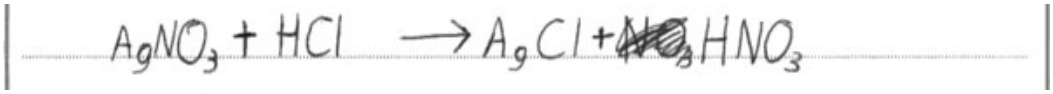
The candidate has not read the question and realised that no gas has been made or seen that there was a bung on top of the conical flask.

Results Plus: Examiner Tip

Check that you read the question fully. When practicals are being discussed ensure that you are clear as to what the reactants and the products are.

iii

Candidates showed that they could write equations and many scored here. However candidates that had not learnt the formulae of the common laboratory acids did not score here.



Results Plus: Examiner Comments

Fine, 2 marks awarded.



Results Plus: Examiner Comments

Whilst the reactants side of the equation was correct for one mark, this candidate could not recall the formulae of nitric acid, the only other product in the reaction.

Results Plus: Examiner Tip

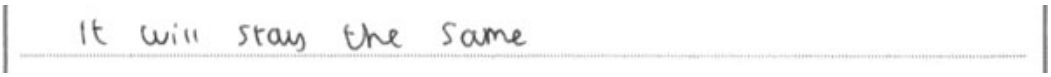
It is important that candidates can recall the formulae of common laboratory compounds used in the specification such as hydrochloric acid and nitric acid.

Q29.

ii

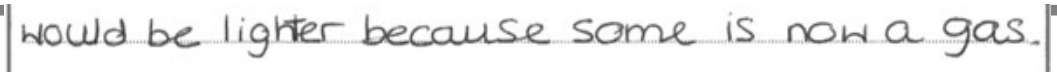
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Results Plus: Examiner Comments

Fine, scores one mark.



Results Plus: Examiner Comments

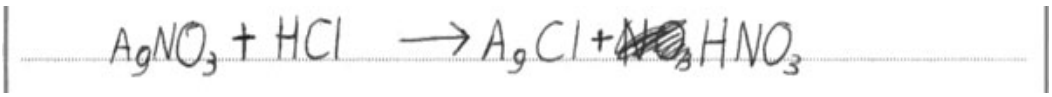
The candidate has not read the question and realised that no gas has been made or seen that there was a bung on top of the conical flask.

Results Plus: Examiner Tip

Check that you read the question fully. When practicals are being discussed ensure that you are clear as to what the reactants and the products are.

iii

Candidates showed that they could write equations and many scored here. However candidates that had not learnt the formulae of the common laboratory acids did not score here.



Results Plus: Examiner Comments

Fine, 2 marks awarded.



Results Plus: Examiner Comments

Whilst the reactants side of the equation was correct for one mark, this candidate could not recall the formulae of nitric acid, the only other product in the reaction.

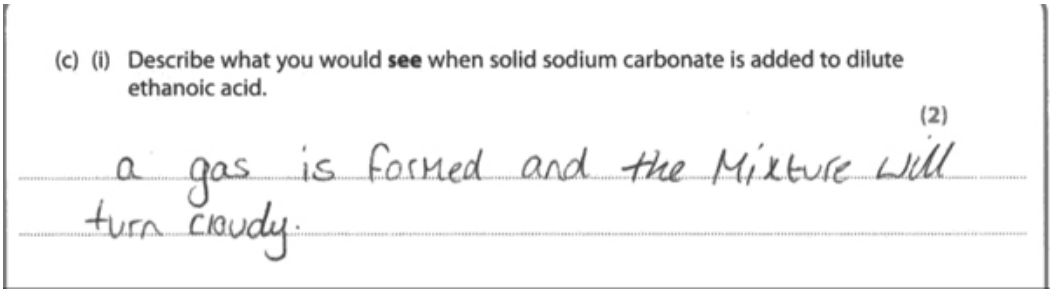
Results Plus: Examiner Tip

It is important that candidates can recall the formulae of common laboratory compounds used in the specification such as hydrochloric acid and nitric acid.

Q30.

(i)

Many candidates were able to describe one observation for the reaction between sodium carbonate and dilute ethanoic acid, but far fewer could describe two observations. Some candidates stated that carbon dioxide is produced but did not state what they would **see**as a gas is formed.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

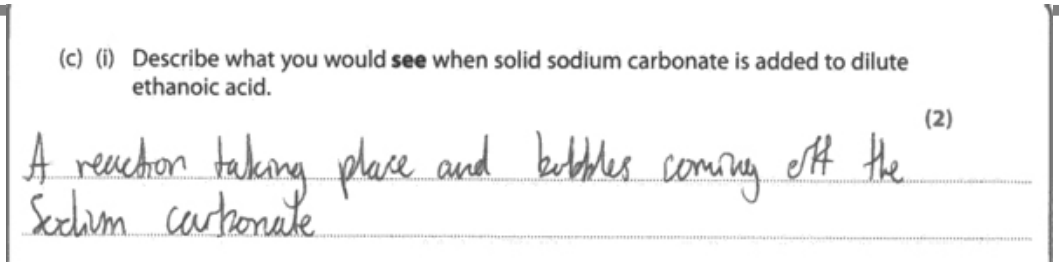
a gas is formed and the Mixture will turn cloudy.

Results Plus: Examiner Comments

This candidate knows that a gas is formed but has not stated what they would **see**during the reaction.

Results Plus: Examiner Tip

When a gas is formed from a reaction involving a solid and a solution, you will always see the gas as fizzing or effervescence.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

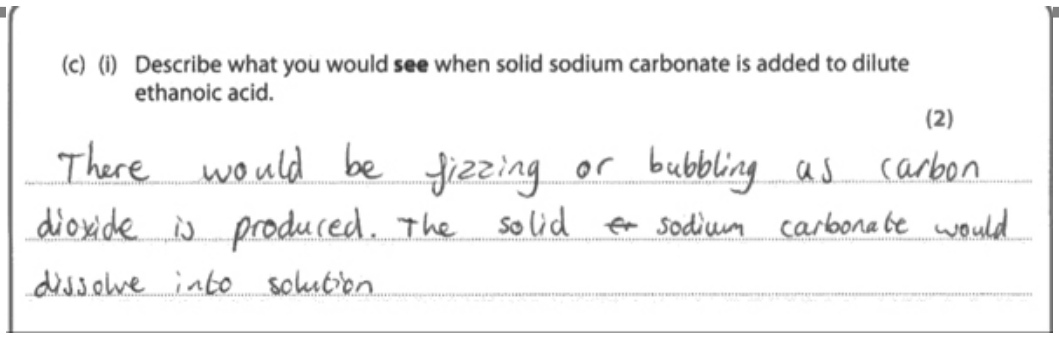
A reaction taking place and bubbles coming off the Sodium carbonate

Results Plus: Examiner Comments

This candidate scored 1 mark for knowing that bubbles would be seen.

Results Plus: Examiner Tip

When you see 2 marks for a question, try to include more detail in your answer.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

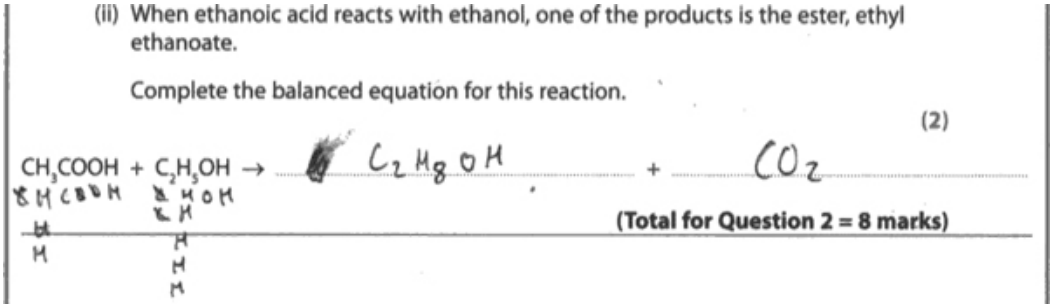
There would be fizzing or bubbling as carbon dioxide is produced. The solid ~~e~~ sodium carbonate would dissolve into solution

Results Plus: Examiner Comments

This is an excellent answer scoring both marks.

(ii)

Although there were some excellent answers to this question, many candidates struggled to write the correct formula for an ester and it was not uncommon to see COO or COOH at the end of the formula. Many candidates did realise that water is formed and gained 1 mark for the formula but some candidates thought that carbon dioxide is produced when a carboxylic acid reacts with an alcohol.



(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ C_2H_8OH + CO_2

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This candidate has been unable to work out the formula for the ester and has carbon dioxide as the other product, which is incorrect. This answer did not score any marks.

Results Plus: Examiner Tip

Remember that a carboxylic acid reacts with an alcohol to produce and ester and water.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ C_4H_7OOH + H_2O

Results Plus: Examiner Comments

This candidate did not know the formula for the ester, but they did know that water is also formed, so scored 1 mark.

Results Plus: Examiner Tip

Learn how to write the formula for an ester.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ $CH_3COOC_2H_5$ + H_2O

Results Plus: Examiner Comments

This is an example of a perfect answer, scoring both marks.

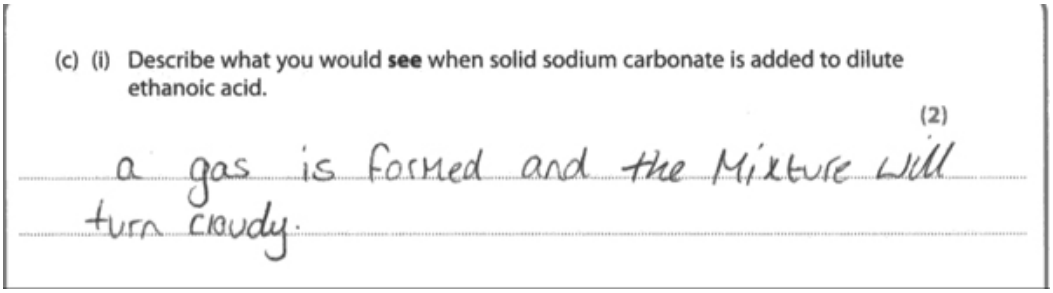
Results Plus: Examiner Tip

Notice how this candidate has crossed through the end H in the ethanoic acid and the OH in the ethanol. They know that water is formed so were able to combine the remaining parts of the molecules to write the correct formula for the ester.

Q31.

(i)

Many candidates were able to describe one observation for the reaction between sodium carbonate and dilute ethanoic acid, but far fewer could describe two observations. Some candidates stated that carbon dioxide is produced but did not state what they would **see** as a gas is formed.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

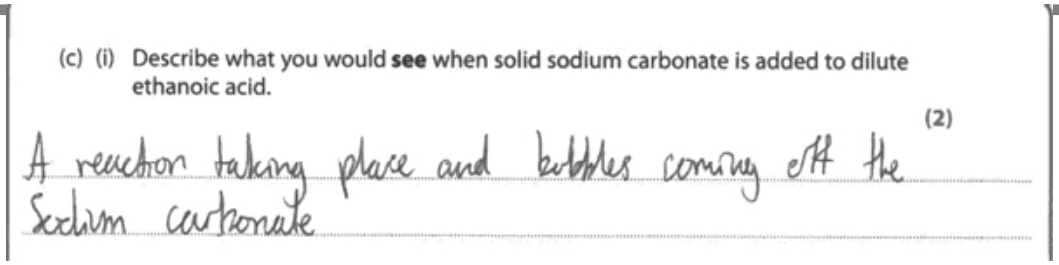
a gas is formed and the Mixture will turn cloudy.

Results Plus: Examiner Comments

This candidate knows that a gas is formed but has not stated what they would **see** during the reaction.

Results Plus: Examiner Tip

When a gas is formed from a reaction involving a solid and a solution, you will always see the gas as fizzing or effervescence.



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

A reaction taking place and bubbles coming off the Sodium carbonate

Results Plus: Examiner Comments

This candidate scored 1 mark for knowing that bubbles would be seen.

Results Plus: Examiner Tip

When you see 2 marks for a question, try to include more detail in your answer.

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

There would be fizzing or bubbling as carbon dioxide is produced. The solid ~~of~~ sodium carbonate would dissolve into solution

Results Plus: Examiner Comments

This is an excellent answer scoring both marks.

(ii)

Although there were some excellent answers to this question, many candidates struggled to write the correct formula for an ester and it was not uncommon to see COO or COOH at the end of the formula. Many candidates did realise that water is formed and gained 1 mark for the formula but some candidates thought that carbon dioxide is produced when a carboxylic acid reacts with an alcohol.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ C_2H_8OH + CO_2

(Total for Question 2 = 8 marks)

Results Plus: Examiner Comments

This candidate has been unable to work out the formula for the ester and has carbon dioxide as the other product, which is incorrect. This answer did not score any marks.

Results Plus: Examiner Tip

Remember that a carboxylic acid reacts with an alcohol to produce and ester and water.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ C_4H_7OOH + H_2O

Results Plus: Examiner Comments

This candidate did not know the formula for the ester, but they did know that water is also formed, so scored 1 mark.

Results Plus: Examiner Tip

Learn how to write the formula for an ester.

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

Results Plus: Examiner Comments

This is an example of a perfect answer, scoring both marks.

Results Plus: Examiner Tip

Notice how this candidate has crossed through the end H in the ethanoic acid and the OH in the ethanol. They know that water is formed so were able to combine the remaining parts of the molecules to write the correct formula for the ester.

Q32.

(a) (i)

This question was generally answered well and scoring the mark. Unfortunately, several candidates were giving two or sometimes three HAZCHEM descriptors or contradictions that meant the mark could not be awarded. More worrying were answers of the type 'Sodium hydroxide is an acid….'.

Reactions

6 (a) A technician made some dilute sodium hydroxide solution by carefully adding some solid sodium hydroxide to pure water.

This is the hazard symbol on a bottle of solid sodium hydroxide.



(i) State what this symbol shows about sodium hydroxide.

(1)

toxic - it can burn through anything (~~arrove~~ arroding)

Results Plus: Examiner Comments

Many candidates were mixing the descriptions for the hazard symbols. 0 mark was given for the answer 'toxic'.

(i) State what this symbol shows about sodium hydroxide.

(1)

it is harmful/corrosive highly acidic

Results Plus: Examiner Comments

Several candidates were hedging their bets by giving alternative answers. Candidates should be deterred from this as an incorrect alternative will negate the mark as in this case. 0 mark given.

Results Plus: Examiner Tip

Know the meanings of the hazard symbols.

Avoid giving alternative answers as in this example as an incorrect answer will negate the mark.

(b)

Of the candidates who scored a mark on this question, the overwhelming majority was for stating that a catalyst speeds up a reaction. However the second point about it not being used up or changed during the reaction was only scored by a minority of the candidates. Many candidates made at an attempt at the second point but stated something similar to 'not involved/does not take part' in the reaction, despite saying it speeded up the reaction. A few of

the most able on this paper did write about lowering activation energy, which gained credit, but is not a requirement of this specification.

The weaker candidates where they did attempt this question were making reference to catalytic convertors on vehicles.

(b) A catalyst is added to some reactions.

Explain the meaning of **catalyst**.

(2)

A catalyst is a substance that either slows down or speeds up the reaction.

Results Plus: Examiner Comments

At this level we consider catalysts as increasing the speed of a reaction. This answer contradicts itself, perhaps by the candidate not being completely sure, so does not score the mark.

(b) A catalyst is added to some reactions.

Explain the meaning of **catalyst**.

(2)

This speeds up a chemical reaction, so if you react two chemicals and the reaction is slow you add a ~~catalyst~~ catayst to speed it up.

Results Plus: Examiner Comments

The same point is being made twice here, so only 1 mark was awarded.

(b) A catalyst is added to some reactions.

Explain the meaning of **catalyst**.

(2)

A catalyst is something thats added to a chemical reaction to speed it up. But it doesn't take place in the reaction.

Results Plus: Examiner Comments

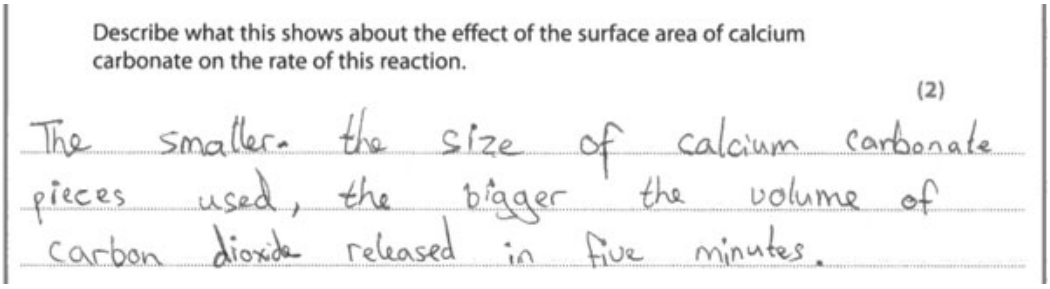
This was given 1 mark for the first sentence in the answer; however, the second sentence was frequently seen and gained no credit.

Results Plus: Examiner Tip

Know the factors that can increase the rate of a chemical reaction and be able to explain how changing that factor causes the increase in the reaction rate.

(c)

There was much confusion over size of calcium carbonate pieces and its surface area; many stated that large had a large surface area, small pieces a small surface area. The majority of the candidates repeated the data in the question and consequently narrowed down their possible score to one by stating that 'the smaller the pieces the faster the reaction'. There were some really elegant one sentence responses scoring both marks, but they were sadly, few and far between.

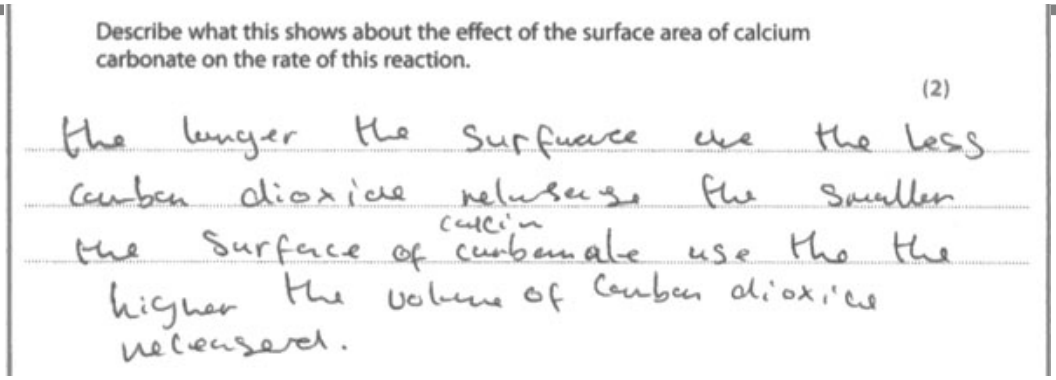

Describe what this shows about the effect of the surface area of calcium carbonate on the rate of this reaction.

(2)

The smaller the size of calcium carbonate pieces used, the bigger the volume of carbon dioxide released in five minutes.

Results Plus: Examiner Comments

This answer merely summarised the table of information in the question and scored 0 marks.


Describe what this shows about the effect of the surface area of calcium carbonate on the rate of this reaction.

(2)

the longer the surfuace use the less carbon dioxide released the smaller the surface of calcium carbonate use the the higher the volume of carbon dioxide released.

Results Plus: Examiner Comments

This is where a candidate has confused particle size with its surface area. In addition, the second half of this answer is the reverse argument of the first half. Many candidates fell into this situation of incorrectly linking large particle size with large surface as well as repeated their answer with the reverse argument as demonstrated here.

Results Plus: Examiner Tip

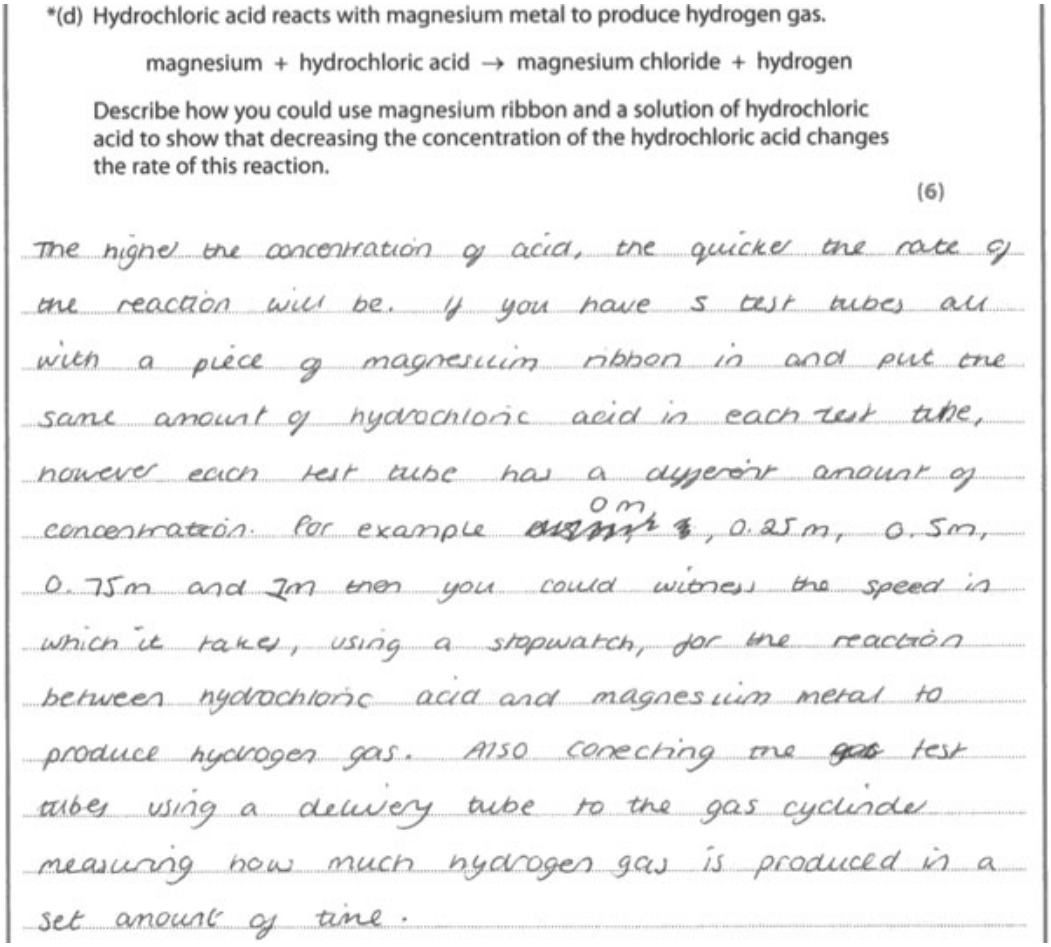
If you take a large lump of solid and start to break it up into smaller pieces, the total surface of the smaller pieces is greater than that of the large lump. This means there is more surface over which reactions can occur and so the reaction is faster.

Remember: the smaller the pieces - the larger the surface area - the faster the reaction.

(d)

As with the other 6-mark question, the response to this was equally disappointing. The weakest candidates largely left this unanswered. About a quarter of the candidates achieved a level 1 answer by a very simple description of adding pieces of magnesium to different concentrations of hydrochloric acid in a suitable container. Some candidates developed this idea to describe how to make or record observations or what conclusions could be drawn. However, few candidates secured level 3, due to the absence of a solid description of a workable method.

Often where no marks were scored the response was couched in general terms and collision theory, not addressing the point of 'tell me how you would do it'. Many candidates wasted lots of lines by repeating the question. Where candidates were more successful, many different methods used to collect the hydrogen gas were seen – some mentioned filling inverted test tubes in water, others mentioned collecting it in a balloon.



*(d) Hydrochloric acid reacts with magnesium metal to produce hydrogen gas.

magnesium + hydrochloric acid → magnesium chloride + hydrogen

Describe how you could use magnesium ribbon and a solution of hydrochloric acid to show that decreasing the concentration of the hydrochloric acid changes the rate of this reaction.

(6)

The higher the concentration of acid, the quicker the rate of the reaction will be. If you have 5 test tubes all with a piece of magnesium ribbon in and put the same amount of hydrochloric acid in each test tube, however each test tube has a different amount of concentration. For example 0m, 0.25m, 0.5m, 0.75m and 1m then you could witness the speed in which it takes, using a stopwatch, for the reaction between hydrochloric acid and magnesium metal to produce hydrogen gas. Also conecting the test tubes using a delivery tube to the gas cyclinder measuring how much hydrogen gas is produced in a set amount of time.

Results Plus: Examiner Comments

This was judged to be a level 3 answer. This answer could be read and understood as to how to go about finding out how decreasing the concentration of hydrochloric acid changes the rate of reaction. However, there were several spelling and grammar errors which meant that this answer scored 5 marks.

- As you change the concentration of acid the rate of reaction will change due to the collision theory.
- The higher the concentration the quicker the reaction as there will be more collisions meaning the magnesium and hydrochloric acid will react together quicker.
- The magnesium ribbon could be used as a way of identifying the rate this reaction has taken place.

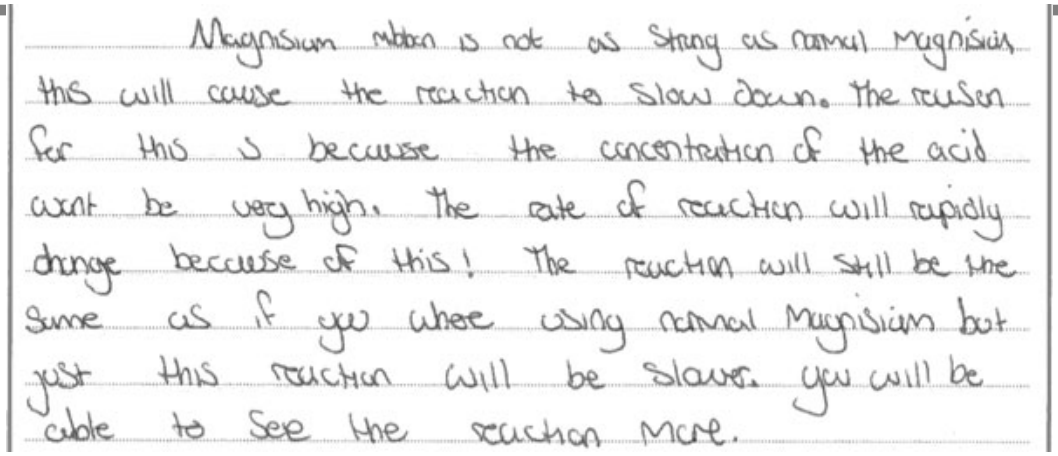
Results Plus: Examiner Comments

Many candidates did not answer the question of how this reaction could be carried out to show that decreasing the concentration changed the rate of reaction. This candidate did give a valid conclusion which was judged to be a level 1 answer with a mark of 1.

~~By~~ adding the magnesium ribbon into the solution of hydrochloric acid can show the reaction between the two by doing this repeatedly with different concentrations of hydrochloric acid will show the decomposing of the magnesium. Therefore showing the reaction between the two. Recording the time of reaction and stages of reaction will help determine whether different concentrations of hydrochloric acid changes the rate of reaction with the magnesium ribbon.

Results Plus: Examiner Comments

This answer was judged to be level 2. However it lacked the detail needed for level 3 and was awarded 4 marks.


Magnisium ribbon is not as strong as normal magnisium this will cause the reaction to slow down. The reason for this is because the concentration of the acid wont be very high. The rate of reaction will rapidly change because of this! The reaction will still be the same as if you where using normal Magnisium but just this reaction will be slower. you will be able to see the reaction more.

Results Plus: Examiner Comments

Several candidates were well off the mark when it came to answering this question. This was an example of where a candidate was probably unsure as to what magnesium ribbon was. Another candidate could only give the response 'I don't know what magnesium ribbon is so I can't answer the question.' This answer really did not answer the question at all and was given 0 marks.

Results Plus: Examiner Tip

Practice answering the 6-mark questions. Read the question carefully and use the information to help you put together your ideas and then write out your answer.

Q33.

(a) (i)

Very few candidates could write a correct formula for sulphuric acid. SO4 was often seen even though hydrogen still appeared on the right-hand side of the equation. More candidates gained the mark for correct products as the formula for zinc sulphate was given but some even lost this mark as they wrote hydrogen as H.

6 (a) A student investigated the rate of a reaction.
The student investigated the reaction between zinc and dilute sulfuric acid.
The products are zinc sulfate, $ZnSO_4$, and hydrogen.

(i) Write the balanced equation for this reaction.

(2)

Zn + SO4 = ZnSO4

Results Plus: Examiner Comments

A common incorrect attempt for the formula of sulfuric acid.

(a) (ii)

This proved to be a very accessible and hence well answered question, with the large majority of candidates producing a level 2 or 3 answer. Most candidates demonstrated a good understanding of the collision theory. The effect of the changed conditions was often well described, with the best answers containing separate considerations of the effect of concentration and temperature. However many candidates did not distinguish between their explanations for temperature and concentration and gave a combined answer rather than explaining each factor in turn. As a result these candidates often referred to an increase in concentration making the particles move faster or having more energy. Sometimes candidates lost marks because they only referred to concentration effects or temperature effects, rather than both. Many candidates omitted the need for successful collisions, simply stating that collision frequency would be increased.

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

The rate of reaction is higer in experiment 2 because the temprature is higer. This is because higher temprature give the particles more energy, this means the particles will be moving at a greater speed. If they are moving at a greater speed it increases the chance of a sucsessful collision. If their are more sucsessful collisions happening at a faster rate this means the reaction will happen quicker.

Results Plus: Examiner Comments

This answer contains a good description of the effect of increasing temperature but does not mention concentration and so is unable to access level 3.

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

The rate of reaction was alot faster due to the difference between the tempurature that was use in experiment 1+2. In experiment 1 the temp was 20 and 2 the temp was 40. this proves that the higher the temp the quicker the reaction is. Also using different amounts of concentrated Sulfuric acid helps to increase the rate of reaction. This is because the peiece of zinc would have more to react with making the reation stronger.

Results Plus: Examiner Comments

This answer just gives a limited description and so is a level 1 response.

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(6)

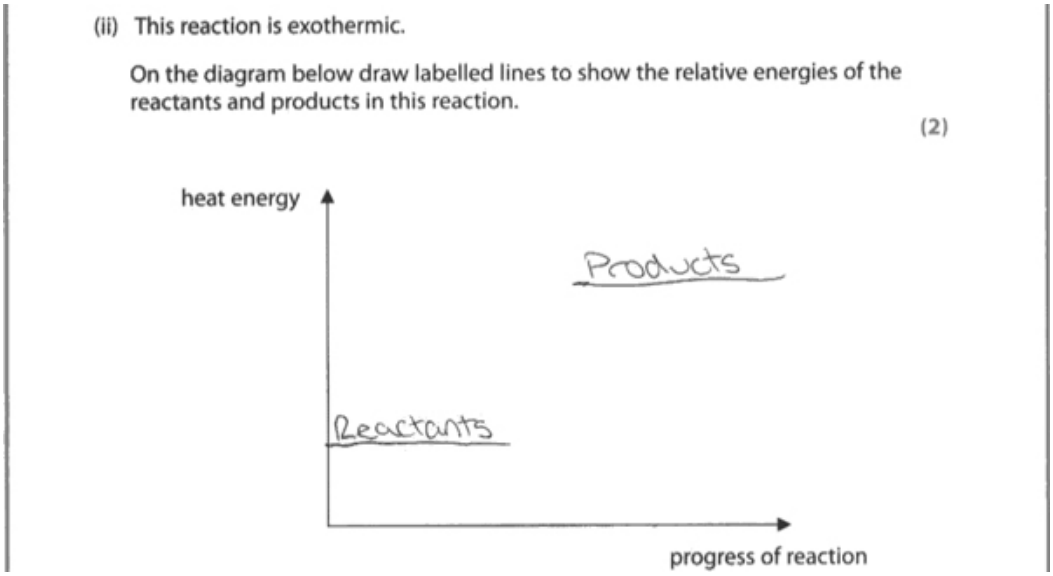
As the concentration of sulfuric acid and the temperature increases, the rate of the reaction also increases. When the concentration increases, there are more particles per cm^3 which means there are more frequent collisions between the particles. More frequent collisions means more successful collisions. When the temperature is increased, the particles move a lot faster. When the particles move faster, they move with a lot more energy which means there are more frequent collisions. The more frequent the collisions are, the more successful the collisions are and therefore the rate of the reaction increases.

Results Plus: Examiner Comments

A detailed description of the effect of increasing the concentration and temperature and worthy of six marks.

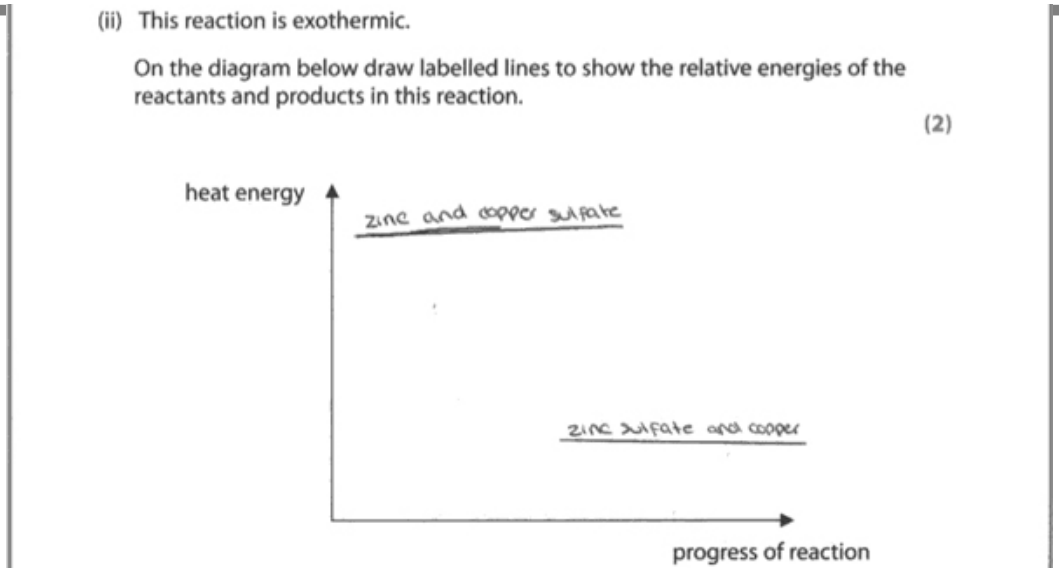
(b) (ii)

Many candidates scored both marks but some lost a mark by either labelling the lines incorrectly or not labelling them at all. Many candidates drew a reaction profile diagram and put in the activation energy "hump" which was obviously acceptable. Some thought the products would be at a higher level than the reactants but others did not draw any horizontal lines and seemingly tried to plot some sort of graph.



Results Plus: Examiner Comments

This is worth one mark as the products line is to the right of the reactants but does not gain the second mark as it shows an endothermic reaction.



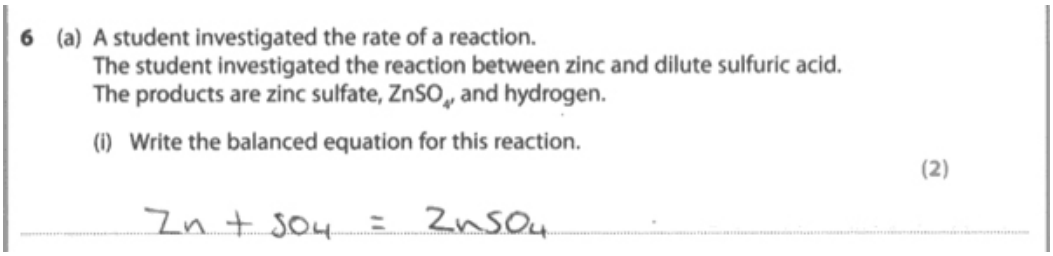
Results Plus: Examiner Comments

A good answer giving the names of the reactants and products (although just "reactants" and "products" was also acceptable) in their correct relative positions.

Q34.

(a) (i)

Very few candidates could write a correct formula for sulphuric acid. SO4 was often seen even though hydrogen still appeared on the right-hand side of the equation. More candidates gained the mark for correct products as the formula for zinc sulphate was given but some even lost this mark as they wrote hydrogen as H.



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(2)

$Zn + SO_4 = ZnSO_4$

Results Plus: Examiner Comments

A common incorrect attempt for the formula of sulfuric acid.

(a) (ii)

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(6)

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Results Plus: Examiner Comments

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In your answer you should refer to the frequency and energy of collisions between particles.

(6)

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Results Plus: Examiner Comments

A detailed description of the effect of increasing the concentration and temperature and worthy of six marks.

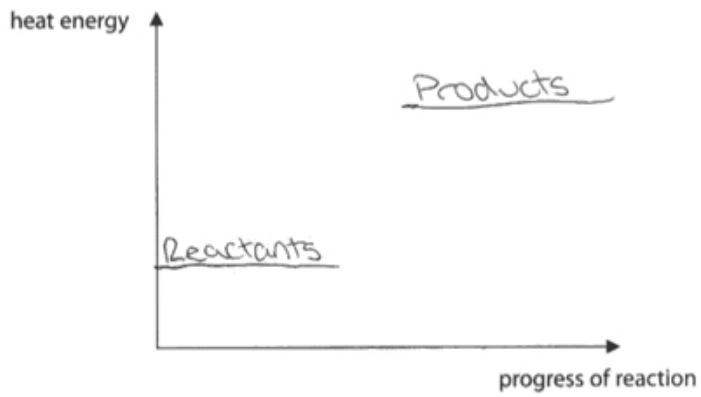
(b) (ii)

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(ii) This reaction is exothermic.

On the diagram below draw labelled lines to show the relative energies of the reactants and products in this reaction.

(2)



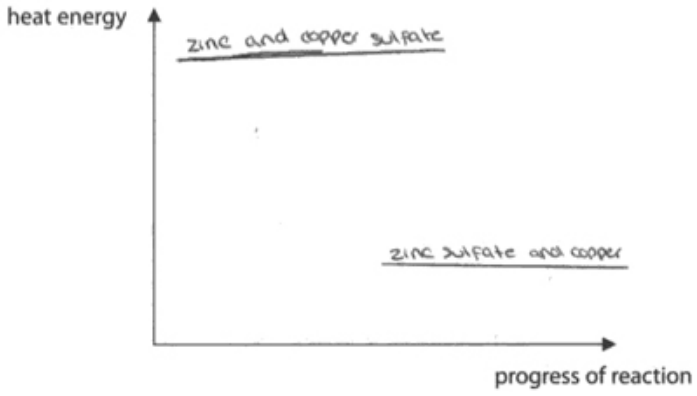
Results Plus: Examiner Comments

This is worth one mark as the products line is to the right of the reactants but does not gain the second mark as it shows an endothermic reaction.

(ii) This reaction is exothermic.

On the diagram below draw labelled lines to show the relative energies of the reactants and products in this reaction.

(2)



Results Plus: Examiner Comments

A good answer giving the names of the reactants and products (although just "reactants" and "products" was also acceptable) in their correct relative positions.

Q35. No Examiner's Report available for this question

Q36.

The majority of candidates were able to identify a safety precaution that should be taken when using barium chloride, many were also able to go on to give a valid reason for the statement.

Those that did not score, did not think about the specific safety hazard here and gave random and often generic precautions such as tying hair back, use well-ventilated room or simply stated 'wear protective clothing' or 'PPE' all of which gained no credit.

Barium chloride is toxic.

Explain one safety precaution that should be taken when using barium chloride.

(2)

Windows open so that gas can't build up and cause harm to the person

Results Plus: Examiner Comments

Opening the windows was not deemed a suitable safety precaution and no credit was awarded.

Barium chloride is toxic.

Explain one safety precaution that should be taken when using barium chloride.

(2)

wear safety goggles so that it doesnt get in your eye and burn you. Also girls with long hair tie it up.

Results Plus: Examiner Comments

This example gained two marks, one for the precaution of goggles and one for the explanation, that it deos not go in your eyes.
Generic lab rules such as tie hair up, put your bags under the table were ignored.

Results Plus: Examiner Tip

When asked for safety precautions, candidates should be taught to look for safety considerations specific to the situation or hazard rather than giving generic lab rules.

Q37.

(b)

The question told the candidates that the compound was ionic so if they mentioned molecular, intermolecular or covalent in their explanations they did not score any marks. Many identified "strong bonds" which gained a mark, but then followed this by referring to high temperature being needed to melt the compound or that the bonds would be hard to break, instead of the required reference to a lot of energy being required.

(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

Barium chloride has a high melting point because it's particles are held together by strong bonds in a lattice structure.

Results Plus: Examiner Comments

This was awarded one mark for the mention of strong bonds.

(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

Barium chloride has a high melting point because it is an ionic substance, meaning that it has strong bonds which need a lot of energy to break, and a strong lattice structure.

Results Plus: Examiner Comments

This was worth two marks for referring to strong bonds and a lot of energy needed to break them.

(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

barium chloride has high melting point because its an ionic compound and it has a strong electrostatic force of attraction between the oppositely charged ions in the lattice, this requires high energy to break the bonds

Results Plus: Examiner Comments

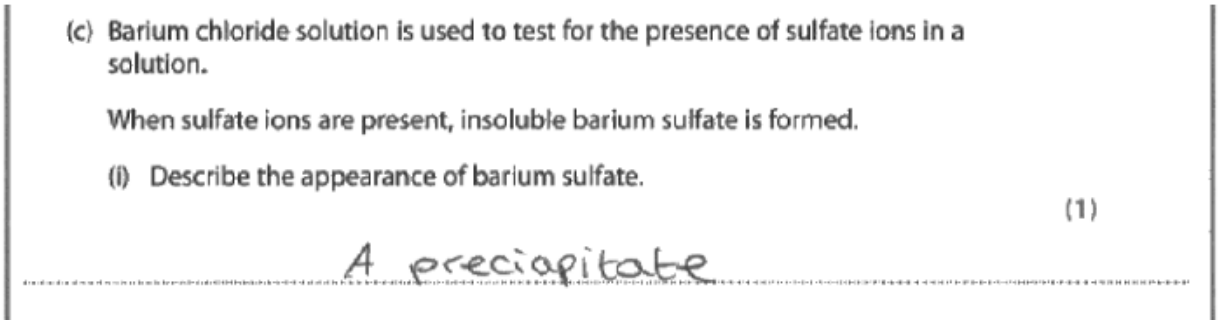
This is an example of a very good answer giving a full explanation of the high melting point of an

ionic compound.

(c)(i)

It was disappointing to find that there was an almost exactly even split between correct and incorrect answers.

Some candidates, unfortunately, simply answered "white" and so did not gain the mark because they did not add precipitate or solid. It appeared that others simply guessed or got confused with other tests and so there were wide ranging suggestions including yellow precipitate, orange solid, brown liquid/precipitate.



(c) Barium chloride solution is used to test for the presence of sulfate ions in a solution.

When sulfate ions are present, insoluble barium sulfate is formed.

(i) Describe the appearance of barium sulfate.

(1)

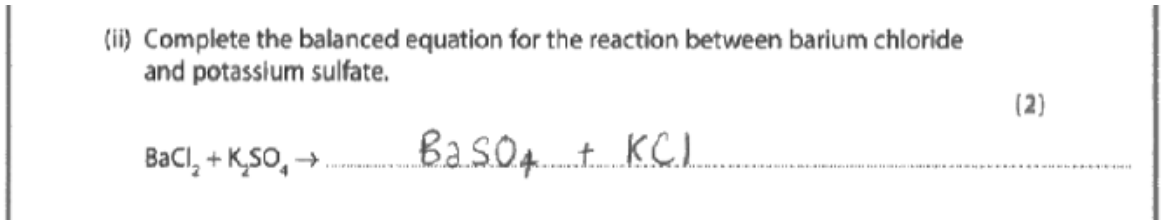
A precipitate

Results Plus: Examiner Comments

No mention of white so no mark awarded.

(c)(ii)

It is very disappointing to report that only about a quarter of candidates gained any credit here, especially given that they already had the left hand side of the equation.
Most incorrect answers seemed to include K_2Cl_2.



(ii) Complete the balanced equation for the reaction between barium chloride and potassium sulfate.

(2)

$BaCl_2 + K_2SO_4 \rightarrow$ $BaSO_4 + KCl$

Results Plus: Examiner Comments

This was worth one mark for correct formulae but it had not been balanced.

(ii) Complete the balanced equation for the reaction between barium chloride and potassium sulfate.

(2)

$BaCl_2 + K_2SO_4 \rightarrow$ $BaSO_4 + K_2Cl_2$

Results Plus: Examiner Comments

Answers like this were the most common of all.

(d)(ii)

There were some very good answers describing how to prepare a sample of lead carbonate with many scoring full marks.

However others failed to say that the two salt solutions should be mixed/reacted and others gave an incorrect sequence of steps.

It was quite common for candidates to suggest the use of heat or the addition of another reagent, usually an acid.

The use of a separating funnel was sometimes given as a method of separation with fractional distillation also being suggested.

(ii) Lead carbonate is an insoluble salt.

Describe how a pure, dry sample of solid lead carbonate can be obtained from sodium carbonate solution and lead nitrate solution.

(3)

Sodium carbonate solution and lead nitrate solution are mixed together. Then, the insoluble salt formed is filtered to take out the lead carbonate. The lead carbonate is the washed with distilled water (to make sure that no other ions are involved) and then it's dried.

(Total for Question = 10 marks)

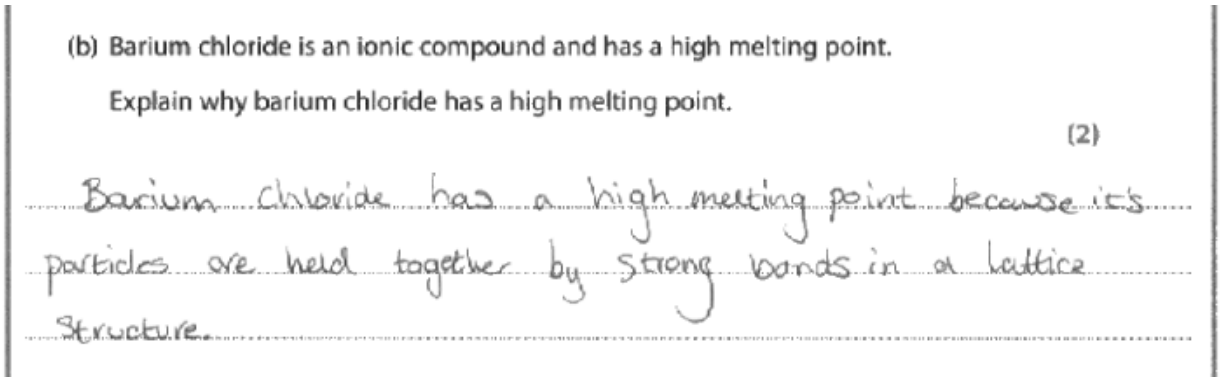
Results Plus: Examiner Comments

A response worth all three marks.

Q38.

(b)

The question told the candidates that the compound was ionic so if they mentioned molecular, intermolecular or covalent in their explanations they did not score any marks. Many identified "strong bonds" which gained a mark, but then followed this by referring to high temperature being needed to melt the compound or that the bonds would be hard to break, instead of the required reference to a lot of energy being required.



(b) Barium chloride is an ionic compound and has a high melting point.

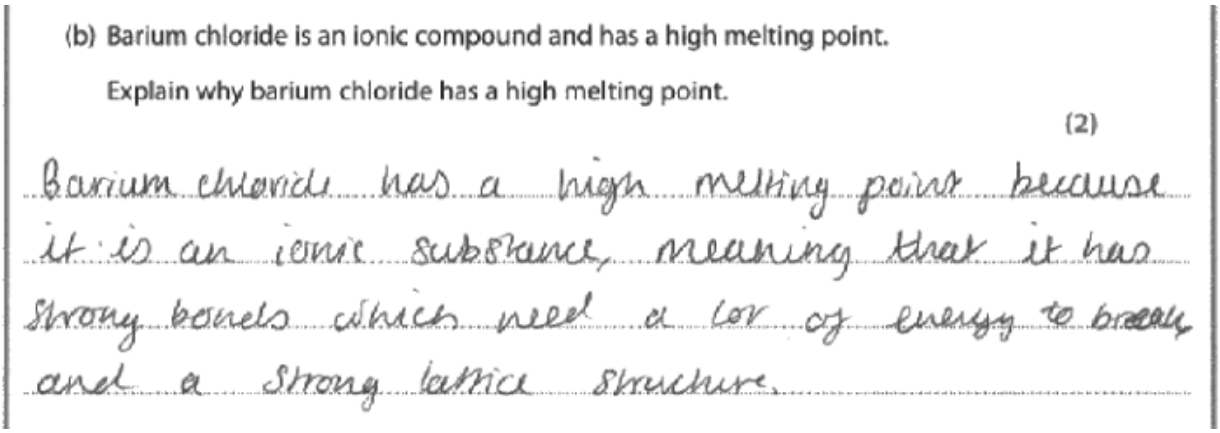
Explain why barium chloride has a high melting point.

(2)

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Results Plus: Examiner Comments

This was awarded one mark for the mention of strong bonds.



(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

Barium chloride has a high melting point because it is an ionic substance, meaning that it has strong bonds which need a lot of energy to break, and a strong lattice structure.

Results Plus: Examiner Comments

This was worth two marks for referring to strong bonds and a lot of energy needed to break them.

(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

Barium chloride has high melting point because its an ionic compound and it has a strong electrostatic force of attraction between the oppositely charged ions in the lattice, this requires high energy to break the bonds

Results Plus: Examiner Comments

This is an example of a very good answer giving a full explanation of the high melting point of an ionic compound.

(c)(i)

It was disappointing to find that there was an almost exactly even split between correct and incorrect answers.

Some candidates, unfortunately, simply answered "white" and so did not gain the mark because they did not add precipitate or solid. It appeared that others simply guessed or got confused with other tests and so there were wide ranging suggestions including yellow precipitate, orange solid, brown liquid/precipitate.

(c) Barium chloride solution is used to test for the presence of sulfate ions in a solution.

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(i) Describe the appearance of barium sulfate.

(1)

A precipitate

Results Plus: Examiner Comments

No mention of white so no mark awarded.

(c)(ii)

It is very disappointing to report that only about a quarter of candidates gained any credit here, especially given that they already had the left hand side of the equation.
Most incorrect answers seemed to include K_2Cl_2.

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$BaCl_2 + K_2SO_4 \rightarrow$ $BaSO_4 + K_2Cl_2$

Results Plus: Examiner Comments

Answers like this were the most common of all.

(d)(ii)

There were some very good answers describing how to prepare a sample of lead carbonate with many scoring full marks.

However others failed to say that the two salt solutions should be mixed/reacted and others gave an incorrect sequence of steps.

It was quite common for candidates to suggest the use of heat or the addition of another reagent, usually an acid.

The use of a separating funnel was sometimes given as a method of separation with fractional distillation also being suggested.

(ii) Lead carbonate is an insoluble salt.

Describe how a pure, dry sample of solid lead carbonate can be obtained from sodium carbonate solution and lead nitrate solution.

(3)

Sodium carbonate solution and lead nitrate solution are mixed together. Then, the insoluble salt formed is filtered to take out ~~remove~~ the lead carbonate. The lead carbonate is the washed with distilled water (to make sure that no other ions are involved) and then it's dried.

(Total for Question = 10 marks)

Results Plus: Examiner Comments

A response worth all three marks.

Q39.

(b)

A significant number of candidates were unable to use the information about solubility to work out the correct state symbols for copper carbonate and sodium nitrate. It was not unusual to see (g) given as a state symbol.

(c)

Many candidates were able to work out the correct formula for copper carbonate. Some candidates wrote the formula as $Cu^{2+} + CO_3^{2-}$ and they did not score a mark as this just shows the symbols of the two separate ions.

(1)

$Cu^{2+} + CO_3^{2-}$

Results Plus: Examiner Comments

This candidate has written the symbols of the ions with a '+' sign in the middle and does not score a mark.

Results Plus: Examiner Tip

Practise working out formulae of compounds from the symbols of their ions.

Cu CO_3 Cu CO_3

Results Plus: Examiner Comments

This is an example of a correct answer, scoring 1 mark.

(d)

It was disappointing to see that many candidates were not familiar with this practical procedure.

Some candidates started by describing how to make the mixture but this was not necessary. Some candidates started by heating to evaporate the water and did not realise that the other salt would be left with the lead iodide. Some realised that filtering is necessary to separate a solid from a solution, but a significant number described the use of a separating funnel instead of a funnel and filter paper. Many also just mentioned using filter paper without a funnel or used a funnel without filter paper. It was often unclear about where the lead iodide was after filtering. Very few candidates described washing the solid in the filter paper to purify it. Many candidates did not describe a method of drying the solid.

If you was to use heat up the mixture and then pour it down a seperating funnel it would then get rid of the salt and be left with the sample of solid lead iodide.

Results Plus: Examiner Comments

Separating funnels were seen quite frequently in answers to this question. This did not score a mark.

Results Plus: Examiner Tip

Use a separating funnel to separate a mixture of immiscible liquids.

Use a funnel and filter paper to separate a solid from a solution.

A pure dry sample can be obtained by filtering the lead iodide, using filter paper and a funnel, then using distilled water to wash it and remove any impurities then leave the substance to dry.

Results Plus: Examiner Comments

This is an example of a good answer and it scored 3 marks.

(e)(i)

Some candidates were able to identify potassium ions from the lilac colour of the flame.

Candidates should learn the flame test colours in the specification.

(e)(ii)

It was disappointing to see that only a small minority of candidates were able to identify chloride ions in the salt from the description of the test and the result. A few candidates gave the name of the salt instead of the ion. Many candidates just selected a random element to fill the space, with the majority of answers being metals. Candidates should carry out the tests for ions in the specification and learn the tests and results.

ion in salt X potassium chloride

Results Plus: Examiner Comments

This candidate did not score a mark for potassium chloride as the question asked for the identity of the **ion** in the salt that produced the white solid. Only the chloride ions react with silver nitrate to produce a white solid.

ion in salt **X** Chloride

Results Plus: Examiner Comments

This is an example of a correct answer that scored 1 mark.

Results Plus: Examiner Tip

Learn the tests for the ions in the specification.

Q40.

(b)

A significant number of candidates were unable to use the information about solubility to work out the correct state symbols for copper carbonate and sodium nitrate. It was not unusual to see (g) given as a state symbol.

(c)

Many candidates were able to work out the correct formula for copper carbonate. Some candidates wrote the formula as $Cu^{2+} + CO_3^{2-}$ and they did not score a mark as this just shows the symbols of the two separate ions.

(1)

$Cu^{2+} + CO_3^{2-}$

Results Plus: Examiner Comments

This candidate has written the symbols of the ions with a '+' sign in the middle and does not score a mark.

Results Plus: Examiner Tip

Practise working out formulae of compounds from the symbols of their ions.



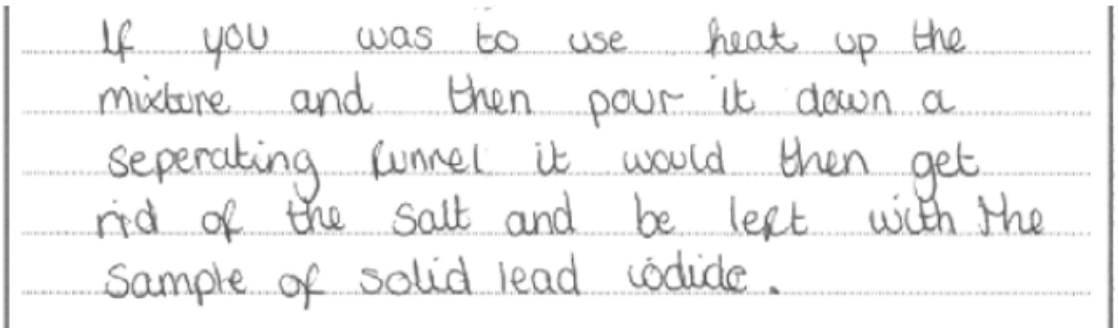
Results Plus: Examiner Comments

This is an example of a correct answer, scoring 1 mark.

(d)

It was disappointing to see that many candidates were not familiar with this practical procedure.

Some candidates started by describing how to make the mixture but this was not necessary. Some candidates started by heating to evaporate the water and did not realise that the other salt would be left with the lead iodide. Some realised that filtering is necessary to separate a solid from a solution, but a significant number described the use of a separating funnel instead of a funnel and filter paper. Many also just mentioned using filter paper without a funnel or used a funnel without filter paper. It was often unclear about where the lead iodide was after filtering. Very few candidates described washing the solid in the filter paper to purify it. Many candidates did not describe a method of drying the solid.


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Results Plus: Examiner Comments

Separating funnels were seen quite frequently in answers to this question. This did not score a mark.

Results Plus: Examiner Tip

Use a separating funnel to separate a mixture of immiscible liquids.

Use a funnel and filter paper to separate a solid from a solution.

A pure dry sample can be obtained by filtering the lead iodide, using filter paper and a funnel, then using distilled water to wash it and remove any impurities then leave the substance to dry.

Results Plus: Examiner Comments

This is an example of a good answer and it scored 3 marks.

(e)(i)

Some candidates were able to identify potassium ions from the lilac colour of the flame.

Candidates should learn the flame test colours in the specification.

(e)(ii)

It was disappointing to see that only a small minority of candidates were able to identify chloride ions in the salt from the description of the test and the result. A few candidates gave the name of the salt instead of the ion. Many candidates just selected a random element to fill the space, with the majority of answers being metals. Candidates should carry out the tests for ions in the specification and learn the tests and results.

ion in salt X potassium chloride

Results Plus: Examiner Comments

This candidate did not score a mark for potassium chloride as the question asked for the identity of the **ion** in the salt that produced the white solid. Only the chloride ions react with silver nitrate to produce a white solid.

ion in salt X Chloride

Results Plus: Examiner Comments

This is an example of a correct answer that scored 1 mark.

Results Plus: Examiner Tip

Learn the tests for the ions in the specification.

Q41. No Examiner's Report available for this question

Q42.

(i)

This question was generally answered well and scoring the mark. Unfortunately, several candidates were giving two or sometimes three HAZCHEM descriptors or contradictions that meant the mark could not be awarded. More worrying were answers of the type 'Sodium hydroxide is an acid....'.

Reactions

6 (a) A technician made some dilute sodium hydroxide solution by carefully adding some solid sodium hydroxide to pure water.

This is the hazard symbol on a bottle of solid sodium hydroxide.



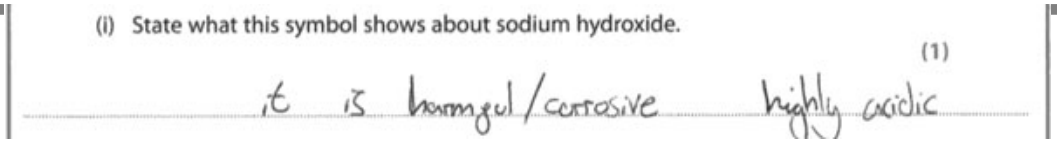
(i) State what this symbol shows about sodium hydroxide.

(1)

toxic - it can burn through anything (~~arreve~~ arroding)

Results Plus: Examiner Comments

Many candidates were mixing the descriptions for the hazard symbols. 0 mark was given for the answer 'toxic'.


(i) State what this symbol shows about sodium hydroxide.

(1)

it is harmful/corrosive highly acidic

Results Plus: Examiner Comments

Several candidates were hedging their bets by giving alternative answers. Candidates should be deterred from this as an incorrect alternative will negate the mark as in this case. 0 mark given.

Results Plus: Examiner Tip

Know the meanings of the hazard symbols.

Avoid giving alternative answers as in this example as an incorrect answer will negate the mark.

Q43. No Examiner's Report available for this question

Q44. No Examiner's Report available for this question

Q45.

(i)

This question was not well answered on the whole with less than half of responses scoring the 1 mark available.

Correct responses referred in similar frequency to either phosphorus, potassium or nitrogen.

Commonly seen incorrect responses frequently referred to other incorrect elements, such as 'oxygen', or gave the names of fertilisers rather than specific elements.

(ii)

This question was not well answered on the whole with less than half of responses scoring the 1 mark available.

Although, there were many fully correct responses, many candidates were unable to write the correct formula of potassium nitrate, or were unable to recognise that water is the other product in this neutralisation reaction.

Examiners noted that many candidates simply repeated the formula of the reactant, KOH, also as the product.

(ii) Potassium nitrate is present in some fertilisers.

Potassium nitrate is formed by the reaction of potassium hydroxide solution with nitric acid.

Complete the balanced equation for this reaction.

(2)

$KOH + HNO_3 \rightarrow$ 3KNO3 + water

Results Plus: Examiner Comments

This response scored 1 mark only.

The correct formula of one of the products, KNO3, has been given. However, although water has been identified as a product, its formula has not been given. Also, there is an incorrect attempt at balancing, so even though the formula of water been correctly stated, the response would have been limited to 1 mark.

(ii) Potassium nitrate is present in some fertilisers.

Potassium nitrate is formed by the reaction of potassium hydroxide solution with nitric acid.

Complete the balanced equation for this reaction.

(2)

$KOH + HNO_3 \rightarrow$ KNO_3 + H_2O

Results Plus: Examiner Comments

An example of a fully correct response. Both the formulae of the correct products, KNO_3, and H_2O, have been given.

Q46. No Examiner's Report available for this question

Q47.

(ii)

Many could give the formula for the molecule of ammonia, where learners did not score, it was often because they had not used the correct scientific conventions.

(ii) Give the formula for the molecule of ammonia.

(1)

Nh 3

Results Plus: Examiner Comments

In some cases, candidates lost marks as they did not write the formula using the correct conventions and used lower case rather than upper case letters in their formula or used a superscript number rather than subscript.

Results Plus: Examiner Comments

Candidates should be taught to write formula using the correct scientific conventions.

(ii) Give the formula for the molecule of ammonia.

(1)

N^3H

Results Plus: Examiner Comments

Candidates should be taught that numbers in formula should be subscript not superscript. This response did not score the mark.

(ii) Give the formula for the molecule of ammonia.

(1)

NH_3

Results Plus: Examiner Comments

Thsi response gained the mark.

(ii) Give the formula for the molecule of ammonia.

(1)

NH_3^+

Results Plus: Examiner Comments

In some cases, candidates added a charge to the ammonia, this did not score.

Q48. No Examiner's Report available for this question

Q49.

(i)

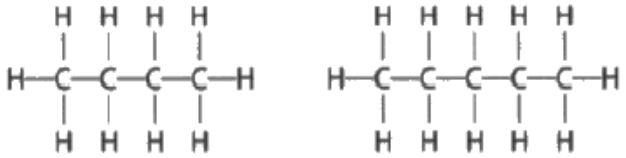
This question was poorly answered with only a third of responses scoring, generally just 1 mark of the 2 marks available.

In many responses, it was evident to examiners that candidates were unclear of what is meant by the term 'homologous series'. Candidates simply repeated information from the stem of the question, especially quoting the molecular formulae of the two alkanes, or simply stating the respective numbers of carbon and hydrogen atoms.

Most responses gaining 1 mark only scored by mentioning stating that pentane has one more carbon or that they differed by one carbon and two hydrogens.

Although the correct general formula was often seen, the term general formula was often confused with the term molecular formula. Many candidates simply gave a definition of a hydrocarbon.

Figure 14 shows the formulae of a molecule of butane and of a molecule of pentane.
Butane and pentane are neighbouring members of the same homologous series.



butane

pentane

Figure 14

(i) Explain, using these formulae, why butane and pentane are neighbouring members of the same homologous series.

(2)

They are both alkanes and they are hydrocarbons because they include only hydrogen and carbon.

Results Plus: Examiner Comments

This response scored 1 mark only.

The correct reference to both the compounds being alkanes scored the mark. The definition of a hydrocarbon is also given but is not relevant.

(ii)

This question was very poorly answered with the majority of responses not scoring any of the 3 marks available.

Most candidates struggled with what was required in this calculation and where to start. In those responses that scored 1 mark only, this was often for writing 4 x 12 = 48, with no further creditworthy material seen afterwards. Very few responses correctly rounded their answers to 3 significant figures.

(ii) Butane has the formula C_4H_{10}.

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

$4 \times 12 = 48.$

$\frac{48}{58} \times 100 = 82.75862\%$

mass of carbon = 83 g

Results Plus: Examiner Comments

This response scored 2 marks.

The calculation is correctly set out. However unfortunately the final answer has been incorrectly rounded to 2 significant figures, rather than 3 significant figures as required by the question.

(iii)

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

Most candidates were abe to construct a word equation with the correct products on the right hand side, especially having been given those products in the stem of the question.

The most commonly seen errors included: writing 'butane + air' rather than 'butane + oxygen'; mixing and matching words and formulae, giving CO_2 or H_2O as one of the products. In some responses, candidates attempted to give a formula equation, some getting the correct formulae, and occasionally some candidates managed to balance it correctly.

(iii) Butane burns completely in air to form carbon dioxide and water.

Write the word equation for this reaction.

(2)

Butane + air → Carbon dioxide + water

Results Plus: Examiner Comments

This response scored 1 mark only.

The response highlights a commonly seen error. The left hand side of the equation does not score since 'air' as opposed to 'oxygen' has been included.

Results Plus: Examiner Tip

Remember in combustion reactions, 'air' is not a reactant and it is 'oxygen' that should be included. Air is not a compound – it is a mixture of gases.

Butane → Carbon Dioxide + Water

Results Plus: Examiner Comments

This response was awarded 1 mark.

One of the reactants in this combustion reaction, namely oxygen, has been omitted, most probably because it the only one of the species not given in the stem of the question.

Results Plus: Examiner Tip

Remember – oxygen is always included as a reactant in combustion reactions.

Q50. No Examiner's Report available for this question

Q51. No Examiner's Report available for this question

Q52. No Examiner's Report available for this question

Q53.

This question was generally answered well with the large majority of candidates knowing or deducing that water was the product, although some formed OH or H_2O_2. There were perhaps more errors in the formulae for hydrogen and oxygen, with some answers including ions or H and/or O. The large majority of equations with correct formulae were correctly balanced.

In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.

The overall reaction occurring in this fuel cell is a reaction of hydrogen with oxygen.

Write the balanced equation for this reaction.

(2)

$H_2 + O \longrightarrow H_2O$

Results Plus: Examiner Comments

Many candidates forget that gaseous elements, excluding group 0, are diatomic.

In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.

The overall reaction occurring in this fuel cell is a reaction of hydrogen with oxygen.

Write the balanced equation for this reaction.

(2)

$H_2^+ + O^- \rightarrow H_2O$

Results Plus: Examiner Comments

Candidates should learn that charges should only be included in ionic or half equations.

Q54.

Many candidates knew the formulae for oxygen and sulfur dioxide and often scored all of the marks. Those who got this question wrong, indicated that oxygen was O (or even O_3) and not O_2 and sulfur dioxide was commonly mistaken as SO_4. Marks were also lost for not using the formulae provided in the question.

Some nickel ores contain nickel sulfide.

(i) In the first stage of extracting nickel from nickel sulfide, the nickel sulfide, NiS, is heated in air to form nickel oxide, NiO, and sulfur dioxide.

Write the balanced equation for this reaction.

(2)

$2NiS + 5O_2 \rightarrow 2NiO + 2SO_4$

Results Plus: Examiner Comments

SO_4 was a surprisingly common formula used for sulfur dioxide.

Q55. No Examiner's Report available for this question

Q56.

(i)

This question was well answered on the whole with most responses scoring the 2 marks available.

The majority of responses gave both zinc oxide and carbon as the reactants and also zinc and carbon dioxide as the correct products. The stem of the question gave the candidates all the names of the species involved in the reaction.

Commonly seen errors and omissions included: giving only one product and not both, giving a mixture of names and formulae, giving additional products such as 'water' and 'zinc carbonate', or mixing up reactants and products.

In several responses examiners noted that candidates were unsure of the conventions for writing word equations, namely incorrectly writing the word 'and' between the products or reactants rather than the correct '+' sign.

Zinc can be extracted by heating zinc oxide with carbon.

The products are zinc and carbon dioxide.

(i) Write the word equation for this reaction.

(2)

~~zinc oxide + carbon →~~

zinc oxide + carbon dioxide → zinc carbonate

Results Plus: Examiner Comments

A typical example of a response that did not score.

Although zinc oxide is correctly shown on the reactants side of the equation, carbon dioxide has also been incorrectly included. The 'zinc carbonate' has been incorrectly shown as the only product.

Results Plus: Examiner Tip

Writing word equations is a common feature of the chemistry specification. Use the information, that is to say; the names of the reactants and products, in this case all names are given in the stem, to help you write the word equation.

(ii)

This question was poorly answered on the whole with most responses not scoring the 1 mark available.

The use of the term 'reduction' to describe the type of reaction when an oxide loses oxygen was rarely seen in responses.

Typically incorrect responses included references to 'oxidation' or 'de-oxidisation'.

Q57. No Examiner's Report available for this question

Q58. No Examiner's Report available for this question

Q59.

This question was not well answered with just over half of the responses scoring, mainly 1 mark out of the 3 marks available.

Of those candidates who attempted this equation, the most commonly scoring attempts showed HCl (or ClH) as the product. It was evident from the majority of responses that very few candidates knew that both chlorine and hydrogen were diatomic, with most responses showing both reactants as monatomic. Generally, in a very few responses seen, if the formulae of both the reactants and products were correct, the balancing was also correct.

Chlorine reacts with hydrogen to form hydrogen chloride.

Write the balanced equation for this reaction.

(3)

$Cl_2 + H_2 \rightarrow 2HCl$

Results Plus: Examiner Comments

A good example of a fully correct response.

The formulae of all the correct species have been given and are all correctly balanced.

$2Cl + H_2 \rightarrow 2HCl$

Results Plus: Examiner Comments

This response scored 1 mark only.

The formula for the product, namely HCl, is correct. However, the formula for chlorine is incorrectly shown, i.e. the candidate has not recognised that chlorine exists as a diatomic

molecule.

Q60.

Although most candidates could write the formula of hydrochloric acid correctly on the right hand side of the equation, a large number were not able to write the correct formula of one or both of the diatomic molecules on the left hand side, therefore losing the second and the third marking point. On this question candidates were not penalised for letters in the formulae that had been written too small.

Chlorine reacts with hydrogen to form hydrogen chloride.

Write the balanced equation for this reaction.

(3)

$2Cl_2 + H_2 \longrightarrow 2HCl_2$

Results Plus: Examiner Comments

Another common error was to write the formula of hydrochloric acid as HCl_2, since the formula on the right hand side was incorrect the balancing mark could not be awarded.

Write the balanced equation for this reaction.

(3)

$Cl_2 + H_2 \rightarrow 2HCl$

Results Plus: Examiner Comments

Those that were able to write the correct formula on both sides of the equation were often then able to balance these formulae to gain the third mark so few scored a mark of 2.

Write the balanced equation for this reaction.

(3)

$2H^+ + Cl_2^- \rightarrow 2HCl$

Results Plus: Examiner Comments

A noticeable number of candidates wrote hydrogen and chlorine as ions. This was not allowed, however if the formula were otherwise correct the balancing mark could have still be awarded. In this example, just 1 mark was scored.

Q61.

Candidates performed well in this question with many gaining full marks for the correct balanced equation for the complete combustion of ethene in oxygen.

A sample of ethene is burned completely in oxygen.

Write the balanced equation for this reaction.

(3)

$C_2H_4 + O_2 \rightarrow CH_3COOH$

Results Plus: Examiner Comments

Where candidates lost marks, it was often as they gave the formula of oxygen as O rather than O2. Others lost marks as they were not aware that the products of the complete combustion were carbon dioxide and water with a common misconception being that ethanoic acid would be produced.

Write the balanced equation for this reaction.

(3)

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

Results Plus: Examiner Comments

Those that knew all the formula of the reactants and products were often able to balance these correctly to gain the third marking point and gain 3 marks as in this example.

Q62.

Candidates gain lost marks in this balanced equation as they did not seem to be aware that fluorine is a diatomic element and therefore gave the formula as F rather than F_2, therefore losing the first mark. As all formula had to be correct for the balancing mark, the second mark was often then lost too.

Fluorine reacts vigorously with iron to produce iron(III) fluoride, FeF_3.

Write the balanced equation for this reaction.

(2)

3F + Fe → FeF3

Results Plus: Examiner Comments

The most common incorrect answer that scored no marks.

3 F_2 + 2Fe → 2FeF_3

Results Plus: Examiner Comments

A good answer that scored both marks.

Q63.

The problem for some candidates lay in knowing/recalling the formula for ammonia and thus deducing the third product with many suggesting that it was CO_2. Those who correctly identified water as the third product and recalled the formula of ammonia nearly always balanced the equation correctly.

Q64.

Writing ionic equations, along with balanced equations, is a skill that candidates should practice in preparation for a chemistry examination. It was disappointing to see how few could score full marks here. Errors included not having ions present, use of strange chemical formulae (eg AgN), incorrect formulae of ions and two negative ions combining together.

Mark Scheme

Q1.

Question Number	Answer	Acceptable answers	Mark
(a)	**D** aq l		**(1)**

Question Number	Answer	acceptable answers	Mark
(b)	$H^+ + OH^-$ (1) → H_2O (1)	LHS (1) RHS (1) ignore state symbols, even if incorrect. allow inclusion of spectator ions, Na^+ and Cl^-, if shown on both sides for one mark max	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	suitable acid-base indicator eg methyl orange, phenolphthalein	litmus reject universal indicator allow recognisable phonetic spelling	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	correct colour change for suitable indicator in 4(c)(i): methyl orange : yellow → orange/pink/red phenolphthalein : magenta/pink → colourless	 litmus : blue → red ignore clear	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)	rel mass NaOH = 23.0 + 16.0 + 1.00 (1) concentration = $\frac{20.0}{\text{formula mass}}$ x 1 (1)	(= 40.0) (1) 0.5 (mol dm^{-3}) without working (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(e)	moles of NaOH = $\frac{25.0 \times 1.50}{1000}$ (1) (= 0.0375 moles) ratio 1 : 1 / moles NaOH = moles HCl (1) conc of HCl = $\frac{0.0375 \times 1000}{30.0}$ (1) (= 1.25 (mol dm^{-3})) OR 25.0 x 1.50 = 30.0 x conc acid (2) conc of HCl = $\frac{25.0 \times 1.50}{30.0}$ (1) (=1.25 (mol dm^{-3}))	0.0375 (1) – without working shown conc of HCl = 1.25 (mol dm^{-3})(3) without any working shown allow ecf conc = $\frac{30.0 \times 1.50}{25.0}$ = 1.80 (2) (mol dm^{-3}) allow 0.00125 /0.125 / 12.5 max 2	**(3)**

Q2.

Question Number	**Answer**	**Additional guidance**	**Mark**
	flammable	allow inflammable	**(1)** AO 3 2b

Q3.

Question Number	Answer	Acceptable answers	Mark
(a)	B potassium and caesium, copper and iron		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	A description linking (regular arrangement of) positive ions /cations (1) (surrounded by) {delocalised/sea of} electrons (1)	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks overall metal ions reject "negative and positive particles" / positive atoms / protons ignore descriptions of atoms in rows/ layers of particles etc cloud of electrons ignore free	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	An explanation linking M1 electrons (1) M2 move/flow (1) M2 dep on M1	 pass through / travel For M2: ignore free/delocalised (electrons) ignore electricity flows ignore (electrons) vibrate ignore carry/pass the current/charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description including any two from floats (1) moves (around) (1) effervescence / fizzing / bubbles (1) melts/changes to a ball shape (1) becomes smaller /disappears (1)	moves (around) on the surface (2) white smoke formed ignore gas/hydrogen given off dissolves / explodes Ignore: burns/catches fire/ignites/flame/sparks ignore addition of indicators	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ LHS (1) RHS (1) balancing of correct formulae(1)	NaHO ignore brackets around OH Use of lower case h, upper case A, lower case o, or use of superscripts or large numbers inside the formulae loses 1 mark only ignore state symbols	**(3)**

Q4.

Question Number	Answer	Acceptable answers	Mark
(a)	B potassium and caesium, copper and iron		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	A description linking (regular arrangement of) positive ions /cations (1) (surrounded by) {delocalised/sea of} electrons (1)	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks overall metal ions reject "negative and positive particles" / positive atoms / protons ignore descriptions of atoms in rows/ layers of particles etc cloud of electrons ignore free	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	An explanation linking M1 electrons (1) M2 move/flow (1) M2 dep on M1	 pass through / travel For M2: ignore free/delocalised (electrons) ignore electricity flows ignore (electrons) vibrate ignore carry/pass the current/charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	A description including any two from floats (1) moves (around) (1) effervescence / fizzing / bubbles (1) melts/changes to a ball shape (1) becomes smaller /disappears (1)	moves (around) on the surface (2) white smoke formed ignore gas/hydrogen given off dissolves / explodes Ignore: burns/catches fire/ignites/flame/sparks ignore addition of indicators	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ LHS (1) RHS (1) balancing of correct formulae(1)	NaHO ignore brackets around OH Use of lower case h, upper case A, lower case o, or use of superscripts or large numbers inside the formulae loses 1 mark only ignore state symbols	**(3)**

Q5.

	Answer	**Acceptable answers**	**Mark**
	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ • reactant formulae (1) • product formulae (1) • balancing of correct formulae (1)	accept multiples reject incorrect use of cases and non-subscripts	(3)

Q6.

	Answer	**Acceptable answers**	**Mark**
	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ • reactant formulae (1)	accept multiples	(3)

	• product formulae (1) • balancing of correct formulae (1)	reject incorrect use of cases and non-subscripts	

Q7.

Question number	Answer	Mark
	• carbon (1) • hydrogen (1)	(2)

Q8.

	Answer	Acceptable answers	Mark
(a)(i)	A description including 2 points from add yeast (to the glucose solution) (1) anaerobic conditions/in absence of air/attach airlock/insert plug of cotton wool (1) warm / less than 40°C (1)	correctly named enzyme for fermentation eg zymase	**(2)**
(a)(ii)	ethanol (1) carbon dioxide (1)	C_2H_5OH CO_2	**(2)**
(a)(iii)	C – fractional distillation		**(1)**
(a)(iv)	any harmful effect eg alcoholism / liver damage / slows reactions / anti-social behaviour / injuries / become drunk / depression / damage to (suitable named) organs / damage to foetus	danger to others / alcohol poisoning ignore affects reaction times alone	**(1)**
(b)(i)	36 ±1 (°C)		**(1)**
(b)(ii)	increases /OWTTE		**(1)** **grad**
(c)(i)	**C** C_2H_6		**(1)**
(c)(ii)	**C** propene		**(1)**

Q9.

Question Number	Answer	Acceptable answers	Mark
(a)	**C** preservative		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	M1 named indicator (1) M2 correct colour (1) M2 dependent on M1	universal Indicator – yellow/orange/red methyl orange – red phenolphthalein – colourless (red/blue) litmus - red	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c) (i)	oxygen (1)	O_2 reject O	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	hydrogen (1)	H_2 reject H	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(iii)	carbon dioxide (1)	CO_2	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)	ethanoic acid + ethanol → ethyl ethanoate + water (2) left hand side (1) right hand side (1)	allow recognisable misspellings allow reactants and products in either order allow = for → allow correct formulae if formulae are used do not allow incorrect use of the subscripts / upper / lower case	**(2)**

Q10.

Question Number	Answer	Acceptable answers	Mark
(a)	**C** preservative		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	M1 named indicator (1) M2 correct colour (1) M2 dependent on M1	universal Indicator – yellow/orange/red methyl orange – red phenolphthalein – colourless (red/blue) litmus - red	**(2)**

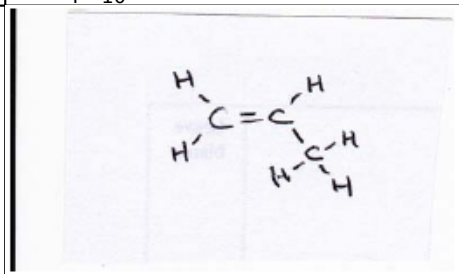
Question Number	Answer	Acceptable answers	Mark
(c) (i)	oxygen (1)	O_2 reject O	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	hydrogen (1)	H_2 reject H	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(iii)	carbon dioxide (1)	CO_2	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)	ethanoic acid + ethanol → ethyl ethanoate + water (2) left hand side (1) right hand side (1)	allow recognisable misspellings allow reactants and products in either order allow = for → allow correct formulae if formulae are used do not allow incorrect use of the subscripts / upper / lower case	**(2)**

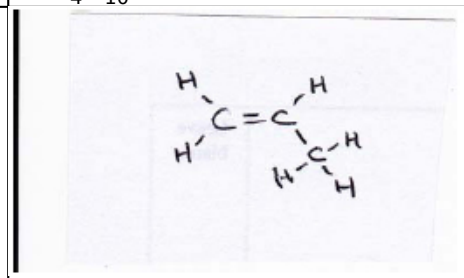
Q11.

	Answer	Acceptable answers	Mark
(a)(i)	D C_4H_{10}		**(1)**
(a)(ii)	 **one** C=C in a molecule with three consecutive carbon atoms (1) rest of structure correct, ignore bond angles, conditional on first marking point(1)	allow $-CH_3$ do not allow two C=C in a molecule allow (1) for completely correct dot and cross diagram	**(2)**

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(b)	C oxidised		**(1)**
(c)(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**
(c)(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$/ $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$(1) H_2O (1)	allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	**(2)**

Q12.

	Answer	Acceptable answers	Mark
(a)(i)	D C_4H_{10}		**(1)**
(a)(ii)	 **one**C=C in a molecule with three consecutive carbon atoms (1) rest of structure correct, ignore bond angles, conditional on first marking point(1)	allow -CH_3 do not allow two C=C in a molecule allow (1) for completely correct dot and cross diagram	**(2)**
(b)	C oxidised		**(1)**
(c)(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**
(c)(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$/	allow displayed formulae/ $C_4H_8O_2$ do	**(2)**

	$CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$(1) H_2O (1)	not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	propanol + oxygen → propanoic acid + water (2) allow $CH_3CH_2CH_2OH + O_2 \rightarrow CH_3CH_2COOH + H_2O$ (2)	allow 1 mark for any three correctly named substances air is not acceptable for oxygen if a mixture of words and symbols, ignore all of the symbols if 5 substances in equation remove 1 mark if 6 or more substances in equation, score 0	**(2)** AO 2 1

Question Number	Answer	Mark
(ii)	**C** -COOH **The only correct answer is C** ***A*** *is not correct because this is the functional group of alcohols* ***B*** *is not correct because this is a methyl group* ***D*** *is not correct because this is not a functional group*	**(1)** AO 1 1

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	propanol + oxygen → propanoic acid + water (2) allow $CH_3CH_2CH_2OH + O_2 \rightarrow CH_3CH_2COOH + H_2O$ (2)	Allow 1 mark for any three correctly named substances Air is not acceptable for oxygen If a mixture of words and symbols, ignore all of the symbols If 5 substances in equation, remove 1 mark If 6 or more substances in equation, score 0	**(2)** AO 2 1

Question Number	Answer	Mark
(ii)	**C** -COOH **The only correct answer is C** ***A*** *is not correct because this is functional group of alcohols* ***B*** *is not correct because this is a methyl group* ***D*** *is not correct because this is not a functional group*	**(1)** AO 1 1

Q15.

Question Number	Answers	Acceptable Answers	Mark
(a)	<table><tr><th></th><th>relative mass</th><th>relative charge</th><th>position in atom</th></tr><tr><td>proton</td><td>1</td><td>(+1)</td><td>in nucleus</td></tr><tr><td>neutron</td><td>(1)</td><td>0</td><td>(in nucleus)</td></tr><tr><td>electron</td><td>1/1837</td><td>-1</td><td>in shells</td></tr></table> all 6 correct (3) 4 or 5 correct (2) 2 or 3 correct (1)	ignore units reject relative mass of proton: +1/1+ for relative mass of electron: anything smaller than 1/1500/0.00067 (almost) 0/negligible/very small for relative charge on neutron: none/no charge/neutral for position of electron in an atom: in orbits / orbitals / energy levels / around the nucleus /outside the nucleus ignore rings ignore inner/outer	**(3)**

Question Number	Answers	Acceptable Answers	Mark
(b)	D equal numbers of protons and electrons		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(i)	Ca	Reject CA / ca /cA ignore calcium	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(ii)	O	ignore any negative charge on the O ignore oxygen reject: oxide/O_2	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(i)	13	Allow correct working even if wrong answer	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(ii)	**D** AlN		**(1)**

Q16.

Question Number	Answers	Acceptable Answers	Mark
(a)	<table><tr><td></td><td>relative mass</td><td>relative charge</td><td>position in atom</td></tr><tr><td>proton</td><td>**1**</td><td>(+1)</td><td>**in nucleus**</td></tr><tr><td>neutron</td><td>(1)</td><td>**0**</td><td>(in nucleus)</td></tr><tr><td>electron</td><td>**1/1837**</td><td>**-1**</td><td>**in shells**</td></tr></table> all 6 correct (3) 4 or 5 correct (2) 2 or 3 correct (1)	ignore units reject relative mass of proton: +1/1+ for relative mass of electron: anything smaller than 1/1500/0.00067 (almost) 0/negligible/very small for relative charge on neutron: none/no charge/neutral for position of electron in an atom: in orbits / orbitals / energy levels / around the nucleus /outside the nucleus ignore rings ignore inner/outer	**(3)**

Question Number	Answers	Acceptable Answers	Mark
(b)	D equal numbers of protons and electrons		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(i)	Ca	Reject CA / ca /cA ignore calcium	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(ii)	O	ignore any negative charge on the O ignore oxygen reject: oxide/O_2	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(i)	13	Allow correct working even if wrong answer	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(ii)	**D** AlN		**(1)**

Q17.

	Answer	**Acceptable answers**	**Mark**
(i)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ reactants (1) products (1)	Accept multiples If not correctly balanced max 1 Must be subscripts where relevant	**(2)**

		Indicative Content	
QWC	***(ii)**	A description including some of the following points **general points** • reactions occur when particles collide • more frequent collisions cause higher rate of r • mass and size of zinc pieces same so no effect reaction • because same surface area • two factors have been altered in the same exp • cannot be certain of effect of each **concentration** • experiment 2 higher/triple concentration of ac • so more particles (in same volume) • so more frequent collisions between particles • more successful collisions **temperature** • experiment 2 higher temperature • particles move faster • particles have more energy • so more frequent collisions between particles rate) • more successful collisions • so more energetic collisions between particles • more particles have enough energy to react (a energy) when they collide	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temperature is higher and concentration is higher so reaction is faster e.g. temperature is higher so particles move faster so reaction is faster • 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. temperature is higher so particles move faster and concentration is higher so more particles so reaction is faster eg when concentration is higher there will be more particles so more frequent collisions so faster reaction e.g. when temperature is higher particles move faster so more successful collisions so faster reaction • 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. higher concentration of acid so more	

		particles so more frequent collisions so faster reaction and higher temperature so particles have more energy so more successful collisions so faster reaction • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q18.

	Answer	**Acceptable answers**	**Mark**
(i)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ reactants (1) products (1)	Accept multiples If not correctly balanced max 1 Must be subscripts where relevant	**(2)**

		Indicative Content	
QWC	***(ii)**	A description including some of the following points **general points** • reactions occur when particles collide • more frequent collisions cause higher rate of r • mass and size of zinc pieces same so no effect reaction • because same surface area • two factors have been altered in the same exp • cannot be certain of effect of each **concentration** • experiment 2 higher/triple concentration of ac • so more particles (in same volume) • so more frequent collisions between particles • more successful collisions **temperature** • experiment 2 higher temperature • particles move faster • particles have more energy • so more frequent collisions between particles rate) • more successful collisions • so more energetic collisions between particles • more particles have enough energy to react (a energy) when they collide	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temperature is higher and concentration is	

		higher so reaction is faster e.g. temperature is higher so particles move faster so reaction is faster • 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. temperature is higher so particles move faster and concentration is higher so more particles so reaction is faster eg when concentration is higher there will be more particles so more frequent collisions so faster reaction e.g. when temperature is higher particles move faster so more successful collisions so faster reaction • 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. higher concentration of acid so more particles so more frequent collisions so faster reaction and higher temperature so particles have more energy so more successful collisions so faster reaction • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q19.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking (aq) (means) aqueous/dissolved in water (1) (l) (means) liquid (1)	 ignore diluted ignore can be dissolved in water/ magnesium chloride is soluble in water do not allow mixed with a solution/a liquid solution	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	effervescence/bubbles/ fizzing OR magnesium/solid/it disappears OR temperature rise	ignore hydrogen/gas released/ formed /given off dissolves / gets smaller ignore reacts ignore heat given out but any incorrect observation scores 0	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	(gas) syringe	(upturned) burette/measuring cylinder/graduated flask (filled with water)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii) Clip (iii) + graph	140	range 136-144	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(iii) Clip (ii) + graph	curve above original(1) levels at same volume (1)	curve must start at origin does not need to finish at same time as original curve no marks for over-writing original curve (after 10 cm^3 volume)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(d)	Explanation linking (rate of reaction/it) increases (1) larger surface area (1)	 speed (of reaction) increases reaction/it is faster/quicker ignore takes less time more frequent collisions more collisions per second ignore just more collisions ignore greater chance of collisions	**(2)**

Question Number	Answer	Acceptable answers	Mark
(e)	An explanation linking: increase in temperature (1) (so) exothermic (reaction) (1)	 temperature went up (by 41°C) it got hot(ter) ignore just 'heat increases' heat (energy) produced/released /given out/lost	**(2)**

Q20.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking (aq) (means) aqueous/dissolved in water (1) (l) (means) liquid (1)	 ignore diluted ignore can be dissolved in water/ magnesium chloride is soluble in water do not allow mixed with a solution/a liquid solution	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	effervescence/bubbles/ fizzing OR magnesium/solid/it disappears OR temperature rise	ignore hydrogen/gas released/ formed /given off dissolves / gets smaller ignore reacts ignore heat given out but any incorrect observation scores 0	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	(gas) syringe	(upturned) burette/measuring cylinder/graduated flask (filled with water)	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii) Clip (iii) + graph	140	range 136-144	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(iii) Clip (ii) + graph	curve above original(1) levels at same volume (1)	curve must start at origin does not need to finish at same time as original curve no marks for over-writing original curve (after 10 cm^3 volume)	**(2)**

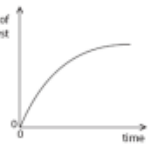
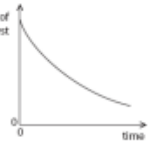
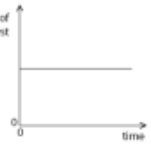
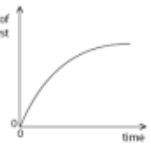
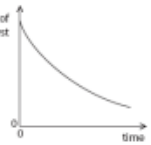
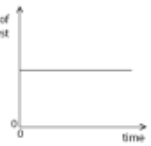
Question Number	Answer	Acceptable answers	Mark
(d)	Explanation linking (rate of reaction/it) increases (1) larger surface area (1)	 speed (of reaction) increases reaction/it is faster/quicker ignore takes less time more frequent collisions more collisions per second ignore just more collisions ignore greater chance of collisions	**(2)**

Question Number	Answer	Acceptable answers	Mark
(e)	An explanation linking: increase in temperature (1) (so) exothermic (reaction) (1)	 temperature went up (by 41ºC) it got hot(ter) ignore just 'heat increases' heat (energy) produced/released /given out/lost	**(2)**

Q21.

Question Number	Answer	Acceptable answers	Mark
(a)	A use hydrochloric acid which is more dilute		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking two of M1 {particles/reactants/collisions} have more energy (1) M2 more frequent collisions (1) M3 more {productive/successful/effective} collisions (1)	 atoms/ions/molecules as alternatives to particles reject electrons particles move faster more collisions per unit time ignore collisions are more likely/greater chance/probability of collisions/faster collisions more particles have required activation energy	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	**C** ☐ A  ☐ B  ☐ C  ☐ D  ☐ A  ☐ B  ☐ C  ☐ D 		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	$2H_2O_2 \rightarrow 2H_2O + O_2$ (2) all formulae correct (1) balancing correct formulae (1)	multiples or halves reject other reactants or products ignore heat on arrow or elsewhere ignore state symbols ignore use of lower case h, lower case o, or use of superscripts or large numbers inside the formulae	**(2)**

Question Number	Answer	Acceptable answers	Mark
(d)	An explanation linking M1 energy needed to break bonds / energy released when bonds formed (1) M2 more heat / energy is released than needed (1) M2 dependent on scoring M1	bond breaking is endothermic / bond making is exothermic if any contradictory statements made in M1, the mark cannot be awarded (and so M2 cannot be awarded either) ignore numbers of bonds eg more bonds formed than broken "more energy is released forming bonds than needed to break bonds" (2)	**(2)**

Q22.

	Answer	Acceptable answers	Mark
	$C_2H_4 + H_2o \rightarrow C_2H_5OH$ C_2H_4 as **reactant** (1) rest of equation correct conditional on C_2H_4 as a reactant (1)	do not allow H2O / H^2O / lower case h/HOH allow C_2H_6O for ethanol ignore state symbols	**(2)**

Q23.

	Answer	Acceptable answers	Mark
	$C_2H_4 + H_2o \rightarrow C_2H_5OH$ C_2H_4 as **reactant** (1)	do not allow H2O / H^2O / lower case h/HOH	

	rest of equation correct conditional on C_2H_4 as a reactant (1)	allow C_2H_6O for ethanol ignore state symbols	**(2)**

Q24.

Question Number	Answer	Mark
(i)	**B** -78 -33 does not conduct **The only correct answer is B** ***A*** *is not correct because simple molecular, covalent substances do not have high mpt and bpt* ***C*** *is not correct because ammonia is a gas at room temperature and does not conduct* ***D*** *is not correct because simple molecular, covalent substances do not have these properties*	**(1)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	$N_2 + 3H_2 \rightarrow 2NH_3$ (2) left hand side formulae (1) balancing of correct formulae (1)	accept multiples allow = or ⇌ in place of → ignore state symbols even if incorrect do not allow N2, n2, etc	**(2)** AO 2 1

Q25.

Question Number	Answer	Additional guidance	Mark
(i)	$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ left hand side (1) right hand side (1) balancing of correct species (1)	allow multiples ignore incorrect state symbols	**(3)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking • {iron(II) hydroxide / iron(II) ions / Fe^{2+}} **oxidised** (by air) (1) • (it goes brown due to formation of) {iron(III) hydroxide / iron(III) ions / Fe^{3+}} (1)	'it' = iron(II) hydroxide 'precipitate' = iron(II) hydroxide Fe^{2+} is oxidised to Fe^{3+} OR Iron(II) is oxidised to iron(III) both score 2 $Fe^{2+} \rightarrow Fe^{3+} + e^-$ scores 1 mark for MP2 ignore rusting	**(2)** AO 3 2a AO 3 2b

Q26.

	Answer	Acceptable answers	Mark
	(CH_3COOH +) NaOH (1) (→ CH_3COONa +) H_2O (1)	NaHO ignore attempts to balance	**(2)**

Q27.

	Answer	Acceptable answers	Mark
	(CH_3COOH +) NaOH (1) (→ CH_3COONa +) H_2O (1)	NaHO ignore attempts to balance	**(2)**

Q28.

	Answer	Acceptable answers	Mark
	D AgCl(s)		(1)
	same/no change		(1)
	$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ • reactant formulae (1) • product formulae (1)	$Ag^+ + Cl^- \rightarrow AgCl$ max 1 if any incorrect attempt to balance reject incorrect use of cases and	(2)

		non-subscripts	

Q29.

	Answer	Acceptable answers	Mark
	D AgCl(s)		(1)
	same/no change		(1)
	$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ • reactant formulae (1) • product formulae (1)	$Ag^+ + Cl^- \rightarrow AgCl$ max 1 if any incorrect attempt to balance reject incorrect use of cases and non-subscripts	(2)

Q30.

	Answer	Acceptable answers	Mark
(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**
(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$/ $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$(1) H_2O (1)	allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	**(2)**

Q31.

	Answer	Acceptable answers	Mark
(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**
(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$/ $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$(1) H_2O (1)	allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	**(2)**

Q32.

	Answer	Acceptable answers	Mark
(a)(i)	corrosive	damages skin / clothes causes burns	**(1)**
(a)(ii)	C neutralisation		**(1)**
(b)	An explanation to include • (substance that) increases rate / speeds up reaction (1) • without being {used up / changed} itself (1)	ignore slows down a reaction lowers activation energy reject provides energy / heat (for 2nd mark)	**(2)**
(c)	A description to include • smaller pieces have larger surface area / ORA (1) • larger surface area, {higher / faster} rate (1) ORA	small**er** pieces give fast**er** rate (1) ORA allow 'bigger surface area produces more carbon dioxide' (or similarly phrased) for one mark	**(2)**

	Indicative Content	

QWC	***(d)**	A description / comparison/ explanation / etc including following points **method – what needs to be carried out** • dilute the acid • (to make) different concentrations / stated cor values • add magnesium to acid • in suitable container • equal volumes of the acids • equal lengths of magnesium **observations – to make** • observe/ count bubbles • highest concentration magnesium reacts, lowe concentration magnesium does not react • observe/ time magnesium disappearing • use of timer • measure volume gas produced • measure decrease in mass **conclusion – evidence gathered or seen** • formed bubbles faster • magnesium disappears faster • gas produced faster • mass lost faster

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. add magnesium to acid and time the reaction • 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. dilute the acid, add magnesium to both acid solutions and more concentrated one bubbles faster or magnesium reacts quicker • 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. add magnesium to different concentrations of acids in beakers: lower concentration longer time therefore slower reaction • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q33.

	Answer	Acceptable answers	Mark
(a)(i)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ reactants (1) products (1)	Accept multiples If not correctly balanced max 1 Must be subscripts where relevant	**(2)**

		Indicative Content
QWC	***(a)(ii)**	A description including some of the following points **general points** • reactions occur when particles collide • more frequent collisions cause higher rate of r • mass and size of zinc pieces same so no effect reaction • because same surface area • two factors have been altered in the same exp • cannot be certain of effect of each **concentration** • experiment 2 higher/triple concentration of ac • so more particles (in same volume) • so more frequent collisions between particles • more successful collisions **temperature** • experiment 2 higher temperature • particles move faster • particles have more energy • so more frequent collisions between particles rate) • more successful collisions • so more energetic collisions between particles • more particles have enough energy to react (a energy) when they collide

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. temperature is higher and concentration is higher so reaction is faster e.g. temperature is higher so particles move faster so reaction is faster • 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. temperature is higher so particles move faster and concentration is higher so more particles so reaction is faster eg when concentration is higher there will be more particles so more frequent collisions so faster reaction e.g. when temperature is higher particles move faster so more

		successful collisions so faster reaction • 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. higher concentration of acid so more particles so more frequent collisions so faster reaction and higher temperature so particles have more energy so more successful collisions so faster reaction • 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**
(b)(i)	B displacement		**(1)**
(b)(ii)	Shown on diagram • horizontal reactant line above product line (1) • horizontal product line to right of reactant line (1)	lines must be correctly labelled eg reactants/Zn + $CuSO_4$ and products/ $CuSO_4$ and Cu ignore any extra lines/curves/labels if not drawn lines but just labels in correct relative positions max 1 If two lines drawn in correct positions but no labels max 1	**(2)**

Q34.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ reactants (1) products (1)	Accept multiples If not correctly balanced max 1 Must be subscripts where relevant	**(2)**

		Indicative Content	
QWC	***(a)(ii)**	A description including some of the following points **general points** • reactions occur when particles collide • more frequent collisions cause higher rate of r	

			• mass and size of zinc pieces same so no effect reaction • because same surface area • two factors have been altered in the same exp • cannot be certain of effect of each **concentration** • experiment 2 higher/triple concentration of ac • so more particles (in same volume) • so more frequent collisions between particles • more successful collisions **temperature** • experiment 2 higher temperature • particles move faster • particles have more energy • so more frequent collisions between particles rate) • more successful collisions • so more energetic collisions between particles • more particles have enough energy to react (a energy) when they collide
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temperature is higher and concentration is higher so reaction is faster e.g. temperature is higher so particles move faster so reaction is faster • 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. temperature is higher so particles move faster and concentration is higher so more particles so reaction is faster eg when concentration is higher there will be more particles so more frequent collisions so faster reaction e.g. when temperature is higher particles move faster so more successful collisions so faster reaction • 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. higher concentration of acid so more particles so more frequent collisions so faster reaction and higher temperature so particles have more energy so more successful collisions so faster reaction • 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
(b)(i)	B displacement		**(1)**
(b)(ii)	Shown on diagram • horizontal reactant line above product line (1) • horizontal product line to right of reactant line (1)	lines must be correctly labelled eg reactants/Zn + $CuSO_4$ and products/ $CuSO_4$ and Cu ignore any extra lines/curves/labels if not drawn lines but just labels in correct relative positions max 1 If two lines drawn in correct positions but no labels max 1	**(2)**

Q35.

Question number	Answer	Additional guidance	Mark
	safety screen / eye protection / gloves	Ignore 'tie long hair back'	**(1)**

Q36.

Question Number	Answer	Additional guidance	Mark
	An explanation linking one of the following pairs of points • wear gloves (1) • {so does not contact/to protect your} skin (1) OR • wear goggles (1) • {so does not contact/to protect} the eyes (1) OR • use in fume cupboard / mask (1) • so you do not inhale it (1)	second mark dependent on first ignore protective/safety clothing	**(2)** AO 3 2a AO 3 2b

Q37.

Question Number	Answers	Acceptable Answers	Mark
(a)	A aluminium nitrate and lead sulfate		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(b)	An explanation linking two of the following strong (forces of / electrostatic) attraction (1) (between) oppositely charged ions (1) requires lot of heat/energy {to separate ions/overcome forces/break bonds} (1)	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks overall strong bonds ignore "between atoms" for this mark ignore strong lattice / giant structure positive and negative ions reject between bonds reject charged atoms for this mark {high / more} {heat / energy} ignore hard to melt/high temperature needed	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(c)(i)	**white** {precipitate /solid}	**white** powder	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(ii)	$BaSO_4$ + 2KCl (2) OR $BaSO_4$ + KCl (1)	SO_4Ba / ClK Ignore incorrect use of case, or use of superscript or large number 4	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(d)(i)	C K^+		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(ii)	A description linking three of the following (sequence has to be correct for full marks) M1 add/mix/react only sodium carbonate (solution) and lead nitrate (solution) (1) M2 filter (off precipitate) (1) **M3 dep on M2** M3 wash/rinse (solid/residue with distilled water) OR dry using {filter paper/paper towel/in a (warm/drying) oven} (1)	 add/mix/react the (two) solutions/them for M1 ignore warm/heat mixture if any indication of heating to evaporate anywhere only M1 can be scored if any other reagent added eg acid can score max 2 for question decant (off the solution) reject if wash with acid or other reagent leave to dry / in the sun / on a radiator / near a window reject heat/hot oven	**(3)**

Q38.

Question Number	Answers	Acceptable Answers	Mark
(a)	A aluminium nitrate and lead sulfate		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(b)	An explanation linking two of the following strong (forces of / electrostatic) attraction (1) (between) oppositely charged <u>ions</u> (1) requires lot of heat/energy {to separate ions/overcome forces/break bonds} (1)	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks overall strong bonds ignore "between atoms" for this mark ignore strong lattice / giant structure positive and negative <u>ions</u> reject between bonds reject charged atoms for this mark {high / more} {heat / energy} ignore hard to melt/high temperature needed	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(c)(i)	**white** {precipitate /solid}	**white** powder	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(ii)	$BaSO_4$ + 2KCl (2) OR $BaSO_4$ + KCl (1)	SO_4Ba / ClK Ignore incorrect use of case, or use of superscript or large number 4	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(d)(i)	C K^+		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(ii)	A description linking three of the following (sequence has to be correct for full marks) M1 add/mix/react only sodium carbonate (solution) and lead nitrate (solution) (1) M2 filter (off precipitate) (1) **M3 dep on M2** M3 wash/rinse (solid/residue with distilled water) OR dry using {filter paper/paper towel/in a (warm/drying) oven} (1)	add/mix/react the (two) solutions/them for M1 ignore warm/heat mixture if any indication of heating to evaporate anywhere only M1 can be scored if any other reagent added eg acid can score max 2 for question decant (off the solution) reject if wash with acid or other reagent leave to dry / in the sun / on a radiator / near a window reject heat/hot oven	**(3)**

Q39.

Question Number	Answer	Acceptable answers	Mark
(a)	C precipitation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	copper carbonate (s) (1) sodium nitrate (aq)(1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	$CuCO_3$ Ignore any 'balancing' number in front of $CuCO_3$ Ignore any working to find the formula	$Cu(CO_3)/Cu^{2+}CO_3^{2-}$ / $(Cu)^{2+}(CO_3)^{2-}$ / $(Cu^{2+})(CO_3^{2-})$ do not allow superscript 3 ie $CuCO^3$ do not allow $Cu(CO)_3$	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)		Maximum **2** marks if another chemical is added to the original mixture Maximum **2** marks if heat or evaporate is used on the original mixture or the filtrate	
	First mark filter/filtration/filtering (1)	description or diagram of filtering ie funnel **and** filter paper do not allow sieving/ sifting/ draining /decanting do not allow separating funnel	
	Second and third marks A description including **two** of the following		
	wash/rinse (with distilled water) (1)	pour water through solid in filter paper / clean solid with water do not allow this mark if washing is done after drying	
	any method of drying (1)	leave to dry do not allow just 'dry'	
	{lead iodide/the solid/the precipitate/the insoluble salt} is {the residue/left on the paper} (1)	do not allow other {solids/salts} left with the lead iodide	**(3)**

Question Number	Answer	Acceptable answers	Mark
(e)(i)	potassium / K^+	K	**(1)**

Question Number	Answer	Acceptable answers	Mark
(e)(ii)	chloride / Cl^-	chlorine (ion) / Cl do not allow Cl_2	**(1)**

(Total for Question = 9 marks)

Q40.

Question Number	Answer	Acceptable answers	Mark
(a)	C precipitation		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	copper carbonate (s) (1) sodium nitrate (aq)(1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	$CuCO_3$ Ignore any 'balancing' number in front of $CuCO_3$ Ignore any working to find the formula	$Cu(CO_3)/Cu^{2+}CO_3^{2-}$ / $(Cu)^{2+}(CO_3)^{2-}$ / $(Cu^{2+})(CO_3^{2-})$ do not allow superscript 3 ie $CuCO^3$ do not allow $Cu(CO)_3$	**(1)**

Question Number	Answer	Acceptable answers	Mark
(d)		Maximum **2** marks if another chemical is added to the original mixture Maximum **2** marks if heat or evaporate is used on the original mixture or the filtrate	
	First mark filter/filtration/filtering (1)	description or diagram of filtering ie funnel **and** filter paper do not allow sieving/ sifting/ draining /decanting do not allow separating funnel	
	Second and third marks A description including **two** of the following		
	wash/rinse (with distilled water) (1)	pour water through solid in filter paper / clean solid with water do not allow this mark if washing is done after drying	
	any method of drying (1)	leave to dry do not allow just 'dry'	
	{lead iodide/the solid/the precipitate/the insoluble salt} is {the residue/left on the paper} (1)	do not allow other {solids/salts} left with the lead iodide	**(3)**

Question Number	Answer	Acceptable answers	Mark
(e)(i)	potassium / K^+	K	**(1)**

Question Number	Answer	Acceptable answers	Mark
(e)(ii)	chloride / Cl^-	chlorine (ion) / Cl do not allow Cl_2	**(1)**

(Total for Question = 9 marks)

Q41.

Question Number	Answer	Mark
	D NaCl | H_2O	**(1)**

Q42.

	Answer	**Acceptable answers**	**Mark**
(i)	corrosive	damages skin / clothes causes burns	**(1)**
(ii)	C neutralisation		**(1)**

Q43.

Question number	**Answer**	**Additional guidance**	**Mark**
(i)	potassium iodide + lead nitrate (1) → lead iodide + potassium nitrate (1) left hand side (1) right hand side (1)	ignore formulae	**(2)**

Question number	**Answer**	**Additional guidance**	**Mark**
(ii)	(mass conserved because) the numbers are the same/nothing is lost/nothing is gained	allow same mass / same weight / same amount	**(1)**

Q44.

Question number	Answer	Additional Guidance	Mark
	use of fume-cupboard / fume hood	allow adequate ventilation gloves (to prevent skin absorption) ignore breathing apparatus, gas mask, mask, PPE	**(1)**

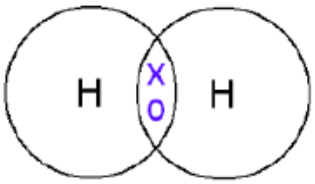
Q45.

Question number	Answer	Additional guidance	Mark
(i)	phosphorus /potassium /nitrogen	accept phonetically correct spellings allow P / K / N	**(1)**
(ii)	$KOH + HNO_3 \rightarrow$ KNO_3 (1) + H_2O (1)	incorrect balancing of correct species 1 mark max allow OH_2 / HOH / NO_3K	**(2)**

Q46.

Question number	Answer	Additional guidance	Mark
(i)	sodium + hydrochloric acid (1) → sodium chloride + hydrogen (1)	allow reactants either way round allow products either way round reject 'sodium chlorine' allow $Na + HCl \rightarrow NaCl + H_2$ (1) $2Na + 2HCl \rightarrow 2NaCl + H_2$ (2)	**(2)**

Question number	Answer	Mark
(ii)	**B** flammable **A** corrosive has a different hazard symbol **C** oxidising has a different hazard symbol **D** toxic has a different hazard symbol	**(1)**

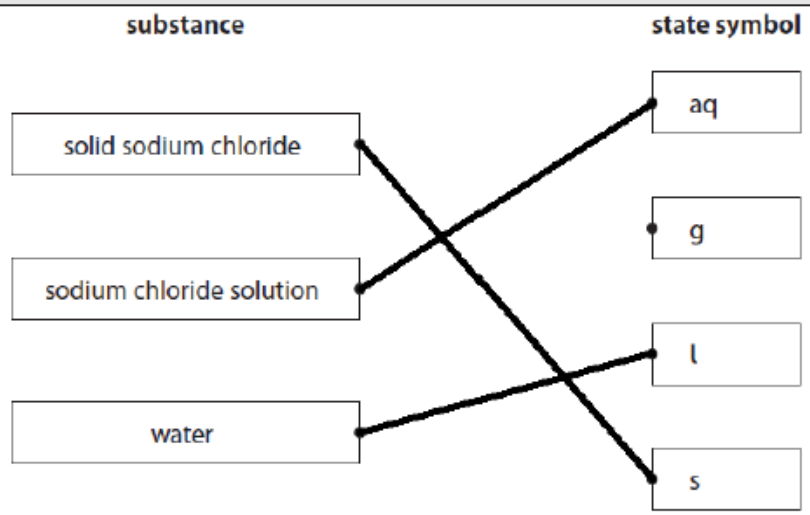
Question number	Answer	Additional guidance	Mark
(iii)		allow dots or crosses or mixture allow other suitable symbols	**(1)**

Q47.

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

Question Number	Answer	Additional guidance	Mark
(ii)	NH_3	do not allow NH^3 / nh_3 / NH3 etc allow H_3N	**(1)** AO 3 2b

Q48.

Question Number	Answer	Mark
	 all 3 correct = 2 any 2 correct = 1 none or one correct = 0	(2)

Q49.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • they differ **by CH_2** / differ by **one** carbon atom / pentane has **one** more carbon (1) • they have the **same** general formula / C_nH_{2n+2} / both alkanes (1)	ignore: similar chemical properties, quoting the two molecular formulae, they are both saturated, both have single bonds (only) reject carbon or hydrogen molecules for MP1 ignore same pattern of formula / **similar** general formula reject same {chemical / molecular} formula	**(2)**
(ii)	82.8 with or without working scores 3 correct answer but incorrectly rounded or not to 3sf scores 2 4 x 12 (1) (= 48) OR $\frac{100}{58}$ (= 1.724...) (1) $\frac{48}{58}$ x 100 (1) (= 82.759) = 82.8 (g) (1)	allow ecf but calculation must use 12, 58, 100 if working rounded to 1dp and carried forward, allow full marks eg 1.72 x 48 = 82.56 (2) or 82.6 (3) allow $\frac{100}{58}$ (1) (= 1.72414) = 1.72 (1) (to 3 sf) OR $\frac{100}{58}$ (1) x 12 (= 20.68966) = 20.7 (1) (to 3 sf) OR 4 x 12 (1) x 100 (= 4800) = 4.80×10^3 (1) (to 3 sf)	**(3)**

Question number	Answer	Additional guidance	Mark
(iii)	butane + oxygen → carbon dioxide + water (2) butane + oxygen → (1) → carbon dioxide + water (1)	allow $C_4H_{10} + 6.5\ O_2 \rightarrow 4CO_2 + 5H_2O$ (2) allow multiples correct formulae no balancing (1) allow hydrogen oxide for water allow reactants and products in either order ignore state symbols allow = for →	(2)

Q50.

Question number	Answer	Mark
	B $CaCO_3$ is the only correct answer **A**, **C** and **D** are incorrect formulae	(1) AO1

Q51.

Question Number	Answer	Mark
	An explanation that combines identification - application of knowledge (2 marks) and reasoning/justification - application of understanding (2 marks) • hydrochloric acid is (almost) fully dissociated into ions (1) • ethanoic acid is only slightly dissociated into ions (1) • but the concentration of acid in the hydrochloric acid is lower (1) • so the concentration of hydrogen ions in the hydrochloric acid is lower (1)	(4)

Q52.

Question Number	Answer	Mark
	hydrogen + chlorine → hydrogen chloride	**(1)**

Q53.

Question number	Answer	Additional guidance	Mark
	$2H_2 + O_2 \rightarrow 2H_2O$ (2) fully correct balanced equation (2) If not (2), then H_2O as product in an equation format, regardless of any other errors (1)	Allow =, ⇌ for → Ignore all words and state symbols Allow multiples reject formulae with charges Do not penalise small letters e.g allow h_2O If H2O or H^2O in otherwise fully correct equation, allow (1)	**(2)**

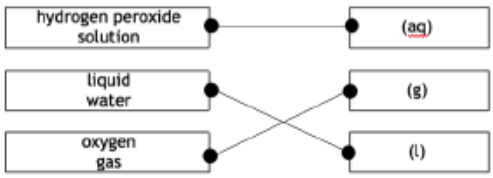
Q54.

Question number	Answer	Additional guidance	Mark
(i)	$2NiS + 3O_2 \rightarrow 2NiO + 2SO_2$ (2) all four formulae (1) balancing correct formulae only (1)	allow = for → allow multiples if wrong subscript or misuse of capital/small letter e.g. O2, O^2, niO, NIS, allow MP1 but cannot score MP2 if more than 4 formulae, can score MP1 but not MP2 ignore state symbols	**(2)**

Question number	Answer	Mark
(ii)	**B** the metal produced by electrolysis is very pure is the only correct answer **A** is incorrect because this is a disadvantage **C** is incorrect because electrolysis is expensive **D** is incorrect because heating with carbon can be used	**(1)**

Q55.

Question number	Answer	Additional guidance	Mark
(i)	hydrogen peroxide → water + oxygen	allow symbol equation if all symbols and balancing are correct	(1) AO2

Question number	Answer	Additional guidance	Mark
(ii)	 (2) all correct (2) 1 correct (1)	reject multiple lines	(2) AO1

Q56.

Question number	Answer	Additional guidance	Mark
(i)	zinc oxide + carbon → zinc + carbon dioxide zinc oxide + carbon → (1) → zinc + carbon dioxide (1)	allow reactants on LHS or products on RHS in either order allow 2 ZnO + C → 2 Zn + CO_2 (2) unbalanced equation (1) ignore state symbols allow = for →	(2)
(ii)	reduction	allow phonetic spellings	(1)

Q57.

Question number	Answer	Mark
(i)	propane + oxygen → carbon dioxide + water • LHS (1) • RHS (1)	(2)

Question number	Answer	Mark
(ii)	to {release/produce} {heat/energy}	(1)

Q58.

Question number	Answer	Mark
(i)	chromium + oxygen → chromium oxide	(1) AO2

Question number	Answer	Mark
(ii)	**D** oxidation is the only correct answer. **A**, **B** are incorrect because these are physical changes. **C** is incorrect because there is no acid-base reaction.	(1) AO1

Question number	Answer	Mark
(iii)	152 with or without working scores 2. (52 x 2) + (16 x 3) (1) = 152 (1)	(2) AO2

Q59.

Question number	Answer	Additional guidance	Mark
	$Cl_2 + H_2 \rightarrow 2HCl$ (3)	do not penalise incorrect small/ capital letters	(3)
	$Cl_2 + H_2 \rightarrow$ (1)	for left hand side formulae, do not allow Cl^2 or Cl2, but allow MP3 if correctly balanced allow reactants in either order	
	→ HCl (1) balancing of correct formulae (1)	allow ClH for HCl allow = for → allow multiples ignore state symbols if molecules have a + or – charge do not allow mark for formulae but allow MP3 for correct balancing	

Q60.

Question number	Answer	Additional guidance	Mark
	$Cl_2 + H_2 \rightarrow 2HCl$ (3) $Cl_2 + H_2 \rightarrow$ (1) $\rightarrow$ HCl (1) balancing of correct formulae (1)	do not penalise incorrect small/ capital letters for left hand side formulae, do not allow Cl^2 or Cl2, but allow MP3 if correctly balanced allow reactants in either order allow ClH for HCl allow = for $\rightarrow$ allow multiples ignore state symbols if molecules have a + or – charge do not allow mark for formulae but allow MP3 for correct balancing	**(3)**

Q61.

Question number	Answer	Additional guidance	Mark
	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ (3) $C_2H_4 + O_2 \rightarrow$ (1) $\rightarrow CO_2 + 2H_2O$ (1) balancing of correct formulae (1)	allow correct multiples allow = for $\rightarrow$ penalise incorrect subscripts once only	**(3)**

Q62.

Question number	Answer	Additional guidance	Mark
	$2Fe + 3F_2 \rightarrow 2FeF_3$ (2) correct formulae only (1) balancing of correct formulae (1)	allow multiples reject Fe(III) on LHS reject incorrect capitals and subscripts reject charges on LHS but ignore charges on RHS. allow = for →	**(2)**

Q63.

Question number	Answer	Mark
	$(NH_4)_2CO_3 + 2RbOH \rightarrow Rb_2CO_3 + 2NH_3 + 2H_2O$ **(3)** Four formulae on correct side of equation (regardless of any other formulae, correct or otherwise) **(1)** Equation with all five formulae and no others **(2)** Fully correct balanced equation **(3)** do not penalise incorrect subscripts/ superscripts/ small letters/ capital letters. Ignore state symbols.	**(3)**

Q64.

Question number	Answer	Additional guidance	Mark
	$Ag^+ + Cl^- \rightarrow AgCl$ (2)	$Ag^+ + Cl^- \rightarrow$ (1) $\rightarrow AgCl$ (1) allow (1) max for equation with no ionic charges	**(2)** **AO2**