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Examiners' Report
June 2018

GCSE Chemistry 1CH0 1H

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Introduction

This examination paper was the first of this series for the 1CH0 1H, Chemistry Higher tier GCSE.This paper, like all the separate science examinations, contains ten questions giving a total of 100 marks. Six of the questions on this paper also appear on the 1SC0 1CH, Combined Science (Chemistry) Higher tier paper.

This paper contains items worth 27 marks that also appear on the Foundation paper. These overlap items are the whole of question 2, question 3 parts (a) – (c) and the whole of question 4.Four of the questions assessed the chemistry topic 5 but did call on a couple of statements from earlier topics. The paper was targeted at grades 9 to 4, with about half the marks for grades 6 to 4.

The paper made use of a variety of question types suitable for candidates at this level; multiple choice, calculations and short answer questions being the frequent types. The paper contained only two extended open response questions (6-mark), but 4-mark questions will feature more prominently in future papers. As with the other Chemistry papers, a minimum of 20% of the marks were for maths, a minimum of 15% for testing practical skills and a maximum of 15% on knowledge in isolation (recall) questions.

Question 1 (b)

Many candidates performed well in this question and understood that the oil acted as barrier or protected the steel. But many only mentioned one factor needed for rusting, either oxygen or water, and so lost out on the second mark. The main misconception was where students mentioned oil minimising friction and then made the link to this causing a decrease in the corrosion with some students thinking lubrication was a sacrificial method of protection.

(b) Figure 1 shows the chain on a bicycle.

Figure 1

Explain how lubricating the chain with oil prevents corrosion of the steel chain.

(2)

It prevents oxygen or water from coming into contact with the steel and reacting with it causing corrosion.

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Examiner Comments

A good answer. The oil acting as a barrier for the first marking point is seen from 'It prevents ..... from coming into contact with ...'. Also, '... oxygen or water ...' showing that both of these are needed for corrosion scored the second marking point.

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Examiner Tip

Focus your answer on the question being asked.

(b) Figure 1 shows the chain on a bicycle.

Figure 1

Explain how lubricating the chain with oil prevents corrosion of the steel chain.

(2)

Oiling and greasing (lubricating) will reduce the amount of friction created. This makes the the bicycle chain not ~~to~~ corrode. The steel is coated with another metal to prevent the corrosion.

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Examiner Comments

The first line of this does not answer the question. Lubricating the chain will reduce friction, but the question is about how lubricating the chain reduces corrosion. This idea of reducing friction was commonly seen and received no credit. There was no mention of air or water in the answer and their involvement in corrosion. So this answer scored 0 marks.

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Examiner Tip

Read the question carefully and answer the question that is stated even underlining key words if it helps you.

Question 1 (c)

Many candidates thought that an alloy has been formed or that iron somehow reacts with zinc. Others ignored the stem of the question and insisted the iron was not exposed, the zinc completely covering the iron. Many candidates recognised that zinc is more reactive than iron, but some said that zinc would rust. Few gave the idea that zinc would corrode easier or in preference to iron. Many just said ‘instead of’. Many seemed to have an idea of sacrificial protection. The word ‘galvanised’ was sometimes seen, but rarely explained.

(c) Iron fences can be galvanised by coating them with a layer of zinc.
When the layer of zinc is scratched exposing the iron to the weather, the iron does not rust.

Explain why the exposed iron does not rust.

(2)

As the rest of the fence is still covered with zinc, the zinc will still rust before the iron as it is more reactive. As it is more reactive it will lose electrons more easily meaning it will prevent the less reactive iron from rusting.

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Examiner Comments

Potentially, this was heading to be a good answer, but was let down by the start of the second line. The candidate stated that the zinc is more reactive (than iron) and so scored the second marking point and that was taken a little further with the zinc's ability to lose electrons more easily. Unfortunately 'zinc will still rust' is incorrect and the first marking point was not given, so overall this answer scored 1 mark.

ResultsPlus
Examiner Tip

'Rust' and 'rusting' are words that are associated with the corrosion of iron and steel only. To that any other metal rusts is incorrect and will not score.

(c) Iron fences can be galvanised by coating them with a layer of zinc.
When the layer of zinc is scratched exposing the iron to the weather, the iron does not rust.

Explain why the exposed iron does not rust.

(2)

Galvansing is an example of sacrificial protection. This is putting a more reactive metal ontop of the iron. The zinc is more reactive ~~bec~~. so it will react instead of the iron.

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Examiner Comments

A good answer and this scored 2 marks. The candidate clearly understands the the reason why the iron is coated by the zinc as seen by the first line which was then explained in the rest of the answer.

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Examiner Tip

Learn all the different ways iron can be prevented from rusting together with an explanation of how that method works.

Question 1 (d)

Most candidates scored a mark for stating that it took a lot of energy to separate the ions/atoms in the metal structure. Fewer than half gave a correct comment about the structure of metals with several candidates losing marks for the use of 'covalent' or 'intermolecular forces'. Some also described the structure and bonding arrangement as for an ionic solid.

(d) Metals have high melting points.

Explain, in terms of their structure and bonding, why metals have high melting points.

(2)

They are bonded with ~~het~~ metallic bonding which are held together by strong electrostatic bonds and have a lattice structure which needs a lot of energy to brake these strong bonds.

(Total for Question 1 = 7 marks)

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Examiner Comments

A good answer where idea of strong electrostatic bonds in a lattice structure scored the 2nd marking point and the idea of lots of energy needed to break the strong bonds for the 3rd marking point.

2 marks overall

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Examiner Tip

Ensure that the type of bond is matches the question. Here metallic bonding is correct but covalent or ionic bonding would be incorrect and would lose the mark.

(d) Metals have high melting points.

Explain, in terms of their structure and bonding, why metals have high melting points.

(2)

Metals have high melting points due to their strong intermolecular forces of attraction. This is caused by the metal's delocalised electrons.

(Total for Question 1 = 7 marks)

ResultsPlus
Examiner Comments

Intermolecular forces is incorrect and was rejected. The second sentence did not go far enough to score a mark. This answer scored 0 marks

ResultsPlus
Examiner Tip

Intermolecular forces are between molecules. There are no molecules in metals or giant ionic solids, so it is not correct to use that term when describing the structure of metals or giant ionic solids.

Question 2 (a) (i)

Although the overwhelming majority of candidates scored marks for a correctly described test for hydrogen, a small number wrote about using a lighted splint and hydrogen extinguishing the flame. A significant minority of candidates lost both marks for using a 'glowing' splint or describing the test for carbon dioxide. Many candidates described how to produce the hydrogen but that wasted candidates' time and answer space.

2 (a) Salts of metals can be prepared by reacting the metal with an acid to produce the salt and hydrogen.

(i) Describe the test to show the gas is hydrogen.

(2)

Squeaky pop test. You place the gas being tested into a test tube and place a glowing splint in to it. If a squeaky pop is heard, hydrogen is present.

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Examiner Comments

Use of a glowing splint in the test was seen on many occassions. This is not the test for hydrogen and so did not score. The second marking point was dependent on the first being correct, so here 'a squeaky pop is heard' did not score. The response scored 0 marks.

ResultsPlus
Examiner Tip

Wrting 'Squeaky pop test' does not gain any credit. When describing the test for a gas marks are given for:

(a) how to carry out the test

(b) the positive result of the test

2 (a) Salts of metals can be prepared by reacting the metal with an acid to produce the salt and hydrogen.

(i) Describe the test to show the gas is hydrogen.

(2)

the test for hydrogen is the squeaky pop test where a splint ~~which a has been in contact with hydrogen~~ is put into a test tube if hydrogen gas is present a pop noise will occur.

ResultsPlus
Examiner Comments

Unfortunately there was no mention of the splint being lit so the first mark could not be awarded. Second mark was dependent on the first so no second mark either.

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Examiner Tip

Learn the tests for all the following gases : hydrogen, oxygen, chlorine, carbon dioxide and ammonia

Question 2 (a) (ii)

This was another well-answered question with the greater majority of candidates scoring both marks, with only a few candidates failing to mention that there were two electrons lost. Just a few mentioned electrons gained or in some cases electrons being shared.

(ii) Nickel is a metal.

Explain how the structure of a nickel atom, Ni, changes when it forms a nickel ion, Ni^{2+}.

(2)

It gains 2 positive electrons on the outer shell making it 2,8,8,4

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Examiner Comments

'Gains' and 'positive' electrons caused the loss of both marks in this answer.

ResultsPlus
Examiner Tip

Formation of positive ions involves loss of electrons and electrons have a negative charge.

hover above test tube with gas, it pops, hydrogen is present.

(ii) Nickel is a metal.

Explain how the structure of a nickel atom, Ni, changes when it forms a nickel ion, Ni^{2+}.

(2)

The Nickel atom gains electrons of the outer shell. Therefore it becomes Ni^{2+} due to added electrons.

ResultsPlus
Examiner Comments

No marks here as electrons are not gained, and no number of electrons is stated.

Question 2 (b)

This question was generally well answered with most students able to carry out the calculation successfully. Common errors included forgetting to convert between cm^3 and dm^3 or in some cases multiplying 23.5 x 250 rather than dividing 23.5/250. Where the conversion from cm^3 to dm^3 was missing, one mark was lost.

(b) A nickel sulfate solution is made by dissolving 23.5 g of nickel sulfate to make 250 cm^3 of solution.

Calculate the concentration of the solution in $g\,dm^{-3}$.

(2)

concentration ($g dm^{-3}$) = $\frac{\text{mass (g)}}{\text{volume } (cm^3)}$

concentration = $\frac{23.5}{250}$ = 0.094 $g dm^{-3}$

concentration = 0.094 $g\,dm^{-3}$

ResultsPlus
Examiner Comments

The first step of dividing the mass by the volume was correct and scored 1 mark. However, the candidate forgot to multiply by 1000 to change the units from g cm^{-3} to g dm^{-3}. So 1 mark was given for 0.094.

(b) A nickel sulfate solution is made by dissolving 23.5 g of nickel sulfate to make 250 cm^3 of solution.

Calculate the concentration of the solution in g dm^{-3}.

(2)

23.5 ÷ 250 = 0.094

0.094 × 240 = 22.56

concentration = 22.56 g dm^{-3}

ResultsPlus
Examiner Comments

The first step of the calculation was correct to give the value of 0.094, but the second step was difficult to understand what it represents. This scored 1 mark.

(b) A nickel sulfate solution is made by dissolving 23.5 g of nickel sulfate to make 250 cm^3 of solution.

Calculate the concentration of the solution in g dm^{-3}.

(2)

250 cm × 10^{-3} = 0.25 dm^{-3} (0.25).

23.5 × 0.25 = 5.875

23.5 ÷ 0.25 = 94

concentration = 94 g dm^{-3}

ResultsPlus
Examiner Comments

The candidate seems unsure as to whether to multiply or divide by 0.25 as both were shown. However the candidate fortuitously decided on the correct route and the answer scored 2 marks.

ResultsPlus
Examiner Tip

Practice calculations of this type.

Question 2 (c)

This was generally well-answered, but the lack of filtration as the first step restricted many candidates to two marks. Most went on to heat the solution, but often there was detail missing as to how dry crystals would be obtained.Some thought that after filtration, the nickel sulfate would be found on the filter and so described how that should be dried. The weaker students tended to describe the addition of the nickel carbonate to the sulfuric acid before a mention of crystallisation. A few answers included fractional distillation as the first step.

(c) Excess solid nickel carbonate is added to dilute sulfuric acid in a beaker.

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

Nickel sulfate is formed in solution.

Describe how a sample of pure, dry nickel sulfate crystals can be obtained from the mixture of nickel sulfate solution and excess solid nickel carbonate in the beaker.

(3)

* Next ~~Firstly~~ you would ~~filter the solution~~ heat the solution using a bunsen burner to allow any water to evaporate from the solution.

*Firstly, you would filter away the excess solid nickel carbonate.

Leave the rest of the solution in a drying cupboard.

(Total for Question 2 = 9 marks)

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Examiner Comments

By carefully wording the answer the candidate did score the 1st mark for 'Firstly you would filter ....'. 'Next you would heat the solution ...' scored the 2nd mark. The final line scored the 3rd mark for leaving it in a warm place - the drying cupboard.

3 marks overall

(c) Excess solid nickel carbonate is added to dilute sulfuric acid in a beaker.

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

Nickel sulfate is formed in solution.

Describe how a sample of pure, dry nickel sulfate crystals can be obtained from the mixture of nickel sulfate solution and excess solid nickel carbonate in the beaker.

(3)

First, you put the solution over a heat source (bunsen burner) to evaporate all of the water. Next you would make a cone with filter paper and put it in a beaker. You would then pour the solution into the filter paper, this will seperate the nikel sulfate and the nikel carbonate. you will then dispose of the nikel carbonate and be left with the pure, dry nikel sulfate crystals.

(Total for Question 2 = 9 marks)

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Examiner Comments

The filtering and heating steps are the wrong way around so 1 mark only was scored.

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Examiner Tip

Practice answering questions that involve practical work. Organise your thoughts into a logical order before starting to write your answer.

Question 3 (a) (ii)

Many candidates answered this very well and obtained the correct answer for three marks. The major errors arose from an incorrect calculation of the formula mass of iron oxide answered or missing the ratio of 1 mole of iron oxide containing two moles of iron. Those that divided by two rather than multiplied by two scored two marks. Those that only achieved the formula mass of the iron oxide scored the first mark.

(ii) The formula of the iron oxide is Fe_2O_3. Fe

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

(56×2)+(16×3) Fe = 56

Fe_2O_3 = 160 = Mr

$\frac{56}{160} \times 240 = 84$

mass of iron = 84 tonnes

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Examiner Comments

Calculation of the formula mass of Fe_2O_3 was calculated correctly and scored the 1st marking point. The second step involved the multiplication of the relative atomic mass of iron by 2 and this was missed out. The final step of scaling up to 240 tonnes was consequentially carried out correctly and scored the 3rd mark. So 2 marks for this response.

(ii) The formula of the iron oxide is Fe_2O_3.

Calculate the maximum mass of iron that can be obtained from 240 tonnes of iron oxide, Fe_2O_3.

(relative atomic masses: O = 16, Fe = 56)

(3)

$Fe_2 = 2 \times 56 = 112$

$O_3 = 3 \times 16 = 48$

$\frac{112}{160} \times \frac{240}{1} = 168$ tonnes

mass of iron = 168 tonnes

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Examiner Comments

The formula masses and proportions were corrctly calculated (160 & 112). These were then used correctly to give the final answer of 168. 3 marks given for this correct answer.

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Examiner Tip

Practice calculations of this type and set out your working in a logical way.

Question 3 (b)

Many candidates were content to repeat the information in the question about electrolysis, rather than answer the question. Most said that aluminium was more reactive than carbon and about half made a relevant statement about the carbon not being able to reduce the aluminium oxide.

(b) Aluminium cannot be extracted by heating its oxide with carbon.
Aluminium has to be extracted from its oxide by electrolysis.

Explain why.

(2)

Aluminium is above ~~copper~~ carbon in the reactivity series so it is very reactive and so heating its oxide with carbon would not work.

ResultsPlus
Examiner Comments

The first part of this response refered to the reactivity of aluminium and scored a mark. The second part of the response is very similar to the stem of the question and did not take the explanation any further. 1 mark was scored overall.

(b) Aluminium cannot be extracted by heating its oxide with carbon.
Aluminium has to be extracted from its oxide by electrolysis.

Explain why.

(2)

Aluminium is more reactive than carbon, hence carbon could not displace it in a reaction, therefore electrolysis is used to extract Aluminium from its ore.

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Examiner Comments

The first line contained a comparison of reactivity scored the 1st mark and the second line contained that it cannot be displaced by carbon which was the 2nd mark.

Question 3 (c)

The greater majority gave electrolysis as the answer here.The common errors included thermal decomposition and reacting with carbon or charcoal.

Question 3 (d)

There were many good answers about a topic which is new to this specification. These candidates had a clear understanding of phytoextraction. However, a few candidates suggested that as the plant grows it leaves exposed copper deposits behind in the soil; some thought that the copper ended up coating the leaves of the plants and some thought the metal accumulated inside the plant and could be extracted on cutting them open.

(d) In recent years, researchers have been investigating alternative methods of extracting metals from soils.

Researchers have found that growing certain plants in appropriate areas can result in the phytoextraction of copper.

Describe how growing plants can result in the phytoextraction of copper.

(2)

phyto extraction is a biological methode of extracting metals. Growing plants have the sub-stence to break down and extract the copper.

(Total for Question 3 = 9 marks)

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Examiner Comments

There was no mention of plants absorbing metal ions for the first mark, or that the plants are burned to leave the copper behind for the second. So 0 marks.

(d) In recent years, researchers have been investigating alternative methods of extracting metals from soils.

Researchers have found that growing certain plants in appropriate areas can result in the phytoextraction of copper.

Describe how growing plants can result in the phytoextraction of copper.

(2)

The plants can be grown in soil that contains the copper metal. As the plant grows it will absorb the metal ions but will not use them and the metal accumulates in the leaves. The plant can be harvested and the metal can be removed by burning the plant.

(Total for Question 3 = 9 marks)

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Examiner Comments

This was a very good answer and scored 2 marks. Mention of metal ions being absorbed scored the first marking point, and then the burning of the plant to get copper scored the 2nd.

Question 4 (a) (i)

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

Question 4 (a) (ii)

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

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

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

(1)

The equation is balanced perfectly

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Examiner Comments

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

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

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

(1)

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

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Examiner Comments

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

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

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

(1)

The reactants equal the entire wanted product.

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

Question 4 (b)

Approximately two-thirds of candidates scored at least 2 marks with the rest scoring 4 marks. Several candidates made an error in calculating the sum of the formula masses of either the reactants (2 x 223 + 12) or the products (2 x 212 + 44). Some candidates were trying to calculate the atom economy of something other than lead. Error carried forward was in place, as with other calculations, but here seemed to be applied more often. Unfortunately, many candidates obtained an answer of 90.393% and forgot apply the approximation, as asked, to 2 significant figures.

(b) Lead can be obtained by heating its oxide with carbon.
The balanced equation for the reaction is

$$2PbO + C \rightarrow 2Pb + CO_2$$

Calculate the atom economy for the production of lead in this reaction.
(relative atomic masses: C = 12, O = 16, Pb = 207
relative formula masses: PbO = 223, CO_2 = 44)

Give your answer to two significant figures.

(4)

2Pb = 2 x 207 = 414

2 x PbO = 446 + C = 12 = 458

$\frac{414}{458}$ x 100 = 90.393

90.4

atom economy = 90.4 %

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Examiner Comments

A correct calculation which was awarded 3 marks, but an incorrect approximation to THREE significant figures gave the answer of 90.4% which meant the last mark was lost.

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Examiner Tip

Ensure you know how to approximate numbers to a given number of significant figures or a given number of decimal places.

(b) Lead can be obtained by heating its oxide with carbon.
The balanced equation for the reaction is

$$2PbO + C \rightarrow 2Pb + CO_2$$

Calculate the atom economy for the production of lead in this reaction.
(relative atomic masses: C = 12, O = 16, Pb = 207
relative formula masses: PbO = 223, CO_2 = 44)

Give your answer to two significant figures.

(4)

$\frac{414}{446+12+44} \times 100 = 82.47011$

$= 82$

atom economy = 82 %

ResultsPlus
Examiner Comments

The candidate made an error in calculating the formula masses of the reactants by the addition of the 44. This lost a mark, but with error carried forward, meant that 3 marks could then be awarded.

Question 4 (c) (i)

Most students knew how to calculate the percentage yield of a reaction. However, a few put (theoretical yield)/(actual yield) and obtained a percentage greater than 100. Some students tried to calculate percentage increase rather than percentage yield. Almost all candidates performed well in this question, but some lost the second mark by not converting the fraction to a percentage.

(c) (i) In an experiment to produce lead, 7.67 g of lead are obtained.
The theoretical yield of lead for the experiment is 11.80 g.

Calculate the percentage yield of lead in this experiment.

(2)

$\frac{7.67}{11.80} = 0.65$

percentage yield = 0.65

ResultsPlus
Examiner Comments

The fraction giving 0.65 scored the first mark, but the candidate did not convert to a percentage. This was seen on many occassions by examiners. 1 mark only here.

(c) (i) In an experiment to produce lead, 7.67 g of lead are obtained.
The theoretical yield of lead for the experiment is 11.80 g.

Calculate the percentage yield of lead in this experiment.

(2)

$\frac{7.67}{11.8} \times 100 = 65$ $100 - 65 = 35$

percentage yield = 35 %

ResultsPlus
Examiner Comments

Some candidates produced this as their answer. The first part showing the fraction and converting to a pecentage being correct, but then another calculation was performed to obtain the final answer of 35% for a reason not clear to us. This scored only 1 mark.

Question 4 (c) (ii)

On the whole, this question was generally well answered. The common incorrect answers included gases escaping, and other products being formed. Some had the words reactants and products mixed up, as in 'not all the products reacted'. Losses through practical work had to refer to loss on transfer between containers rather than spillage or other similar. The majority scored at least one mark.

(ii) In most reactions, the percentage yield of any product is less than 100%.

Give **two** reasons why the percentage yield is less than 100%.

(2)

reason 1 Some of the reactants will react with gases in the atmosphere and be lost that way

reason 2 It can be hard to make sure all of the reactant actually reacts, leaving some left over and wasted

(Total for Question 4 = 11 marks)

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Examiner Comments

This scored 2 marks:
Reason 1 scored marking point 2
Reason 2 scored marking point 1

(ii) In most reactions, the percentage yield of any product is less than 100%.

Give **two** reasons why the percentage yield is less than 100%.

(2)

reason 1 Some products are lost

reason 2 The reaction could be reversible.

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

Only 1 mark scored here.

The 1st reason was too vague.

The 2nd reason scored a mark as a reversible reaction would be one were not all the reactants have been used up.

Question 5 (b) (i)

Well answered, with about two-thirds getting full marks for the ideas of water evaporating and then condensing. Most scoring only one mark was for evaporation and forgetting to state what happened after that. Seawater evaporating was not accepted but seawater evaporates and condenses scored 1 mark. Comments about the salt being left behind were ignored.

(i) Explain how the water in sea water separates to produce the pure water in this apparatus.

(2)

The heat causes the pure water to evaporate as it has a lower boiling point than the salts and minerals in the water. The pure water goes through the distillation tube and condenses in the test tube.

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Examiner Comments

This was considered to be a model answer, even though it included detail about the salts in sea water that was not required to achieve full marks.

(i) Explain how the water in sea water separates to produce the pure water in this apparatus.

(2)

- The salt in the sea water has a ~~lower~~ higher boiling point than water.
- the solution is heated to 100°c so that water vapour can rise to the top. thus leaving salt in the conical flask.
- Then is condensed from vapour to liquid (water vapour → water (liquid))

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Examiner Comments

1 mark for condensation on the last line only for the 2nd marking point.

Although water vapour was mentioned, there is nothing about water evaporating or boiling for the first marking point.

Question 5 (b) (ii)

This question was more demanding than the previous question but about half the candidates scored at least one mark.Most of those scoring went along with the idea of using a (Liebig) condenser (often described as a water-cooled condenser) but then forgot to write about the effect of this on the amount of water collected. Correct scientific terminology was weak in some responses 'cooling tubes' and 'condensing tubes' as examples. The main misconceptions seen were where candidates sealed up the experiment with a bung, and where candidates thought that more heat would be a suitable improvement.

(ii) Explain how the apparatus could be improved to increase the amount of pure water collected from the same volume of sea water.

(2)

use a condensing collumn to cool down the water ~~in~~ during disrillation

ResultsPlus
Examiner Comments

The use of the condensing tube scored the first mark. However, the candidate did not then explain why it would increase the amount of pure water collected. 1 mark only here.

(ii) Explain how the apparatus could be improved to increase the amount of pure water collected from the same volume of sea water.

(2)

Add a condensing tube or put a bung / Cover the tube the water is being collected in.

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Examiner Comments

Adding the condensing tube would have scored the first marking point, but the candidate then followed that with another 'improvement'. The use of the bung created a closed system which would not have worked, so 0 marks overall.

ResultsPlus
Examiner Tip

Do not give alternatives in an answer. Markers do not pick the best one. If a wrong answer is given as one of the alternatives, that loses the mark.

Question 5 (c)

About half the candidates scored 2 or more marks, but only a minority scored all 4.

Despite the graph showing the melting point, many thought that, by point B the solid had melted and was now a liquid. This group of candidates then erroneously thought that the line B-C represented the heating of the liquid phase and C-D the gas phase.

Many candidates missed the part of the question which asked for changes in the movement and arrangement of the particles. However, many did achieve 1 mark for the arrangement or movement of particles in the solid state and 1 for the arrangement or movement of particles in the liquid state. Although many realised that the phase was changing from point B to point C, few explained the shape of the graph – ie the horizontal line showing the temperature remained the same as the energy was used to break the intermolecular forces at the melting point.

Explain the shape of the graph in terms of the changes in the movement and arrangement of the particles as the substance is heated.

(4)

- From point A-B, the solid is being heated up and ~~B~~ by point B, the solid reaches the melting point and becomes a liquid. At this point the particles are more free moving as the rigid solid structure has been broken

- From point B-C, there is no change in temperature as ~~energy~~ the energy is being used to break the bonds of the solid.
- From point C-D, the liquid is heating up at a faster rate ~~that~~ than when in solid state because the particles are more free moving meaning more collisions meaning more energy.

(Total for Question 5 = 9 marks)

ResultsPlus
Examiner Comments

From A to B - 0 scored because the candidate thought that the substance had melted by point B, there was nothing about particles in the solid up to its melting point.

From B to C - 1 mark for energy used to break bonds.

From C to D - 1 mark for 'more free moving' paricles.

Explain the shape of the graph in terms of the changes in the movement and arrangement of the particles as the substance is heated.

(4)

At point A, the particles in the substance are receiving more energy as it gets heated so they move around more. At point B, the substance has reached it's melting point and the particles have enough energy to break their bonds. The temperature stops increasing as the supplied energy from the heating is used to break the bonds, not increase the temperature. At point C, the thermal energy being supplied is used to increase the substance's temperature, not break bonds, so the graph goes up again to point D.

(Total for Question 5 = 9 marks)

ResultsPlus
Examiner Comments

1 mark was awarded here for the temperature not increasing between B & C as the supplied energy is used to break bonds.
Nothing to credit for either A-B or C-D.

1 mark only

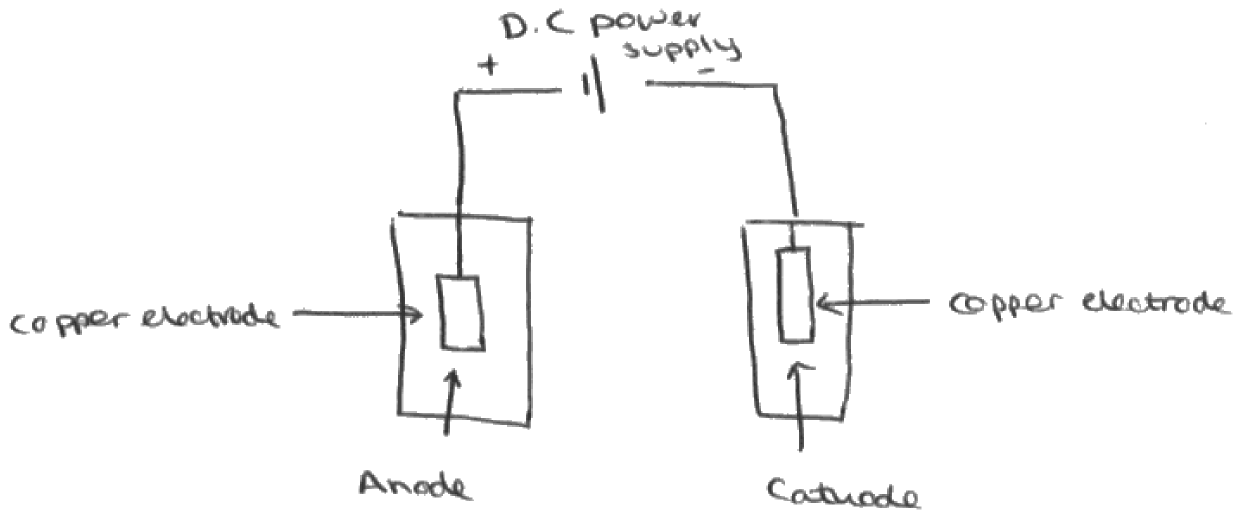
Question 6 (b) (i)

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

(b) Copper sulfate solution was electrolysed using copper electrodes.

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

(2)



ResultsPlus
Examiner Comments

There were 2 errors in this diagram.

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

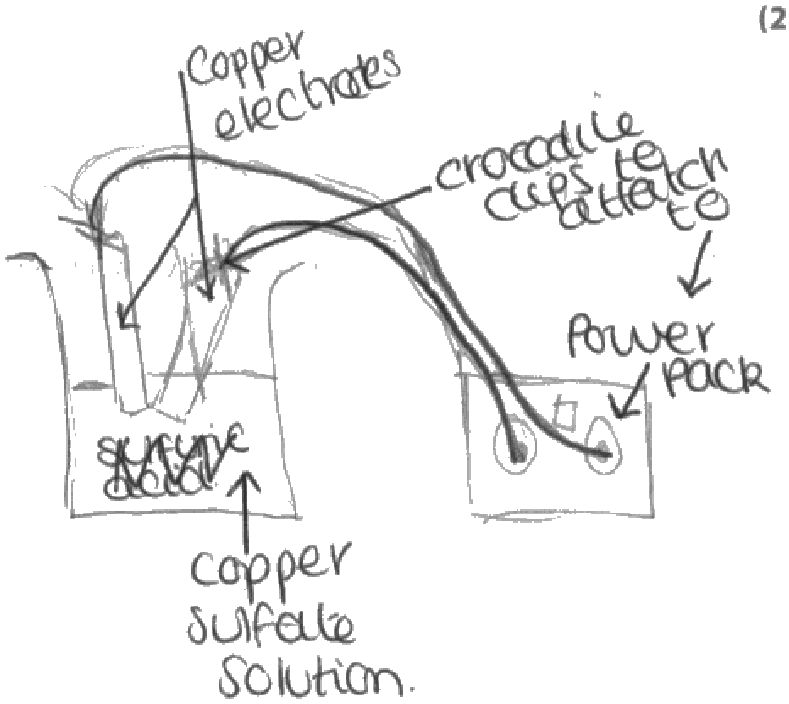
The electrodes were placed in separate containers, which not form a complete circuit. Both electrodes need to be in the same solution for electrolysis to take place

0 marks for this answer.

(b) Copper sulfate solution was electrolysed using copper electrodes.

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

(2)



ResultsPlus
Examiner Comments

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

Question 6 (b) (ii)

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

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

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

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

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

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

Figure 6

Explain these results.

(4)

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

ResultsPlus
Examiner Comments

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

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

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

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

Figure 6

Explain these results.

(4)

As the electrons are copper they are non-inert meaning they will take part in the process. The anode loses mass as copper ions leave it during the reaction as it is positive. Cathode gains copper atoms as it is negative so the mass increases.
Half equations: Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$
Anode: $Cu \rightarrow Cu^{2+} + 2e^-$

ResultsPlus

Examiner Comments

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

ResultsPlus

Examiner Tip

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

Question 6 (c)

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

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

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

(2)

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

(Total for Question 6 = 10 marks)

ResultsPlus

Examiner Comments

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

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

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

(2)

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

(Total for Question 6 = 10 marks)

ResultsPlus
Examiner Comments

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

ResultsPlus
Examiner Tip

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

Question 7 (b)

Many candidates here did not appreciate the ratio of sulfur dioxide : oxygen in the equation and so gave an answer of 750 dm^3 whereas others used the ratio incorrectly and gave an answer of 1500 dm^3.

Question 7 (c)

A difficult calculation but it did differentiate across the ability range. For most, taking the volume of sulfur dioxide and dividing by the molar volume to give the amount of gas was the first step. Some made the error here by diving by the formula mass instead. The other common error was forgetting to convert the units from g to kg.

(c) **Calculate the mass, in kilograms, of 750 dm^3 of sulfur dioxide, measured at room temperature and pressure.**
(relative formula mass: SO_2 = 64;
1 mol of any gas at room temperature and pressure occupies 24 dm^3)

M
C V

(3)

mass = concentration x volume
mass = 24 x 750 = 18000g
= 18kg

mass of sulfur dioxide = 18 **kg**

ResultsPlus
Examiner Comments

The candidate started with the wrong idea of mass = concentration x volume.

The second step of 24 x 750 did not score, but the conversion of g to kg was given a mark. 1 mark overall here.

(c) Calculate the mass, in kilograms, of 750 dm^3 of sulfur dioxide, measured at room temperature and pressure.
(relative formula mass: SO_2 = 64;
1 mol of any gas at room temperature and pressure occupies 24 dm^3)

(3)

mass/Volume x2 mass = Mr. mole

Mass/mol x24 24 = n/V

250x24 18000 = n

mass = mr. mol
= 64 x 18000 = ~~1152Kg~~

mass of sulfur dioxide = ~~18~~ 1152 kg

ResultsPlus
Examiner Comments

The first step to calculate the number of moles was incorrect - so no 1st mark. After that moles (wrong) x 64 scores 2nd mp as error carried forward; then the answer is divided by 1000 converting g to kg to get 1152 for the 3rd mp.

2 marks overall

Question 7 (d)

The performance of candidates, in general, for this question was not as good as that for Q08c as the ideas of equilibrium tend to be harder for some to explain. Even so, the number scoring 0 was still quite small, showing that for the overall majority this question was still quite accessible.

Most candidates treated each change of condition in turn to justify why the set of conditions B would be used. Many were able to explain in good depth the effect on the equilibrium yield and the rate of attainment of equilibrium for each condition considered and these answers resulted in a deserved level 3 mark.

For the weaker candidates, some answers could not be credited because of a lack of explanation of correctly quoted changes of condition. There was confusion between the effect of rate and equilibrium position. Many failed to explain the effect of the catalyst effectively, simply stating that it would not be used up. The weaker candidates tended to focus on the cost of producing a temperature of 425 °C instead of 680 °C.

Explain, by considering the effect of changing the conditions on the rate of attainment of equilibrium and on the equilibrium yield of sulfur trioxide, why the manufacturer chooses the set of conditions B rather than the set of conditions A.

(6)

As a manufactur the person needs to take into account cost when mass producing this chemical. Upholding the temperature in condition A will increase the yield of the sulfur trioxide due to the forward reaction being exothermic. However upholding that temperature is far more costly than the temperature of condition B. A laboratory might use condition A as it doesn't use a catalyst, this is important for accuracy in order to avoid any contamination or by-products. A manufacturer however is more concerned about producing the chemical faster and so will use a catalyst in order to achieve the same yield that it could achieve if they increased the temperature which would be too costly for the manufacturer. B allows the same efficiency as A but at a lower cost.

ResultsPlus
Examiner Comments

Level 1 - 1 mark
This candidate discussed cost and this was not creditworthy.
It was confused about the effect of higher temperature, incorrectly stating that it will give higher equilibrium yield.
It showed that a catalyst would increase the speed of the reaction and this was creditworthy but they did not appreciate that this would be in both directions and so only 1 mark was awarded.
Had the candidate mentioned the catalyst speeded up the reaction in both directions (only), then this would have been worth 2 marks at the upper end of Level 1.

Explain, by considering the effect of changing the conditions on the rate of attainment of equilibrium and on the equilibrium yield of sulfur trioxide, why the manufacturer chooses the set of conditions B rather than the set of conditions A.

(6)

Set of conditions A has a lower pressure than set B therefore there will be a lower yield because ~~an a higher in~~ an higher pressure shifts the equilibrium to the direction of the ~~react~~ side with fewer molecules (in the forwards reaction). The temperature used in conditions A is higher than the temperature in conditions B, therefore to counteract the increase in the temperature, equilibrium will shift in the ~~direction~~ endothermic direction - ~~towards the~~ produces more reactants - decreasing yield but increasing the rate of reaction. To compensate for the lower temperature, set of conditions B includes a catalyst, this means that ~~a decrea~~ the rate of reaction will increase without the need to increase temperature and decrease yield, the catalyst will not affect the yield directly. Due to all of this, set of conditions B was chose rather than conditions A because a higher pressure increases rate of reaction and yield and a lower temperature increases the yield but decreases ~~do~~ rate of reaction, however this is counterbalanced by the use of a catalyst which increases the rate of reaction and therefore indirectly increases yield.

ResultsPlus
Examiner Comments

Level 3 -6 marks
This candidate correctly discussed the effect of pressure, temperature and catalyst on the rate of reaction and the equilibrium yield. Although rate of attainment of equilibrium had not been mentioned, the effect of rate of reaction had been discussed in addition to the effect on (equilibrium) yield for temperature, pressure and catalyst.
Overall this was a good answer and fell into the Level 3 category. Note: Not all indicative points need to be included for a Level 3 mark.

ResultsPlus
Examiner Tip

Practice answering these 6-mark answer - there are plenty in the past papers for the previous specification.

Question 8 (a) (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)

$2N + 3H_2 \rightarrow 2NH_3$

ResultsPlus
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)

$N_2 + H_2 \rightarrow NH_3$

ResultsPlus
Examiner Comments

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

ResultsPlus
Examiner Tip

Practice writing and balancing equations from word equations.

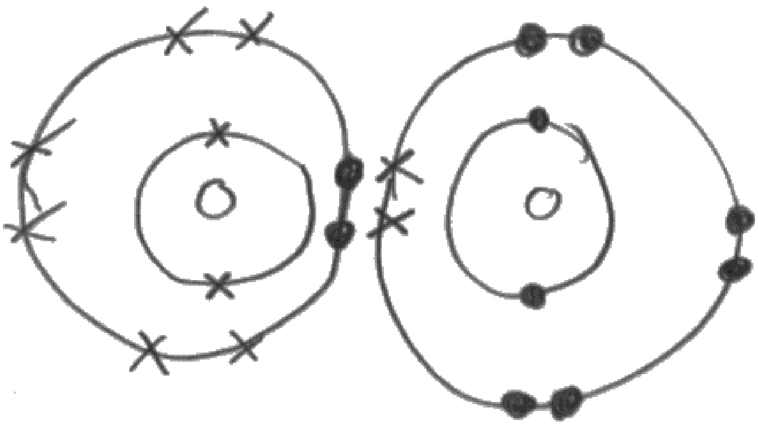
Question 8 (b)

Generally, this was answered well, with about two-thirds of the candidates showing the double bond with slightly fewer scoring the second mark for the rest of the diagram being correct. Here the common mistake was showing an extra 5 electrons rather than 4, on each oxygen atom in the molecule. In future examinations at this level, candidates could be asked to draw the dot and diagrams for a variety of molecules by applying the principles they have met using those in the specification.

(b) Oxygen, O_2, is also a simple molecular, covalent substance.

Draw a dot and cross diagram for the molecule of oxygen.

(2)



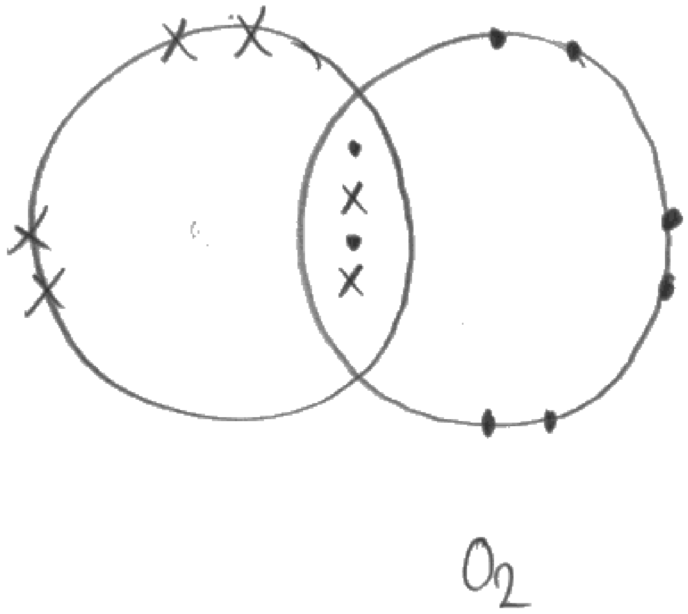
ResultsPlus
Examiner Comments

This scored 0 as there were no shared pairs of electrons to form the double bond.

(b) Oxygen, O_2, is also a simple molecular, covalent substance.

Draw a dot and cross diagram for the molecule of oxygen.

(2)



ResultsPlus
Examiner Comments

The double bond shared between the two atoms scored the first mark, but the second was not awarded owing to the 6 electrons around the right hand atom.

1 mark only

ResultsPlus
Examiner Tip

Have a look at past papers for the previous specification to see the range of dot and cross diagrams that have appeared before.

Question 8 (c)

This open response question proved to be very accessible even for the weakest candidates with only small number scoring 0 as for many this would feel like familiar territory. Level 2 was achieved by the highest number of candidates and over a third of the candidates achieved level 3.

In general, the melting points of the allotropes were explained quite well, but sometimes the conductivity was stated rather than explained.Most managed to justify the melting point of diamond as being extremely high due to the large number of bonds that needed to be broken, but some had flawed arguments when writing weak intermolecular forces. Graphene was frequently read as graphite judging by the number of candidates that wrote about layers sliding etc, suggesting that they had not read the question properly.

The more able candidates could explain conductivity in terms of delocalised electrons in graphene and no delocalised electrons in diamond based on the electrons in carbon involved in bonding. However, for the fullerene, arguments were a little more shaky here as many were not certain about the ability of fullerene to conduct electricity.

It was noticed that the weaker candidates tended to wasted time and space referring to either uses of each allotrope, which were not wanted.

Explain, in terms of their structures and bonding, their relative melting points, strengths and abilities to conduct electricity.

(6)

graphene would ~~be the~~ have the lowest melting point because it only has 3 ~~covalent~~ bonds between ~~each~~ an atom and these bonds are als quite sparse, unlike the fullerene atom. Even though fullerene only has 3 bonds an atom, it's tightly packed structure would mean it needs the second most energy to melt.

Diamonds have 4 bonds per atom meaning it would need the most amount of energy to melt and break those bonds.

graphene would be the only one there that is able to conduct electricity because of it's ~~loosely~~ loose arrangement and 3 ~~atoms~~ bonds per atom

ResultsPlus
Examiner Comments

There were some valid points but these were not really linked to make a coherent argument. However, the answer linked diamond needing the most amount of energy to melt it and break those bonds with it containing 4 bonds per atom, so giving this some lines of reasoning. Also it noted that graphene conducts electricity without a real explanation. This was in between a 'good answer' (Level 3) and a weak answer (Level 1) with just enough to put this into Level 2, but as it was a weak Level 2, so given 3 marks.

Explain, in terms of their structures and bonding, their relative melting points, strengths and abilities to conduct electricity.

(6)

Diamond has a very complex structure, diamond also is very strong, has a very high melting point, also has the ability to conduct electricity

Graphene has a simple covalent bond structure, graphene has a low melting point, graphene is not very strong, graphene is able to conduct electricity

Fullerene, C_{60} has a complex ball structure, fullerene would be very strong because of its structure. Also would have a high melting point, fullerene would not conduct electricity.

ResultsPlus
Examiner Comments

This answer contained a series of random facts, some of which were correct. The incorrect statements need to be ignored when looking at 6-mark questions as here they were not contradictory. These statements were not related with no lines of reasoning. Overall a weak answer and was Level 1 - 2 marks.

Question 9 (a) (i)

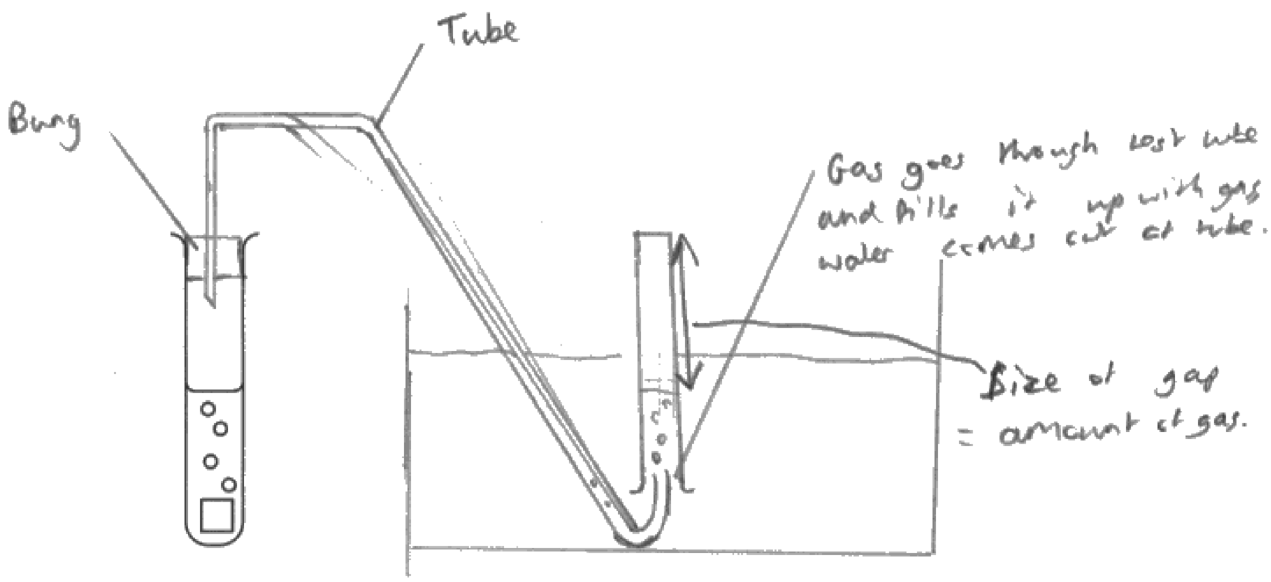
The overwhelming majority managed to put the metals into the correct order of reactivity, with a few scoring 1 mark for having two metals in the correct order and some had the written order in reverse and scored no marks for this.

Question 9 (a) (ii)

The overall response to this was similar to the other diagram drawing question where there were some very poor diagrams seen, but also many well-constructed labelled diagrams showing how the volume of gas could be measured. We were a little generous with the drawing of a gas syringe. Common mistakes were drawing a test tube to collect the gas with no graduations and missing the bung when connecting the delivery tube to the test-tube shown. Some misread the question and measured mass loss.About a quarter of the candidates did not score.

(ii) Complete the diagram below to show how the student could add to the apparatus to measure the volume of gas produced in the two minutes.

(2)

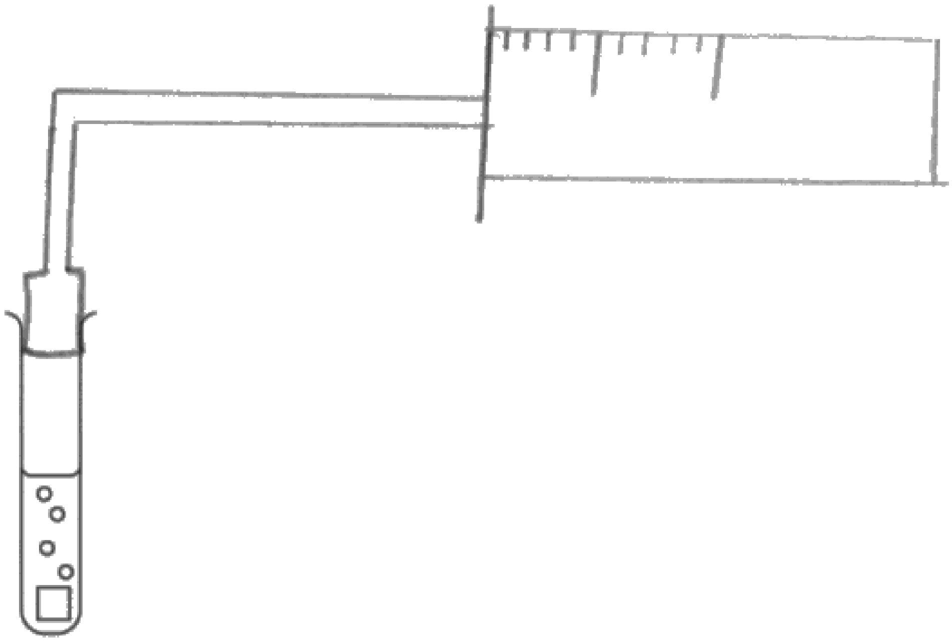


ResultsPlus
Examiner Comments

1 mark was given for the delivery tube connected to the test-tube. However, the inverted collecting tube is not graduated, and despite the annotation, could not be awarded the second mark.
1 mark only

(ii) Complete the diagram below to show how the student could add to the apparatus to measure the volume of gas produced in the two minutes.

(2)



ResultsPlus
Examiner Comments

This was not the best of diagrams, but was awarded 2 marks.
The delivery tube was in place and the other apparatus was close enough to represent a gas syringe, including the graduations.

ResultsPlus
Examiner Tip

The question asked for a labelled diagram. The labels help to inform what the apparatus is, if it's not immediately obvious.

Question 9 (b)

About half the candidates managed to score marks here. A variety of approaches were seen to answer this question correctly and identify that equation A represented the reaction taking place. Some worked out the number of moles of iron and copper and showed that since these amounts were equal, so equation A was the correct one.

Other successful approaches included: starting with 10.00 g iron, they calculated the mass of copper produced using both equations – the mass obtained from equation A matched the mass of copper given in the question. Others had a similar approach but started with 11.34 g of copper and calculated the mass of iron that would be required to produce that mass of copper by each equation.

(b) When iron reacts with copper sulfate solution, solid copper is formed.

Two possible equations for this reaction are

A $CuSO_4 + Fe \rightarrow Cu + FeSO_4$
B $3CuSO_4 + 2Fe \rightarrow 3Cu + Fe_2(SO_4)_3$

It was found that 10.00 g of iron powder reacted with excess copper sulfate solution to produce 11.34 g of copper.

Carry out a calculation to decide which equation, **A** or **B**, represents the reaction taking place.
(relative atomic masses: Fe = 56.0, Cu = 63.5)

moles = $\frac{mass}{Mr}$ **(2)**

A Fe=56 $\frac{10}{56}$ = 0.17857142 moles

A takes place 0.17857142 × 63.5 = 11.34g of copper

$\frac{10}{56 \times 2} = \frac{5}{56}$ $\frac{5}{56} \times (63.5 \times 3) = 17.$ $17 \neq 11.34$

∴ Reaction A takes place

ResultsPlus
Examiner Comments

This method was frequently seen. The candidate has calculated the mass of copper formed in equation A (1st marking point) then linked this to the correct equation (2nd marking point). There was little explanation however the sign for 'therefore' indicated that the candidate used this calculation to making their judgement.

(b) When iron reacts with copper sulfate solution, solid copper is formed.

Two possible equations for this reaction are

A $CuSO_4 + Fe \rightarrow Cu + FeSO_4$
B $3CuSO_4 + 2Fe \rightarrow 3Cu + Fe_2(SO_4)_3$

It was found that 10.00 g of iron powder reacted with excess copper sulfate solution to produce 11.34 g of copper.

Carry out a calculation to decide which equation, **A** or **B**, represents the reaction taking place.
(relative atomic masses: Fe = 56.0, Cu = 63.5)

(2)

190.5
B = – + 112 -> ~~1184~~ ÷112 ×10
÷112 ×10
10 17.0

A = – + 56 -> 63.5 A represents
×10 ÷56 ×10 the reation.
10 11.34

ResultsPlus
Examiner Comments

The candidate has used an alternative method for this calculation.
For equation B 2 mol Fe gives 3 mol Cu ie 112 (g) Fe gives 190.5 (g) Cu. This was then scaled down to 10(.00) g of iron to give 17.0 g Cu. Similar treatment for equation A then gave 11.34 g Cu from 10.00 g Fe. So the candidate has clearly calculated mass of copper formed in both equations (1st marking point), this was then linked to equation A (2nd marking point).

Question 9 (c)

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

(c) Acid solutions contain hydrogen ions. Metal + acid → salt + hydrog

Aluminium reacts with dilute hydrochloric acid to form a solution containing aluminium ions, Al^{3+}. carbonate + acid → salt + water + CO_2

Complete the balanced ionic equation for this reaction.

(2)

3Al + 3 H^+ → M Al^{3+} + H_2

ResultsPlus
Examiner Comments

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

(c) Acid solutions contain hydrogen ions.

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

Complete the balanced ionic equation for this reaction.

(2)

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

ResultsPlus
Examiner Comments

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

ResultsPlus
Examiner Tip

State symbols are not needed unless asked for.

Question 9 (d)

Many candidates recognised that the pH should rise or increase when the concentration decreased but did not say by how much.

Question 9 (e)

This was a difficult question, aimed at challenging the more able and about a quarter of candidates scored full marks here. The weaker candidates tended to leave this alone, but some who attempted it were not familiar with standard form. There were many good attempts but wrong answers usually started with $1 \times 6.02 \times 10^{23}$.

(e) Calculate the mass, in g, of a hydrogen atom, using the data below.
(relative atomic mass: H = 1.00;
Avogadro constant = 6.02×10^{23})

(3)

$\frac{1}{6.02 \times 10^{23}} = 1.7 \times 10^{-24}$

mass of hydrogen atom = 1.7×10^{-24} g

(Total for Question 9 = 12 marks)

ResultsPlus
Examiner Comments

This response scored 3 marks.
Here the correct answer has been correctly rounded to 2 sf. If it had been incorrectly rounded then only marking points 1 & 2 could be awarded.

ResultsPlus
Examiner Tip

Powers of 10 are examinable on Chemistry papers. Make sure you know how to use them.

(e) Calculate the mass, in g, of a hydrogen atom, using the data below.
(relative atomic mass: H = 1.00;
Avogadro constant = 6.02×10^{23})

(3)

$1 \times 2 = 2$

$2 \div 6.02 \times 10^{23} = 3.32 \times 10^{-24}$

mass of hydrogen atom = 3.32×10^{-24} g

(Total for Question 9 = 12 marks)

ResultsPlus
Examiner Comments

The candidate here made the error of thinking that the hydrogen molecule was required and so multiplied the relative atomic mass by 2. This led to answer twice as big as the true answer. So, with one error made, this scored 2 marks.

ResultsPlus
Examiner Tip

If the Avogadro constant is given, you need to use it.

If the Avogadro constant is NOT given, you do NOT need to use it.

Question 10 (a)

The correct colour change for the indicator methyl orange in this situation was correctly given less than half the candidates. A common error was to have the colours but the wrong way round probably resulting from the candidate not reading the question where it said that the acid was in the conical flask to start with. Some gave a colour change for phenolphthalein and the weaker candidates tended to give random colours.

Question 10 (b)

The question was about the details of a titration that would lead to an accurate result being obtained. This was intentionally set as a hard question to test the more able candidates.Marks were given for detail needed (such as use of a white tile) and the explanation (so the indicator colour change can be seen more clearly). Relatively few candidates scored full marks here, however many did offer reasonable details but did not follow the detail with an explanation of how it would lead to a more accurate result, but these did still score marks.

Incorrect ideas included timing the reaction or changing the indicator. Others discussed the idea of fair test or the need to repeat readings. Candidates often confused accuracy for reliability. Concordancy was mentioned frequently.

(b) A brief report of the practical method has been given above.
Further detail can be added to this method to ensure that anyone following the method will obtain an accurate result.

Explain **two** details that could be added to this practical method to ensure an accurate result is obtained.

(4)

1 make sure you swirl the flask to make sure the acid and the alkali are always reacting together. this will ensure that the neutralisation reaction takes place as early as possible.

2 Add the solution of sodium hydroxide to the acid dropwise in order to gain an accurate result each time. this will ensure that you don't put too much alkali into the flask.

ResultsPlus
Examiner Comments

1st detail : Swirling with the implication that it is to ensure that the chemicals react together scored 2 marks.
2nd detail : Adding sodium hydroxide solution dropwise scored 1 mark as the explanation that the addition would be stopped as colour change would then be seen on the addition of 1 drop of alkali was not given. The explanation here was not sufficient for the mark.
So 3 marks overall.

(b) A brief report of the practical method has been given above.
Further detail can be added to this method to ensure that anyone following the method will obtain an accurate result.

Explain **two** details that could be added to this practical method to ensure an accurate result is obtained.

(4)

1 Perform a rough titration before, in order to find rough value ~~an estimate~~ of the first, and ~~repeats~~ repeat the experiment using this value to slow down the amount of ~~acid~~ sodium hydroxide being added, as you approach this ~~number~~ volume.

2 Read the value of the volume of acid used by looking ~~at~~ at the meniscus at eye level.

ResultsPlus
Examiner Comments

For the 1st detail, the performing of a rough titration by itself would not lead to an increase in accuracy of a titration result, so was ignored as the rest of the answer was based on knowing this approximate value, then the addition of the sodium hydroxide solution would then be added slowly in an accurate titration when approaching that value.

The reading of the meniscus of any solution would help to improve the accuracy. However, in both cases, no reason was given so this answer only scored 2 marks - 1 for each detail.

ResultsPlus
Examiner Tip

Revision of all the core practicals will help towards the 15% of marks for testing practical skills and practical work.

Question 10 (c)

About half the candidates had no idea how to calculate the concentration of the sulfuric acid using the information provided. Candidates need to be advised that if relative atomic masses are not given for a particular calculation, then they will not be needed. This was the cause of many candidates going wrong here.

Showing working enabled candidates to score some marks. Several candidates forgot to use the equation to work out the number of moles of acid from the number of moles of alkali, so leading to an answer of 0.194 mol dm^{-3}, so scoring 3 marks. The other misconception frequently seen was the omission of converting from cm^3 to dm^3. It was noticed that there many centres where their candidates knew how to perform this type of calculation with marks of mostly 3 or 4 being awarded.

(c) In the titration, 25.00 cm³ of dilute sulfuric acid reacted with 24.25 cm³ of 0.200 mol dm⁻³ sodium hydroxide solution, NaOH.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the concentration of the dilute sulfuric acid, H_2SO_4, in mol dm⁻³.

(4)

~~0.200~~ / 0.02425   24.25 cm³ = 0.02425 dm³

$H_2SO_4 : 2NaOH$

0.2 × 0.02425   1 : 2

= 4.8 × 10⁻³ mols   x : 4.8 × 10⁻³

1 : 2.4 × 10⁻³ : 4.8 × 10⁻³

2.4 × 10⁻³ mols

2.4 × 10⁻³ / 0.025   25 cm³ = 0.025 dm³

= 0.096 mol dm⁻³

concentration of sulfuric acid = 0.096 mol dm⁻³

ResultsPlus
Examiner Comments

The candidate took the result of step one as 0.0048 and not 0.00485, so lost the first mark.
The calculation was correct otherwise and scored 3 marks.

ResultsPlus
Examiner Tip

Approximating early on in a calculation will result in an error being made and the loss of a mark.

(c) In the titration, 25.00 cm^3 of dilute sulfuric acid reacted with 24.25 cm^3 of 0.200 mol dm^{-3} sodium hydroxide solution, NaOH.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the concentration of the dilute sulfuric acid, H_2SO_4, in mol dm^{-3}.

(4)

~~24·25 ÷ 0·2 = 121·5 ÷ 2 = 60·625~~

~~60·625 ÷ 24·25 = 2·5~~

~~0·2 ÷ 24·25~~

$\frac{0.2}{\frac{25}{1000} \times 0.5} \times \frac{24.25}{1000}$ = 0·388

~~$\frac{0.2}{24.25}$ × $\frac{0.2}{\frac{24.25}{1000} \times 0.5} \times \frac{24.25}{1000}$ = 0·4~~

concentration of sulfuric acid = ~~0·4~~ ~~0·4~~ 0·388 mol dm^{-3}

ResultsPlus
Examiner Comments

The candidate has divided by 0.5 instead of multiplying by 0.5 so the answer is out by a factor of 4.
Only one mistake was made, so with error carried forward, this scored 3 marks.

ResultsPlus
Examiner Tip

As there wil be a minimum of 20% of the marks for testing maths skills on the paper, it is essential that you practice the standard types of calculation.

Question 10 (d)

The was answered well by those who attempted the question. A common error was converting the concentration that had just been calculated (24.5) into other units. In these instances, the second mark was lost. In some instances, candidates looked up the relative atomic masses of hydrogen, sulfur and oxygen and worked out that the formula mass of sulfuric acid was, indeed, 98.

(d) The concentration of some dilute sulfuric acid, H_2SO_4, is 0.250 mol dm^{-3}.

Calculate the concentration of sulfuric acid in this solution in g dm^{-3}.
(relative formula mass: H_2SO_4 = 98)

(2)

[illegible]   g dm3 / mol | mr

0.0250 × 98

= 2.45

concentration of sulfuric acid = 2.45 g dm^{-3}

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

ResultsPlus
Examiner Comments

There's a factor 10 error here probably due misreading the concentration of 0.250 mol dm^{-3} as 0.0250 mol dm^{-3} as used in the calculation. So 1 mark was awarded here.

ResultsPlus
Examiner Tip

If you get time, always check your calculations for any transcription errors - it could stop you losing a mark or two.

(d) The concentration of some dilute sulfuric acid, H_2SO_4, is 0.250 mol dm^{-3}.

Calculate the concentration of sulfuric acid in this solution in g dm^{-3}.
(relative formula mass: $H_2SO_4 = 98$)

(2)

$H_2SO_4 = 98$ $\frac{\text{mass}}{\text{volume dm}^3}$ moles $\frac{\text{moles.}}{\text{dm}^{-3}}$ moles mass = $\frac{\text{mass}}{Ar}$

$0.25 \times 98 = 24.5g$ $\frac{24.5}{6.125} = 4$

$0.25 \times 24.5 = 6.125$

concentration of sulfuric acid = 4 g dm^{-3}

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

ResultsPlus
Examiner Comments

This reponse contains the correct calculation on the left, but two further processing steps were carried out, which were not explained, to give the final answer of 4. These extra steps meant that overall, this scored 0 marks.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Practice a variety of calculations as described in the specification.
- Learn the formulae of gases and simple compounds as used in the specification.
- Practice writing and balancing equations.
- Practice writing and balancing ionic equations.
- Learn the tests for gases.
- Explain the results obtained from practical work
- Practice drawing diagrams of equipment
- Explain in terms of particles the changes of state
- Practice answering extended open-response questions.

To help with the above, there are plenty of examples in examination papers of the previous specification which had a very similar coverage.

Grade Boundaries

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

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

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