PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 1: KEY CONCEPTS IN CHEMISTRY (PACK 3)

SCORE	PERCENTAGE
/165	%

STEMUP

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Q3. No Examiner's Report available for this question

Q4.

Part (i) was very well answered.

Part (ii) was not so well answered, with some candidates giving J and X from period 3.

(iii) Most candidates had the idea that groups 1 and 7 involved gaining/losing one electron, so A, J and unfortunately X were the most common responses.

Q5.

(i)

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

Most candidates could identify which of the featured elements of the periodic table were non-metals. G and X were the most common elements chosen by the candidates, so most candidates knew of the division between metals and non-metals in the periodic table. However, some chose to name non-metals that were outside the elements under consideration in the question; these did not score. Some chose to use the periodic table to 'translate' the lettered elements in the question, so two of either B, O or Ar also scored, but use of the element names was not credited.

(ii)

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

Just over a quarter of the candidates could give the letters of the featured elements that were in period 2 – that is two of A, E and G or 'translated' as Li, B or O. The most common errors were giving the letters J and X which were in period 3, or using the periodic table (provided for candidates at the back of the examination paper) to identify two elements in group 2 – usually Mg and Ca.

The main misconception noted by examiners was a confusion about which is period 2 and confusion between the meaning of the terms period and group when associated with the periodic table.

(iii)

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

Of those who scored the 1 mark, this was for giving the letter of an element that normally forms

an ion with a charge of +1, namely, A or J, or 'translated' as Li or Na. The most commonly given incorrect choices were Z followed by G. Again, several candidates did not follow the instructions and several named incorrect elements such as hydrogen or potassium which were not the elements under consideration in the question.

Q6.

The vast majority of candidates were able to give the electronic configurations of the ions formed when sodium reacts with chlorine.

Sodium reacts with chlorine to form sodium chloride.

The electronic configuration of the sodium atom is 2.8.1 and the electronic configuration of the chlorine atom is 2.8.7.

Give the electronic configurations of the ions formed.

(2)

Na^+ 2.8.0

Cl^- 2.8.8

Results Plus: Examiner Comments

In some cases, candidates gave the electronic configuration of sodium as 2.8.0, this was accepted and a mark awarded.

Q7. No Examiner's Report available for this question

Q8. No Examiner's Report available for this question

Q9. No Examiner's Report available for this question

Q10.

In general, candidates performed well in this question with many scoring the mark for being able to state a correct property of diamond.

Diamond has a giant covalent structure.

State one property of diamond that is the result of its giant covalent structure.

(1)

High boiling point.

Results Plus: Examiner Comments

A correct property that scored the mark.

Diamond has a giant covalent structure.

State one property of diamond that is the result of its giant covalent structure.

(1)

Strong bonds.

Results Plus: Examiner Comments

Where candidates did not score it was found that this was because they did not understand the meaning of the word 'property', linking their answer to the structure/ bonding of diamond rather than giving a property.

Q11.

(a) (i)

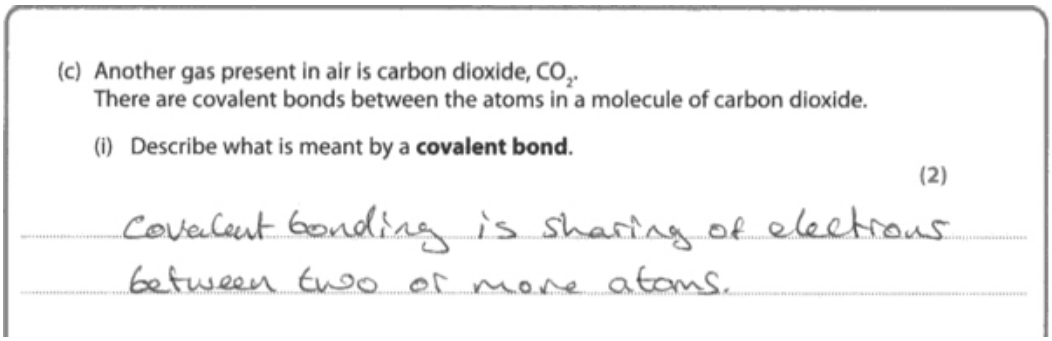
Fractional distillation was correctly given by about two thirds of candidates but some omitted the word fractional.

(a) (ii)

Although many candidates gave a correct answer, quite frequently in terms of removing water or carbon dioxide, there were a surprising number of misconceptions including those who thought cooling was to remove dust particles and others simply stated that cooling the air would make it all the same temperature. Others tried to bring in rates of reaction and talked about a lower temperature stopping the air reacting.

(c) (i)

Many candidates scored 1 mark for stating that covalent bonding involves the sharing of electrons, but they usually failed to gain the second mark for stating that a pair of electrons are shared.



(c) Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a **covalent bond**.

(2)

Covalent bonding is sharing of electrons between two or more atoms.

Results Plus: Examiner Comments

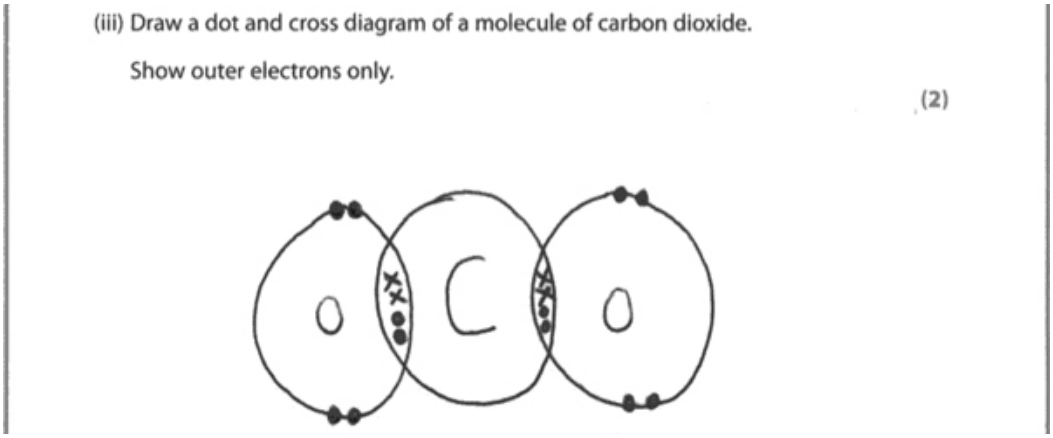
A typical answer worth one mark.

(c) (ii)

The large majority of candidates gave the correct configuration.

(c) (iii)

Most scored a mark for correctly showing a shared pair of electrons in a molecule of carbon dioxide. A common error was to show single bonds between the atoms rather than double bonds and a few candidates who did show double bonds lost marks by putting extra electrons on carbon and/or oxygen. Some candidates lost both marks as they failed to draw a correct CO_2 molecule, CO was often seen and sometimes COC.



(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

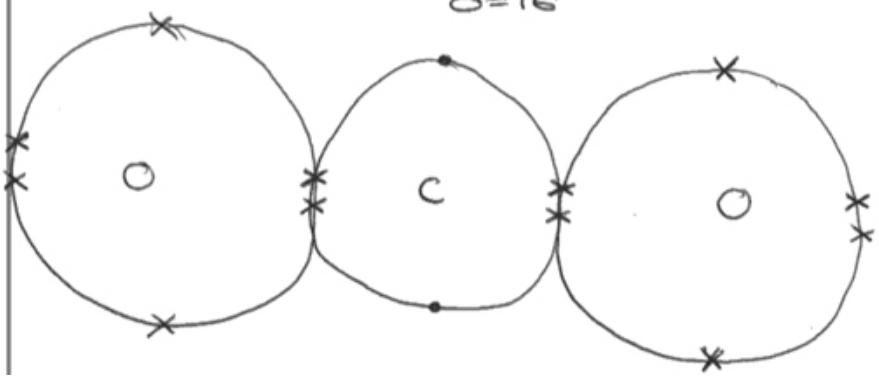
(2)

Results Plus: Examiner Comments

A well drawn answer for two marks.

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only. C=12 O=16 (2)



Results Plus: Examiner Comments

An answer worth 1 mark for showing a shared pair of electrons in a CO_2 molecule.

Q12.

(a) (i)

Fractional distillation was correctly given by about two thirds of candidates but some omitted the word fractional.

(a) (ii)

Although many candidates gave a correct answer, quite frequently in terms of removing water or carbon dioxide, there were a surprising number of misconceptions including those who thought cooling was to remove dust particles and others simply stated that cooling the air would make it all the same temperature. Others tried to bring in rates of reaction and talked about a lower temperature stopping the air reacting.

(c) (i)

Many candidates scored 1 mark for stating that covalent bonding involves the sharing of electrons, but they usually failed to gain the second mark for stating that a pair of electrons are shared.

(c) Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a **covalent bond**. (2)

Covalent bonding is sharing of electrons between two or more atoms.

Results Plus: Examiner Comments

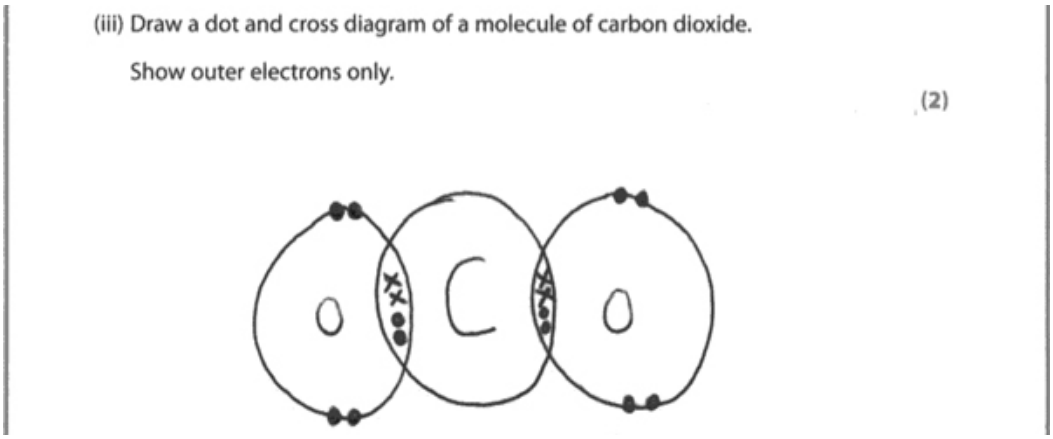
A typical answer worth one mark.

(c) (ii)

The large majority of candidates gave the correct configuration.

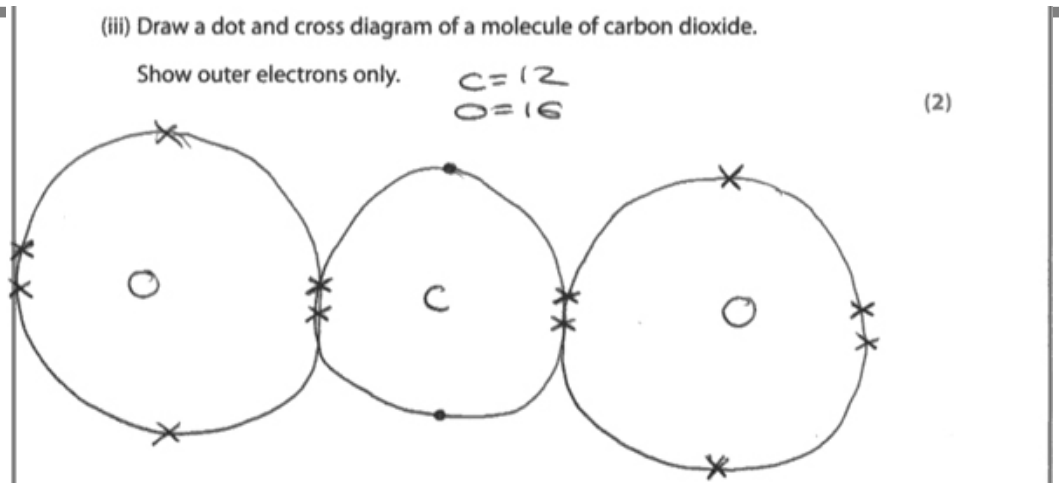
(c) (iii)

Most scored a mark for correctly showing a shared pair of electrons in a molecule of carbon dioxide. A common error was to show single bonds between the atoms rather than double bonds and a few candidates who did show double bonds lost marks by putting extra electrons on carbon and/or oxygen. Some candidates lost both marks as they failed to draw a correct CO_2 molecule, CO was often seen and sometimes COC.



Results Plus: Examiner Comments

A well drawn answer for two marks.



Results Plus: Examiner Comments

An answer worth 1 mark for showing a shared pair of electrons in a CO_2 molecule.

Q13. No Examiner's Report available for this question

Q14.

(i)

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

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)



Results Plus: Examiner Comments

The correct answer, that scored the mark.

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Ammonia reacts with nitric acid to form ammonium nitrate.

(i) Complete the word equation for this reaction.

(1)

NH_3 + NCl → $2NH_3NCl$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(iii)

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

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

(2)

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

Results Plus: Examiner Comments

This good answer scored both marks.

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

(2)

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

Results Plus: Examiner Comments

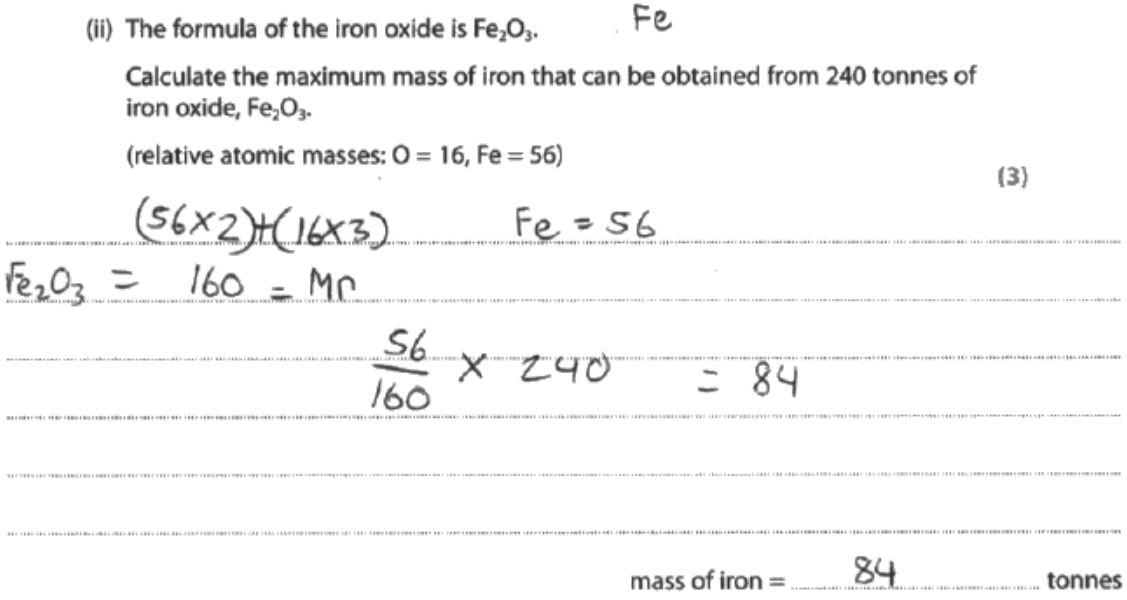
A common misconception seen was that the ammonium nitrate was used as a pesticide.

This example still gained 1 mark for improving crop yield.

Q15.

(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)

(56x2)+(16x3) Fe = 56

Fe_2O_3 = 160 = Mr

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

mass of iron = 84 tonnes

Results Plus: 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

Results Plus: 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.

Results Plus: Examiner Tip

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

Q16.

(ii)

In general, foundation tier candidates found calculating the maximum mass of iron produced in the reaction difficult. However, many were able to score at least 1 mark for calculating the formula mass of iron oxide.

A good proportion of candidates were able to calculate the number of moles as 1.5, but this was often then given as a final answer with no further calculation made.

(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)

56 × 2 = 112 16 × 3 = 48

240 × 160

mass of iron = 38400 tonnes

Results Plus: Examiner Comments

1 mark was awarded here for correctly calculating the relative formula mass of the iron oxide as 160.

(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)

56 × 2 16 × 3

112 + 48

160

28 12

40

224 96

320

mass of iron = 168 tonnes

Results Plus: Examiner Comments

A fully correct answer that scored all three marks available.

Q17.

Candidates were usually aware that intermolecular forces affect boiling point. There remains a confusion between intermolecular and intramolecular forces, with responses sometimes straying into an implicit or even explicit statement that covalent bonds were responsible for level of boiling point, e.g. 'the intermolecular forces between the atoms are weak'. Some candidates did not go on to explain that weak intermolecular forces only required little energy to overcome.

Q18. No Examiner's Report available for this question

Q19.

The information that the two elements both had one electron in the outer shell of their atoms was well described. Some candidates referred to the same number of electrons (not outer electrons) and so did not score.

Q20. No Examiner's Report available for this question

Q21. No Examiner's Report available for this question

Q22.

Candidates scored across the whole mark range available in this extended open response question. Those that did well were able to explain the bonding and structure of all three substances and why the properties of calcium chloride are different from the properties of calcium and chlorine, they were clear and careful with their use of scientific terms. Those that lost marks did so as they referred to free electrons or ions in the wrong context, or did not explain why the properties are different. Some candidates thought that the calcium chloride just took on a mix of the properties of calcium and chlorine.

Q23.

(i) Most candidates linked the cloudiness to a precipitate, slightly fewer to sulfur (even though the equation gave it as a solid product). Others identified NaCl as a solid precipitate (even though the equation gave it as aqueous), whilst others thought that the cloudiness was caused by effervescence.

(ii) It was clear that the majority of candidates had either carried out this investigation or seen it done. A pleasing majority were able to locate a black cross correctly and knew that it would disappear. However, some were confused into discussing the effect of different concentrations of HCl, but omitted to discuss the process for measuring the rate.

Q24.

Candidates found this question quite difficult. The best candidates understood the difference between intermolecular forces and covalent bonds and so answered well. However, many did not show this understanding and gave answers that referred to the weak covalent bonds that needed to be broken.

Carbon dioxide is a simple molecular, covalent compound.

It has a low boiling point of −78.5 °C.

Explain why carbon dioxide has a low boiling point.

(2)

It has weak intermolecular forces which are easily easily broken down.

Results Plus: Examiner Comments

In this case, the candidate correctly refers to the weak intermolecular forces and stated that these are easily broken, simply stating the forces are easily broken was not sufficient to gain the second mark as there needed to some reference to the amount of heat or energy required. Therefore, this answer scored just 1 mark.

Explain why carbon dioxide has a low boiling point.

(2)

Covalent bonds are weak, so require less energy (thermal here) to break the bonds.

Results Plus: Examiner Comments

In this case the reference to the weak covalent bonds means that that this answer was rejected for both mark points and did not score.

Explain why carbon dioxide has a low boiling point.

(2)

Carbon dioxide has a low boiling point because it has weak intermolecular forces that don't require a lot of energy to be overcome.

Results Plus: Examiner Comments

A good answer that scored both marking points.

Q25. No Examiner's Report available for this question

Q26.

A good proportion of learners performed well in question (ii) with many being able to explain that calcium would be found in period 4 of the periodic table because it has four shells of electrons. In some cases, candidates lost the second mark point as they stated that calcium has four outer shells of electrons which was rejected. Where candidates did not score, it was often because they did not read the question carefully and stated what group rather than what period of the periodic table calcium is found in.

Q27.

Most candidates answered this well and recalled definition. When only 1 mark was awarded, this was often because the difference in neutrons but not the same number of protons was given. Candidates are advised in this type of question not to mention electrons which sometimes confused an answer. Some candidates unfortunately mentioned 'different elements with a different number of neutrons'.

Element **E** has an atomic number of 5.
In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

They are particles that have the same number of protons but different number of neutrons. (~~The~~ They have the same atomic number but different mass number).

Results Plus: Examiner Comments

This answer states clearly the standard definition (They are atoms... would have been even better).

Q28.

(i)

This question was not well answered on the whole with just less than half of responses scoring at least 1 of the 2 marks available.

Despite examiners having seen some flawless answers, few candidates were able to define the term 'isotopes' correctly. In the responses that scored 1 mark, this was often for a correct reference to isotopes having a 'different number of neutrons', with no reference to the number of protons, or alternatively mentioning only 'same number of protons'.

It was clear from responses that many candidates had clearly not read the guidance in the question, namely the important phrase 'in terms of subatomic particles'. stated that isotopes have the 'same atomic number but a different mass number'. This was credited with 1 mark, since it was evident that they knew what isotopes were but had not phrased their answer in terms of subatomic particles.

The main misconceptions in many responses that did not score were the incorrect assumption that isotopes are atoms of different elements, or that isotopes means 'electron transfer', showing some confusion with ionic bonding.

Element **E** has an atomic number of 5.
In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

The term isotopes means the transfer of electrons.

Results Plus: Examiner Comments

This is typical of many responses seen which did not score any of the 2 marks available.

The candidate has confused istopes with electron transfer.

Results Plus: Examiner Tip

Learn key definitions of the terms in the specification, namely 'isotopes'.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

atoms that have the same number of protons but different number of neutrons.

Results Plus: Examiner Comments

This response scored both available marks.

There are correct references made to 'same number of protons' and a 'different number of neutrons'.

Q29.

This question was not well answered overall, with the majority of responses managing to score only 1 of the 2 marks available.

It is worthwhile noting that this question required an explanation but many candidates simply gave a description. Almost all candidates only scored the first marking point since they did not explain the trend but only described it, namely that mass decreases for calcium carbonate. There were very few 2 mark responses seen, suggesting they found it very difficult to describe what happens as a reaction progresses. In several of those responses where an explanation was attempted they usually did not score it as they incorrectly stated evaporation rather than loss of a gas.

Another sample of calcium carbonate is heated and the mass of solid remaining is measured each minute.

The results are shown in Figure 11.

time in minutes	0	1	2	3	4	5	6	7
mass of solid remaining in g	9.0	8.1	7.2	6.4	6.0	5.6	5.3	5.2

Figure 11

(i) Explain the trend shown by the data in Figure 11.

(2)

as the time increases, the mass of the solid remaining decrease.

Results Plus: Examiner Comments

This was a commonly seen response scoring 1 mark only.

The correct trend in the data has been described but has not been explained.

(ii)

This questiion was very poorly answered with fewer than a quarter of responses scoring the 1 mark available.

It was clear from the responses that few candidates understood the concept of heating to constant mass.

The major misconception was that many candidates thought that the mass of the solid would decrease to zero or simply that there is still some mass left; others incorrectly thought they needed to know the theoretical yield.

(ii) It is impossible to be sure from this data that the reaction is complete.

State why.

(1)

because the reaction kept decreasing in grams and the data to 5 does not show the point at which the solid stayed at the same mass.

Results Plus: Examiner Comments

This response scored the 1 mark available.

The response correctly mentions that the mass is still decreasing and has not reached a point where the mass stays constant.

(ii) It is impossible to be sure from this data that the reaction is complete.

State why.

(1)

because the mass doesn't reach 0 g it finishes at 5.7g

Results Plus: Examiner Comments

This response was typical those that did not score.

This highlights the misconception of the majority of candidates where they incorrectly assumed that the mass would eventually go down to zero in the thermal decomposition of the calcium carbonate.

Q30.

(i) This question required an explanation, but many just gave a description. The obvious mark was that mass decreases for calcium carbonate, although some did state the rate is slowing down. Some candidates stated that carbon dioxide was released as the explanation for mass loss, but incorrect explanations for the mass decrease were varied and included calcium

carbonate melting and/or evaporating, reacting with oxygen or just 'disappearing'. Very few candidates were able to explain why the rate of reaction decreases as time goes on.

Another sample of calcium carbonate is heated and the mass of solid remaining is measured each minute.

The results are shown in Figure 3.

time in minutes	0	1	2	3	4	5	6	7
mass of solid remaining in g	9.0	8.1	7.2	6.4	6.0	5.6	5.3	5.2

Figure 3

(i) Explain the trend shown by the data in Figure 3.

(2)

As the time went, the mass of said remaining decreased. This is because ~~the reaction~~ one of the products was carbon dioxide which escaped into the atmosphere and therefore the mass decreased.

Results Plus: Examiner Comments

Some candidates just described the pattern in this data. This answer gives a correct explanation as well so scores both marks.

(ii) A considerable number of candidates understood the concept of heating to constant mass, even if they weren't always as good at expressing themselves clearly. Others just stated that the reaction was incomplete but gave no evidence for this idea. Some misunderstood the data completely and thought that it would decrease to zero; others incorrectly thought they needed to know theoretical yield.

Q31. No Examiner's Report available for this question

Q32.

A few candidates scored full marks on this item however many wrote about how the solid did not conduct electricity, but the solution did (for one mark) and then erroneously went on to write about delocalised electrons in the solution and not in the solid. The other significant error seen was when candidates wrote about molten ammonium chloride – again evidence showing that candidates do need to read the question carefully before starting their answer.

Q33.

This question was pleasingly well answered with a large majority of students knowing that calcium nitrate is soluble whereas calcium carbonate is not and many explaining the conductivity of the former as being a result of the presence of free moving ions. Sometimes the explanation was in terms of electrons (or even atoms or particles), not ions, being free to move.

Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

calcium carbonate is insoluble and instead acts as a sediment in water. calcium nitrate can dissolve in water and because it is aqueous it's electrons have energy to move so it becomes an electrolyte

Results Plus: Examiner Comments

This answer shows a common error – that electrons are the free particles, rather than ions.

Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

Calcium nitrate is soluble in water and when it is dissolved in water its ions are free to carry a charge which is what an electrolyte must do. Calcium carbonate is insoluble in water so remains solid when it is mixed with water. Solid ionic compounds do not conduct electricity because the ions are in fixed positions and cannot carry charge. Therefore it cannot be an

Results Plus: Examiner Comments

This is a more comprehensive, more clearly written answer than the other example, and correctly refers to ions.

Q34.

This question proved difficult for many candidates and a large number of blank pages were seen. Most of those that did attempt to answer the question often repeated information from the stem of the question which did not gain credit. Only the best were able to relate the data in the stem to the bonding and forces present in simple molecular, covalent substances and ionic substances. The application of scientific terminology was weak and many candidates could not specifically name the particles involved. Candidates seemed confused between intermolecular forces and bonds between atoms.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

Substance A has a simple molecular, covalent structure. It has a very low melting point of 35°C which suggests that it will only not take a lot of energy to break the bonds within it. This is because a simple molecular, covalent structure has weak inter-molecular forces which can be broken easily. Also, it cannot conduct electricity in any form, as a solid or when molten, as there are no free electrons to carry a current. This is why it does not have the ability to conduct electricity.

However, substance B has a very high melting point. This is due to the strong electrostatic forces within the ionic bonds of this structure. When this ionic structure is a solid, it is not able to conduct electricity as it does not have free electrons. It is held in a lattice structure. However when the structure is molten the ions have dissociated from one another allowing the electrons to move around freely so in that case it is able to conduct electricity.

Due to the strong electrostatic forces within the structure, it will take a lot of energy to break the strong bonds. Therefore, it has a very high melting point of 801°C.

Results Plus: Examiner Comments

The candidate has correctly classified substances A and B as covalent and ionic.

The melting points of substances A and B have been explained, with sufficient linkage of scientific ideas.

The explanation of the conduction of substance B is poor, limited to comments about electrons moving.

Whilst there is confusion in the description of conductivity, the explanation of the melting points alone merits level 3 – 6 marks.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B. (6)

I think Substance B has a ~~ionic~~ ionic Covalent Structure. ~~ionic~~ ionic ~~covalent~~ Structures generally conduct electricity quite well and in the table it conducts as a molten. ~~Covalent~~ ionic ~~ionic~~ Bonds are also very strong. Heat has to break through lots and lots of bonds to melt it and ionic bonds are strong. B has a melting point of 801 °C and A, 333 °C ~~de~~ showing that b has stronger bonds. I think A has a ~~Ionic~~ covalent Structure. It has a low melting point and doesn't conduct electricity. ~~Although~~

Results Plus: Examiner Comments

A and B are classified and the melting point of B is explained.

The whole of the answer links well. Therefore level 2 and awarded 4 marks.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

Substance A is an simple covelant structure this is because this bond is between 2 non-metals and have low melting and boiling because the bond is not strong less energy is needed to break it apart. Substance A has 35°. Simple covelant molecular structures also do not have the abilitty to conduct electricity because there are no positive electrons to attract with the delocalised negative electrons. Substance A ~~also~~ doesnt conduct electricity.

Substance B has an ionic structure because it has a high melting point. Ionic structures have high melting point, because between them is a strong electrostatic force of attraction and need lots of energy to break the force. So high melting point and boiling point is needed. Part of the ionic structure is that when the substance is molten it can conduct electricity because there are positive ions to attract with sea of delocalised negative electrons.

(Total for Question = 10 marks)

Results Plus: Examiner Comments

The candidate has correctly classified substances A and B as covalent and ionic.

They have referred to the low melting point of substance A but the explanation is incorrect.

They have referred to the high melting point of substance B and to strong forces of attraction but they do not say what the forces of attraction are acting between.

Both substances have been correctly classified and there is an explanation for one property.

However the links are not made correctly and therefore a mark of 3 rather than 4 is awarded.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

Substance A have low melting point which mean that forces between the particles in this substance are weak so these particles are able to move which can tell us that substance may be gas or liquid Substance B have high melting point which mean that forces between the particles in this substance are strong and they aren't able to move which may tell us that ~~sub~~ substance B is solid.

Results Plus: Examiner Comments

The substances have not been classified.

However, an explanation for the melting point of each has been attempted. A full explanation has not been given and so therefore only level 1 – 2 marks can be awarded.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

In substance A the substance has a low melting point meaning it's soluble ~~are~~ but does not conduct electricity because it must have strong intermolecular and ~~int~~ intramolecular forces not allowing any electrons to travel through the substance meaning no electrical current can be passed through. this also Means it has a simple molecular structure.

In substance B it has a high melting point meaning its insoluble but only conducts electricity when molten. this means, when heated up the intramolecular forces weaken allowing the molecules to break down allowing an electrical current to pass through. when a solid it has strong ionic and intramolecular forces holding the structure together meaning no electric current can pass through.

Results Plus: Examiner Comments

The candidate has correctly classified substance A as simple molecular and has linked this to a low melting point.

There are many scientific terms that have been included. However, these are not linked to the question and have been used inappropriately. They have therefore been ignored and no credit for their use has been given.

Explain, in terms of bonding and the forces between the particles, the relative melting points and abilities to conduct the electric current of substances A and B.

(6)

Substance A and B are very different as A's melting point is 35°C and B's melting point is 801°C so one is obviously alot stronger than the other, but both substances can't conduct an electric current when solid. B can conduct an electric current when molten but A can't. One has an ionic structure and the other has a simple molecular, covalent structure.

Results Plus: Examiner Comments

The candidate has not classified either substance A or B, they have simply repeated the information in the table and stem of the question, which is not worthy of credit.

Q35.

This extended open-response question was poorly answered with just under half of responses scoring. Of those responses which scored, invariably they scored a Level 1 or Level 2 answer.

Pleasingly, it was noted by examiners that for those candidates who had attempted the question their responses were clearly structured. It was clear that some candidates have seen the description of the formation of sodium and chloride ions from sodium and chlorine atoms using electron configurations. Many conveyed ion formation using clearly drawn diagrams.

A common misconception noted by examiners was that many candidates confused ionic bonding with covalent bonding and frequently (and incorrectly) showed dot and cross diagrams of sodium covalently bonded to chlorine. Some responses had repetition of the exam question, showing the electronic configurations of sodium and chlorine which scored no marks.

Very few candidates attempted a description of the arrangement of ions in sodium chloride. When candidates did describe the structure it was usually very basic, i.e. they did not did not use terms such as lattice, or identify that the positive and negative ions alternate. Very occasionally, there were a few good diagrams showing this.

* Sodium chloride is an ionic compound, containing sodium ions, Na^+, and chloride ions, Cl^-.

Figure 15 shows the electronic configuration of sodium and chlorine.

	electron configuration
sodium	2.8.1
chlorine	2.8.7

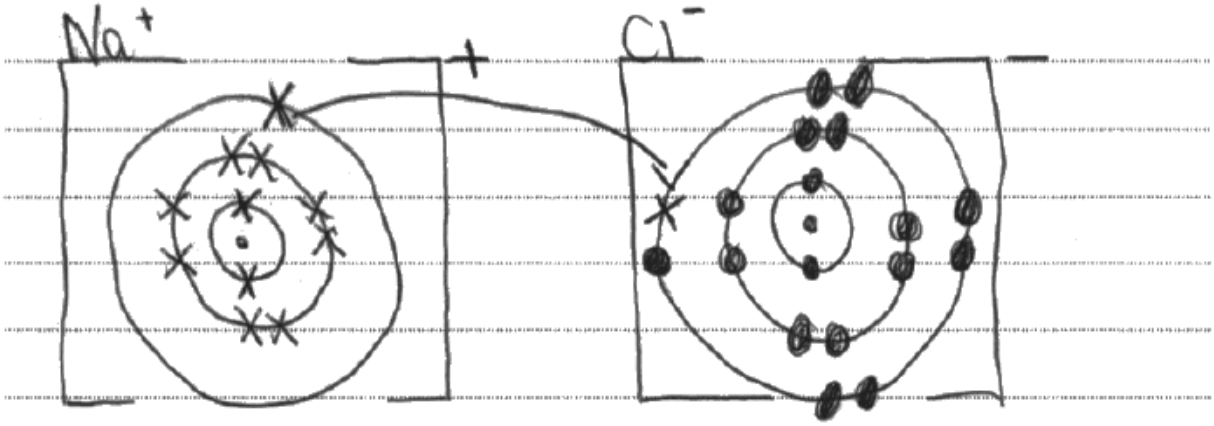
Figure 15

Explain how sodium and chlorine atoms form the ions in sodium chloride and how the ions are arranged in the solid sodium chloride.

You may wish to use diagrams in your answer.

(6)

Sodium is in group 1 will easily become an ion because it can easily get rid of an electron to become positive.
This Chlorine will easily become an ion because it can ~~get rid~~ gain an electrone to become negative.
This means they will easily react with the each other because Sodium can give its electron to Chlorine so they both get to where they want



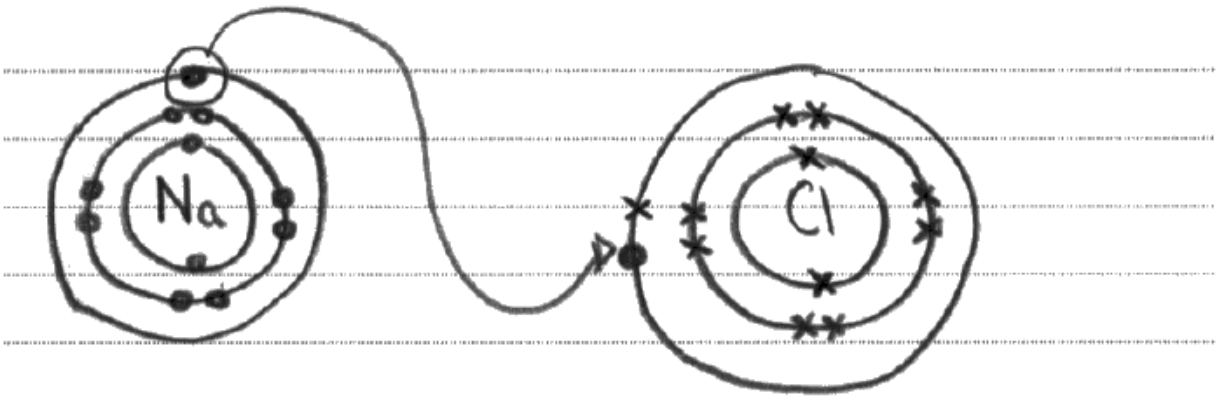
They both now have full outer shells, meaning they can become an ionic compound.

Results Plus: Examiner Comments

This response was awarded Level 3–5 marks

The response correctly explains how both the chlorine and the sodium atoms become ions by the transfer of an electron. This is correctly illustrated by a diagram which clearly shows the origin of the outer shell electron transferred to chlorine from the sodium.

While not perfect, this is sufficient for Level 3 – ideally we would wish to see references to chloride ions and the structure of sodium chloride.



sodium loses/gives one electron to chlorine, giving sodium a +1 ~~charge~~ ion and chlorine a -1 ion. This is because sodium now has more protons than electrons and chlorine now has more electrons than protons.

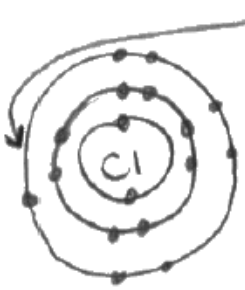
Results Plus: Examiner Comments

This response was awarded Level 2–4 marks

The correct idea of electron transfer has been conveyed to show the loss of an electron from the sodium to the chlorine atom. Ideally we would like to see the charges on the diagram to show the ions and the use of chloride ion in the description.

* Sodium chloride is an ionic compound, containing sodium ions, Na^+, and chloride ions, Cl^-.

Figure 15 shows the electronic configuration of sodium and chlorine.



	electron configuration
sodium	2.8.1
chlorine	2.8.7



Figure 15

Explain how sodium and chlorine atoms form the ions in sodium chloride and how the ions are arranged in the solid sodium chloride.

You may wish to use diagrams in your answer.

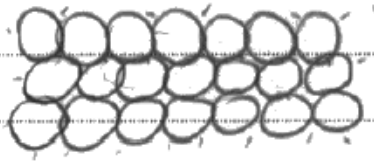
(6)

Sodium has one electron on it's outer shell, this means it's in group one of the periodic table. It has 11 protons and electrons, and 7 neutrons.

Chlorine has 7 electrons on it's outer shell, this means it's in group 7 of the periodic table.

Chlorine needs ^(to gain) one more electron to have a full outer shell, this means that Sodium will lose it's outer shell electron to give to Chlorine. This rearranges how the ions are placed and sodium chloride is formed.

As a solid sodium chloride ions will be arranged in neat, close together lines that will subtly vibrate against each other, all ions will be touching.



Results Plus: Examiner Comments

This response was awarded Level 3–5 marks

The response correctly explains how both the chlorine and the sodium atoms become ions by the transfer of an electron. This is correctly illustrated by a diagram which clearly shows the origin of the electron transferred to chlorine from the sodium. There is also a brief description of the structure of the sodium chloride.

While not perfect, this is sufficient for Level 3 – ideally we would wish to see references to chloride ions and the ions drawn.

Q36.

This was straightforward for many candidates but linking the group number with the number of electrons in the outer shell was seen more than linking the period number with the number of electron shells.

Q37. No Examiner's Report available for this question

Q38.

Examiners reported that it was rare to award 2 marks for this question. Although several scored one mark for making reference to delocalised or free electrons in the graphite structure, many

then did not link this with the idea of an electric current being a flow of electrons. Many just made the comment that the electrons 'carried the charge', for which no credit was given. Equally, many candidates just scored one mark for the idea of electrons being able to move through the graphite structure or between layers, but had not qualified those electrons as being delocalised.

Several misconceptions were seen. For example, a number of candidates referred to moving ions, or made a general reference to 'particles' moving − neither of which were credited. A few students stated that graphite was a metal!

Another misconception which is generally seen on this type of question, but surprisingly not as frequent as in some other previous examinations, has been the use of the term 'spare electrons'. Mention of this does not receive credit, and candidates should be deterred from using it.

Out of context answers were seen such as: 'layers slide past each other', 'weak bonds allow electricity to pass through', 'due to its high melting point', 'it is a metal so it conducts electricity', 'a lot of space in between atoms allowing particles to flow through' and 'due to ionic or giant structure', none of which received credit. Examiners also reported seeing answers in terms of uses and properties of graphite and the bonding within its structure.

Explain, in terms of its structure, how graphite conducts electricity.

(2)

Graphite is made of layers of covalent bonds. They are joined by weak bonds ~~which~~ where electrons ~~have~~ have space to move. This means electricity can pass through.

Results Plus: Examiner Comments

Here the electrons have not been qualified, but the 2nd mark was awarded for the electrons moving.

get the electrons they need to become stable.

Explain, in terms of its structure, how graphite conducts electricity.

(2)

graphite conducts electricity because it has delocalised ~~electrons~~ ions ~~and~~ so its ~~electrons~~ ions are free to move and conduct electricity so the bonds holding it together are weak forces of attraction.

Results Plus: Examiner Comments

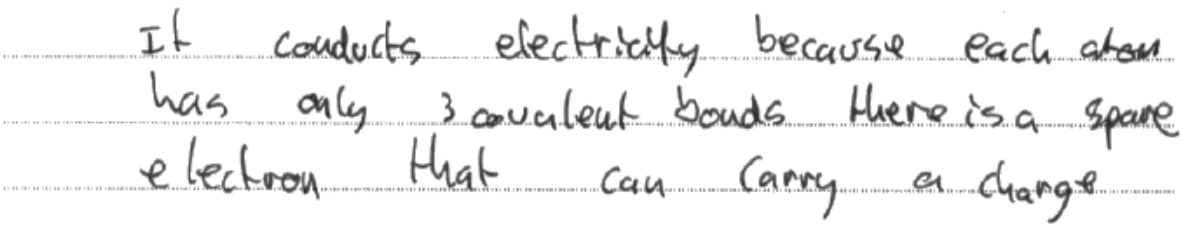
This response refers to delocalised ions which does not achieve the mark, nor does 'ions are free to move'.

Results Plus: Examiner Tip

Electricity is a flow of electrons.

Explain, in terms of its structure, how graphite conducts electricity.

(2)



Results Plus: Examiner Comments

It is not an acceptable alternative to use the term 'spare electron' rather than 'delocalised electron' or 'free electron'. So this answer scored 0 marks.

Q39. No Examiner's Report available for this question

Q40. No Examiner's Report available for this question

Q41.

(b)(i)

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

(b)(ii)

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

(c)(i)

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

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

Results Plus: Examiner Comments

This candidate scored 1 mark for gas.

Results Plus: Examiner Tip

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

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

Results Plus: Examiner Comments

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

(c)(ii)

The majority of candidates could write the correct word equation.

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

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Copy the names of chemicals carefully from the question.



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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



Results Plus: Examiner Comments

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

Q42.

(b)(i)

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

(b)(ii)

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

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

Results Plus: Examiner Comments

This candidate scored 1 mark for gas.

Results Plus: Examiner Tip

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

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

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

Hydrogen + chlorie → hydrogen chlorine

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Copy the names of chemicals carefully from the question.



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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



Results Plus: Examiner Comments

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

Q43.

Barium and sulfur were often stated and scored the mark.

Where candidates did not score the mark, it was often because they thought that the elements combined in barium sulfide included barium and sulfide, other elements were also included in incorrect answer, the most common element added was oxygen, indicating confusion between sulfide and sulfate.

Give the names of the elements combined in barium sulfide. (1)



Results Plus: Examiner Comments

A correct answer that scored the mark.

Give the names of the elements combined in barium sulfide.

(1)

barium sulphuric acid.

Results Plus: Examiner Comments

In some cases, candidates tried to give reactants that might form barium sulfide such as barium and sulfuric acid.

Give the names of the elements combined in barium sulfide.

(1)

barium, sulfur & oxygen.

Results Plus: Examiner Comments

Another error seen frequently was to include oxygen in the list of elements present in the compound. This answer scored no marks.

Give the names of the elements combined in barium sulfide.

(1)

Sulfur and beryllium

Results Plus: Examiner Comments

A common error seen was to state that boron or beryllium was present rather than barium.

Q44.

(a)(ii)

Many candidates could write the symbol for an element in the same period as beryllium. However, a significant number of candidates were confused between a group and a period and

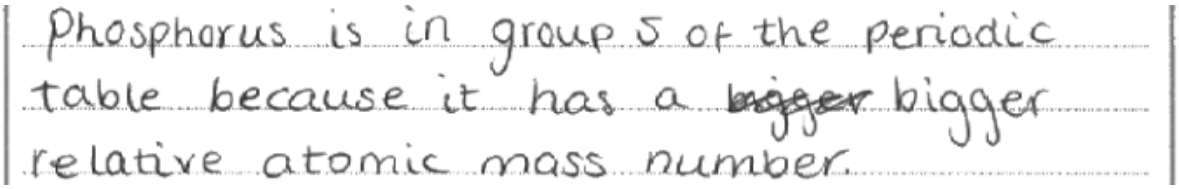
they wrote Mg or Ca as their answer.

(b)(i)

A significant number of candidates were unable to work out the numbers of protons, electrons and neutrons in an atom of beryllium. Candidates should learn how to work out the numbers of protons, electrons and neutrons in an atom from the atomic and mass numbers.

(c)

The majority of candidates were able to relate the group number to the number of electrons in the outer shell. Only a small number of candidates referred to proton, neutrons or atoms in the outer shell. Some candidates just referred to 'it has 5 at the end of the configuration' without explaining what the 5 refers to. Only a few candidates wrote about the similar properties of elements in the same group.

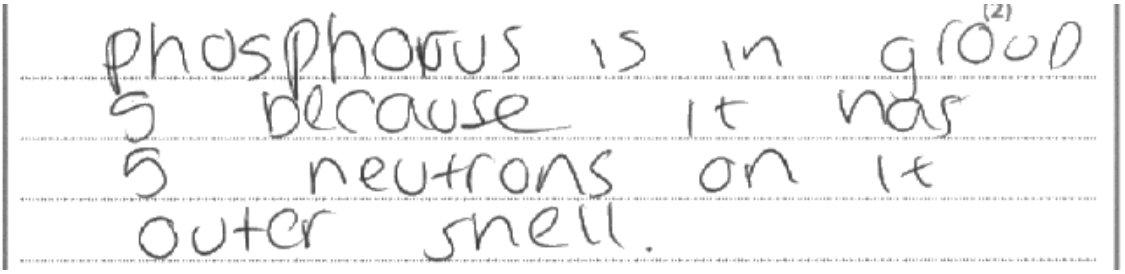


Results Plus: Examiner Comments

This answer did not score any marks as it did not refer to electrons or outer shell.

Results Plus: Examiner Tip

Read the information given in the question. The electronic configuration of phosphorus is given as 2.8.5. The question asks you to use this electronic configuration in your answer.



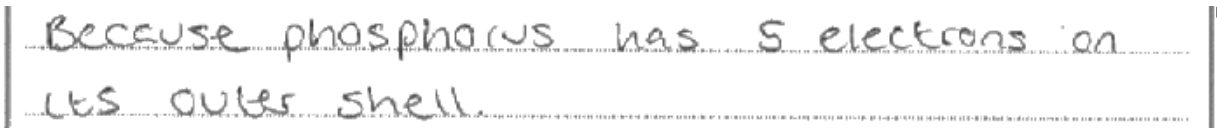
Results Plus: Examiner Comments

This answer scored 1 mark for writing about the outer shell. Neutrons are in the nucleus of an atom. There was a clue in the question. Electronic configuration is the arrangement of **electrons**

in an atom.

Results Plus: Examiner Tip

Learn the positions of the particles in an atom.



Results Plus: Examiner Comments

This is a good answer, scoring 2 marks.

Q45.

(a)(ii)

Many candidates could write the symbol for an element in the same period as beryllium. However, a significant number of candidates were confused between a group and a period and they wrote Mg or Ca as their answer.

(b)(i)

A significant number of candidates were unable to work out the numbers of protons, electrons and neutrons in an atom of beryllium. Candidates should learn how to work out the numbers of protons, electrons and neutrons in an atom from the atomic and mass numbers.

(c)

The majority of candidates were able to relate the group number to the number of electrons in the outer shell. Only a small number of candidates referred to proton, neutrons or atoms in the outer shell. Some candidates just referred to 'it has 5 at the end of the configuration' without explaining what the 5 refers to. Only a few candidates wrote about the similar properties of elements in the same group.

Phosphorus is in group 5 of the periodic table because it has a ~~bigger~~ bigger relative atomic mass number.

Results Plus: Examiner Comments

This answer did not score any marks as it did not refer to electrons or outer shell.

Results Plus: Examiner Tip

Read the information given in the question. The electronic configuration of phosphorus is given as 2.8.5. The question asks you to use this electronic configuration in your answer.

phosphorus is in group 5 because it has 5 neutrons on it outer shell. (2)

Results Plus: Examiner Comments

This answer scored 1 mark for writing about the outer shell. Neutrons are in the nucleus of an atom. There was a clue in the question. Electronic configuration is the arrangement of **electrons** in an atom.

Results Plus: Examiner Tip

Learn the positions of the particles in an atom.

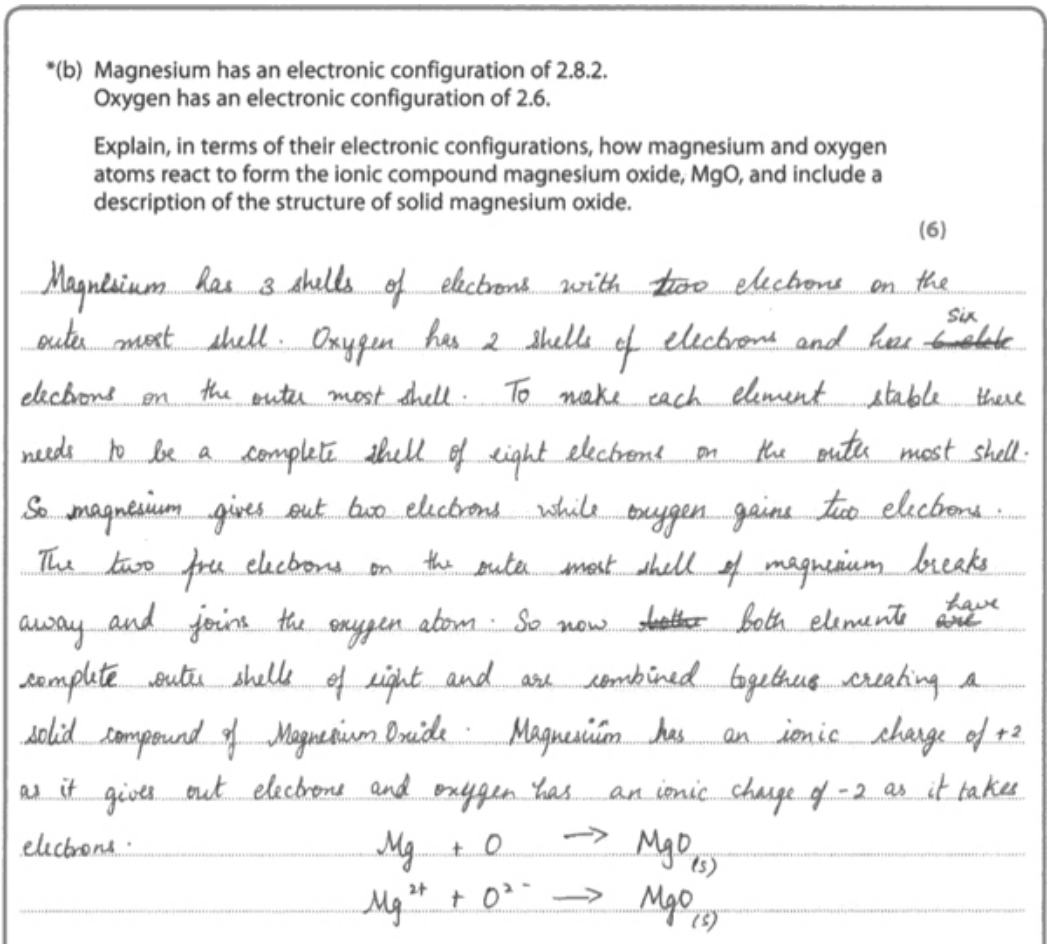
Beceuse phosphorus has 5 electrons on its outer shell.

Results Plus: Examiner Comments

This is a good answer, scoring 2 marks.

Q46.

It was pleasing to see good attempts being made in this free response question with over half of the candidates producing an answer worthy of level 2 or 3. A good understanding of the formation of magnesium oxide was demonstrated by many candidates with the transfer of electrons from magnesium to oxygen being well described, though fewer candidates could provide the correct formulae of the two ions formed. Surprisingly, significant numbers tried to explain the formation of magnesium oxide in terms of covalent bonding even though they were told in the question that magnesium oxide was an ionic compound. The structure of solid magnesium oxide often received scant treatment, and this was the major reason for not achieving level 3. Some candidates did refer to a lattice structure but often did not mention electrostatic attraction between the oppositely charged ions. Some candidates correctly described properties of magnesium oxide but such answers were not answering the question and so did not gain credit.



*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

Magnesium has 3 shells of electrons with ~~two~~ two electrons on the outer most shell. Oxygen has 2 shells of electrons and has ~~six~~ six electrons on the outer most shell. To make each element stable there needs to be a complete shell of eight electrons on the outer most shell. So magnesium gives out two electrons while oxygen gains two electrons. The two free electrons on the outer most shell of magnesium breaks away and joins the oxygen atom. So now ~~both~~ both elements ~~are~~ have complete outer shells of eight and are combined together creating a solid compound of Magnesium Oxide. Magnesium has an ionic charge of +2 as it gives out electrons and oxygen has an ionic charge of -2 as it takes electrons.

$Mg + O \longrightarrow MgO_{(s)}$

$Mg^{2+} + O^{2-} \longrightarrow MgO_{(s)}$

Results Plus: Examiner Comments

A decent description of the formation of the ions and the charges on them are shown but no reference to the structure of magnesium oxide so this was a level 2 answer and given four

marks.

*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

Magnesium has an atomic mass of 24 and an atomic number of 12. This means that the electronic configeration for this is 2, 8, 2. This also means that it has 12 electrons and protons and neutrons. Oxygen has the atomic mass of 16 and the atomic number for it is 8. This means that the electronic configeration for it is 2, 6 and it has 8 electron, 8 protons and 8 neutrons. These two react to form the ionic compound magnesium oxide. The structure of this simple molecular covalent. It has a low melting and boiling point and the electrons are quite far away from eachother and has weak forces of attraction between them.

Results Plus: Examiner Comments

Regrettably even though the candidate has written quite a lot they have not described the ion formation and despite saying it is an ionic compound have then contradicted themself by saying the structure is simple molecular covalent. Hence there is nothing creditworthy here.

Q47.

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Magnesium has 3 shells of electrons with ~~two~~ electrons on the outer most shell. Oxygen has 2 shells of electrons and has ~~6 which~~ six electrons on the outer most shell. To make each element stable there needs to be a complete shell of eight electrons on the outer most shell. So magnesium gives out two electrons while oxygen gains two electrons. The two free electrons on the outer most shell of magnesium breaks away and joins the oxygen atom. So now ~~better~~ both elements ~~are~~ have complete outer shells of eight and are combined together creating a solid compound of Magnesium Oxide. Magnesium has an ionic charge of +2 as it gives out electrons and oxygen has an ionic charge of -2 as it takes electrons.

$Mg + O \rightarrow MgO_{(s)}$

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Results Plus: Examiner Comments

A decent description of the formation of the ions and the charges on them are shown but no reference to the structure of magnesium oxide so this was a level 2 answer and given four marks.

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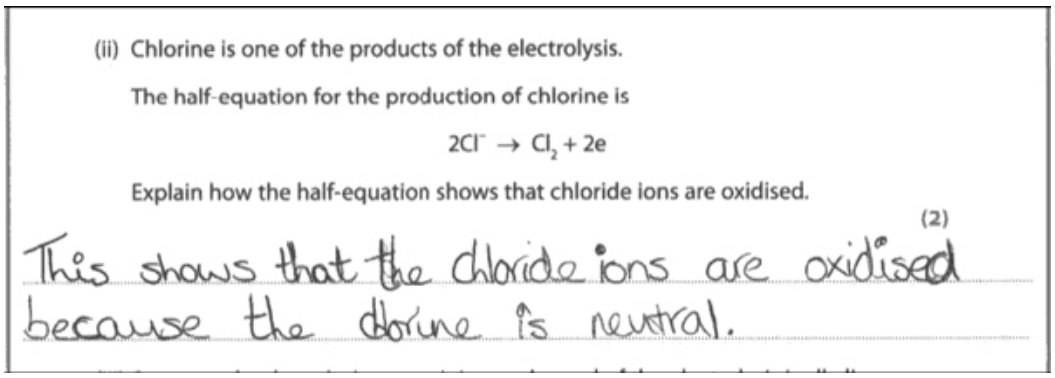
Results Plus: Examiner Comments

Regrettably even though the candidate has written quite a lot they have not described the ion formation and despite saying it is an ionic compound have then contradicted themself by saying the structure is simple molecular covalent. Hence there is nothing creditworthy here.

Q48.

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

The half-equation for the production of chlorine is

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

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

(2)

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

Results Plus: Examiner Comments

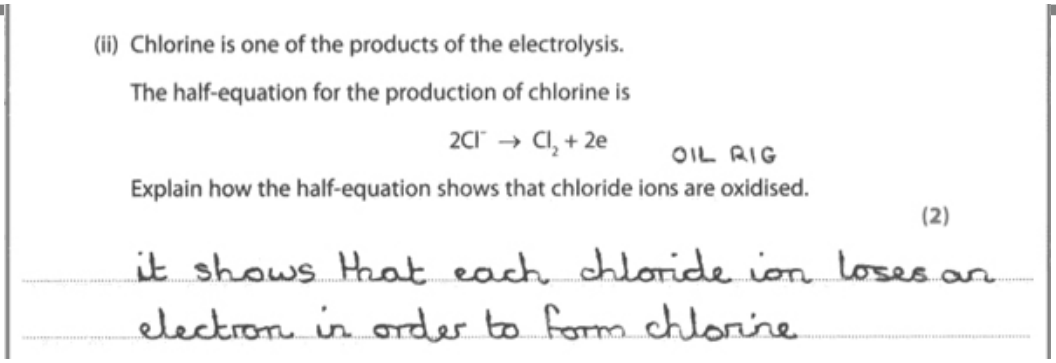
This answer did not score any marks as there was no mention of electrons.

Results Plus: Examiner Tip

Use OIL RIG to help you to remember about oxidation and reduction.

Oxidation **I**s **L**oss of electrons.

Reduction **I**s **G**ain of electrons.



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

The half-equation for the production of chlorine is

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

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

(2)

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

Results Plus: Examiner Comments

This is a very good answer, scoring 2 marks.

(a) (iii)

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

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

(1)

sodium chloride is an alkaline

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

(1)

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

Results Plus: Examiner Comments

This is a very good answer and scored 1 mark.

(a) (iv)

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

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

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

(1)

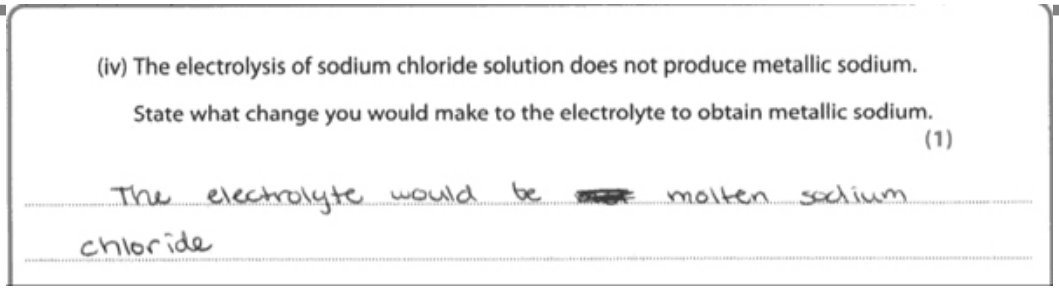
make the cathode and anode sodium so there is something to react with

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Read the question carefully.



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

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

(1)

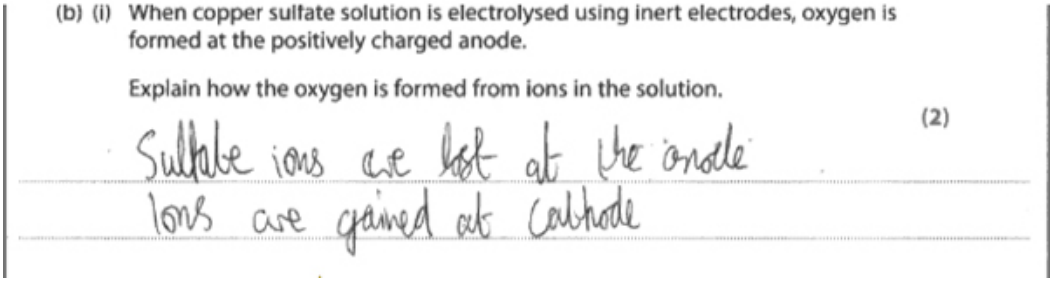
The electrolyte would be molten sodium chloride

Results Plus: Examiner Comments

This is a good answer, scoring 1 mark.

(b) (i)

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



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

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

(2)

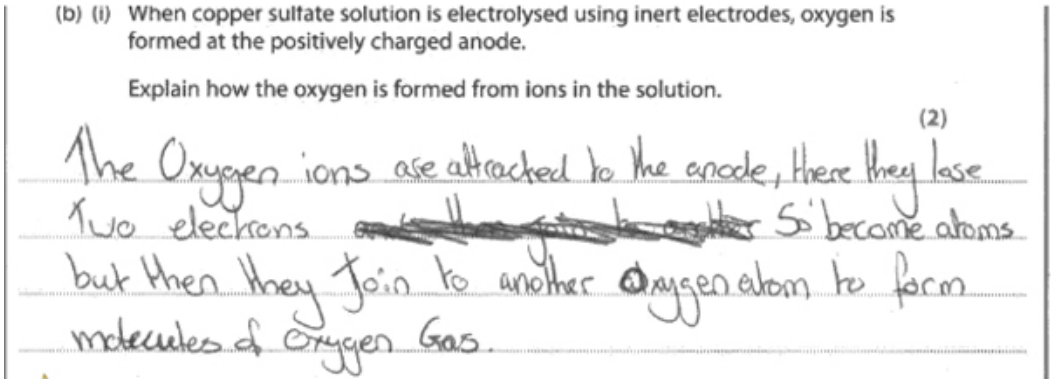
Sulfate ions are lost at the anode
Ions are gained at cathode

Results Plus: Examiner Comments

This candidate did not score any marks.

Results Plus: Examiner Tip

Ions react at the electrodes by gaining or losing electrons.



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

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

(2)

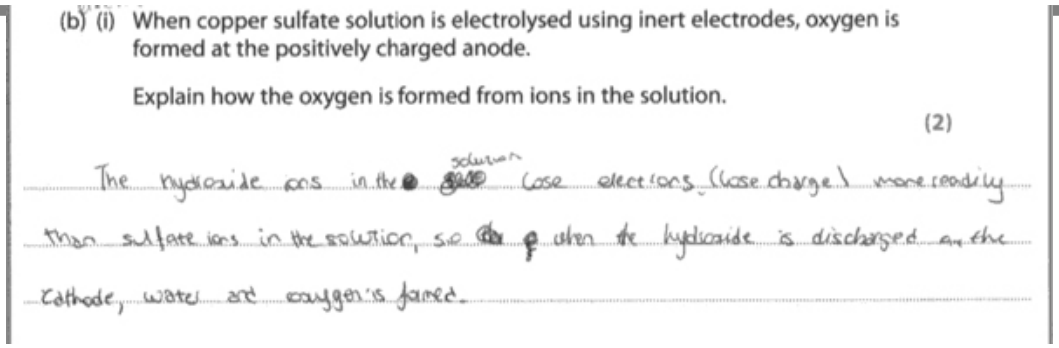
The Oxygen ions are attracted to the anode, there they lose two electrons [redacted] so become atoms but then they join to another Oxygen atom to form molecules of Oxygen Gas.

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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



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

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

(2)

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

Results Plus: Examiner Comments

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

(b) (ii)

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

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

1.27 ÷ 63.5 = 0.02



amount of copper produced = 0.02 mol

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

This correct answer scored 1 mark.

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

12.7 ÷ 63.5 = $\frac{1}{5}$ = 0.2

amount of copper produced = 0.2 mol

(Total for Question 1 = 8 marks)

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

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



Results Plus: Examiner Comments

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

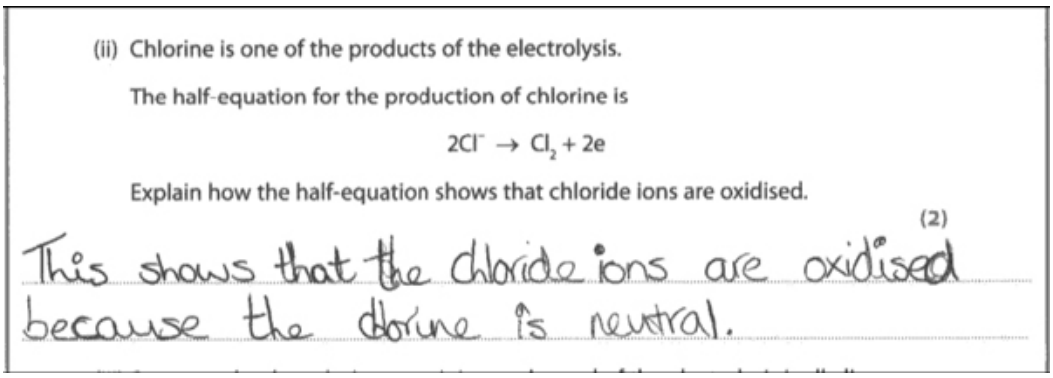
Results Plus: Examiner Tip

Avoid making careless errors. Read the question carefully.

Q49.

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

The half-equation for the production of chlorine is

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

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

(2)

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

Results Plus: Examiner Comments

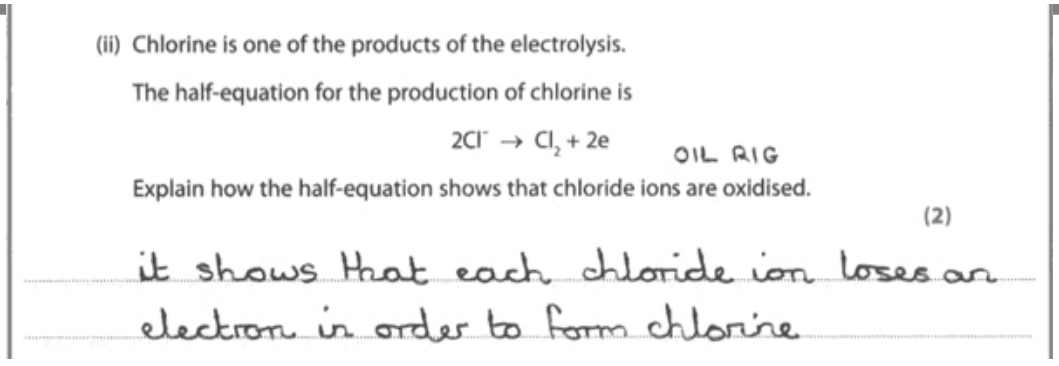
This answer did not score any marks as there was no mention of electrons.

Results Plus: Examiner Tip

Use OIL RIG to help you to remember about oxidation and reduction.

Oxidation **I**s **L**oss of electrons.

Reduction **I**s **G**ain of electrons.



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

The half-equation for the production of chlorine is

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

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

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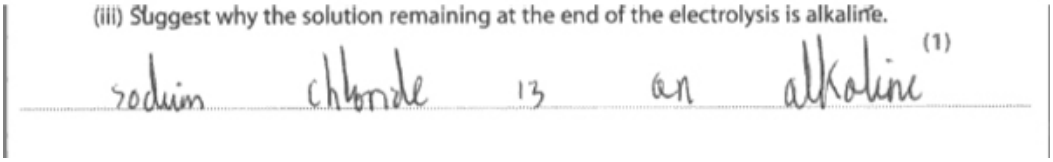
it shows that each chloride ion loses an electron in order to form chlorine

Results Plus: Examiner Comments

This is a very good answer, scoring 2 marks.

(a) (iii)

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


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

(1)

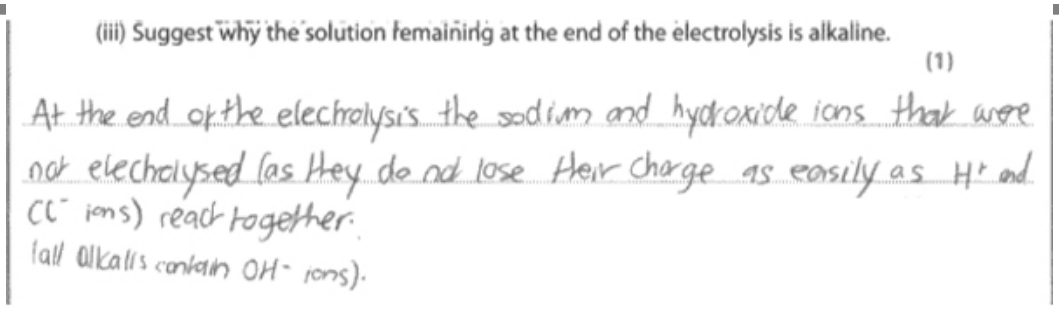
sodium chloride is an alkaline

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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


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

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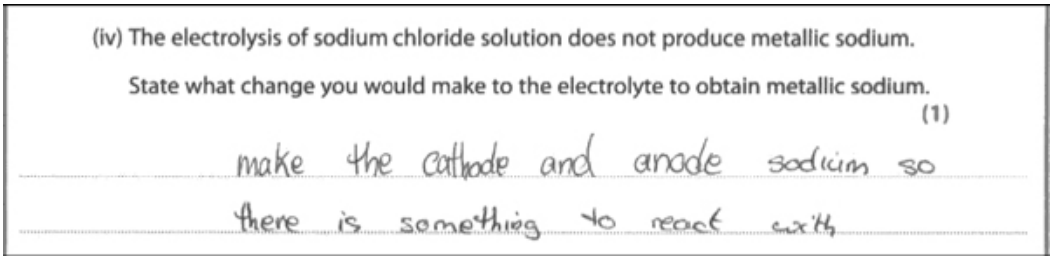
At the end of the electrolysis the sodium and hydroxide ions that were not electrolysed (as they do not lose their charge as easily as H^+ and Cl^- ions) react together.
(all alkalis contain OH^- ions).

Results Plus: Examiner Comments

This is a very good answer and scored 1 mark.

(a) (iv)

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


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

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

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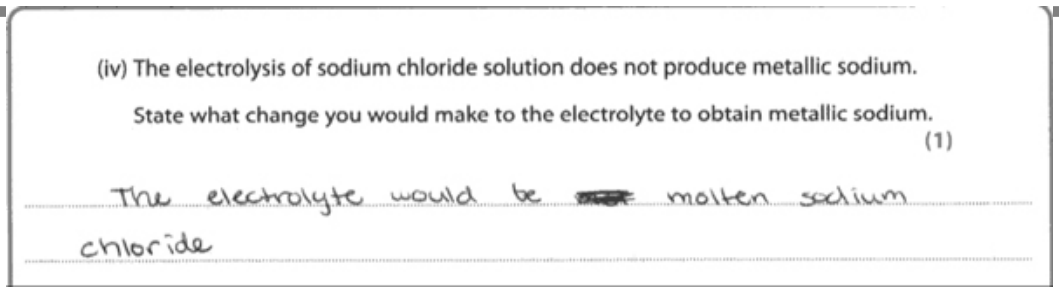
make the cathode and anode sodium so there is something to react with

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Read the question carefully.



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

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

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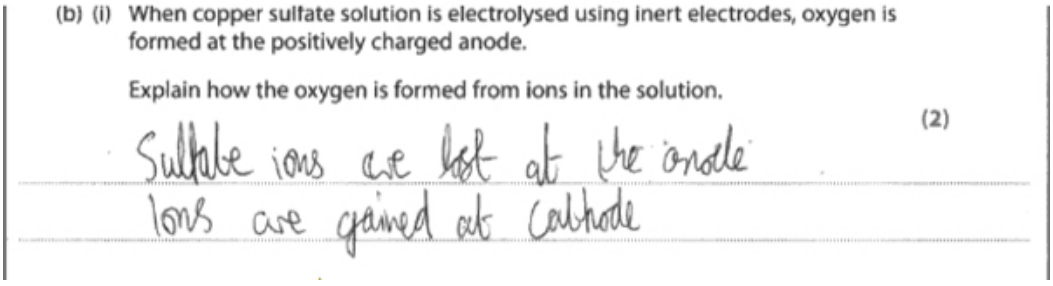
The electrolyte would be molten sodium chloride

Results Plus: Examiner Comments

This is a good answer, scoring 1 mark.

(b) (i)

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



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

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

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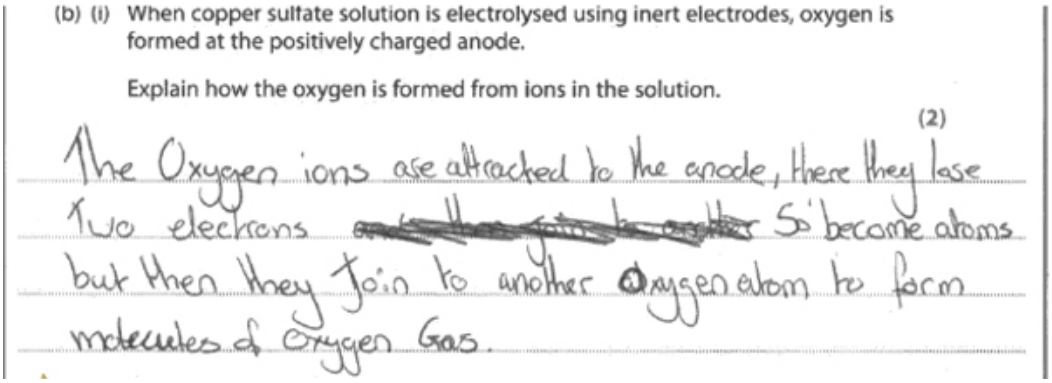
Sulfate ions are lost at the anode
Ions are gained at cathode

Results Plus: Examiner Comments

This candidate did not score any marks.

Results Plus: Examiner Tip

Ions react at the electrodes by gaining or losing electrons.



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

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

(2)

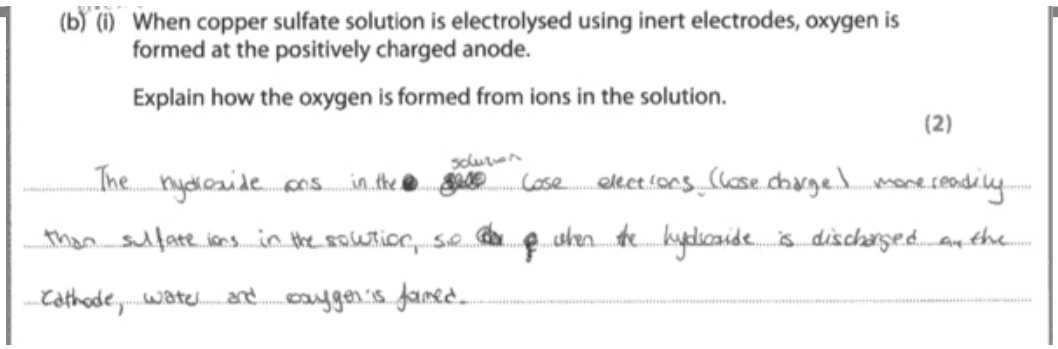
The Oxygen ions are attracted to the anode, there they lose two electrons [illegible] so become atoms but then they join to another Oxygen atom to form molecules of Oxygen Gas.

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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



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

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

(2)

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

Results Plus: Examiner Comments

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

(b) (ii)

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

by the mass of copper.

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

1.27 ÷ 63.5 = 0.02



amount of copper produced = 0.02 mol

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

This correct answer scored 1 mark.

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

12.7 ÷ 63.5 = $\frac{1}{5}$ = 0.2

amount of copper produced = 0.2 mol

(Total for Question 1 = 8 marks)

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

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Avoid making careless errors. Read the question carefully.

Q50.

(i)

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

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

Solid sodium chloride is dissolved in water.

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

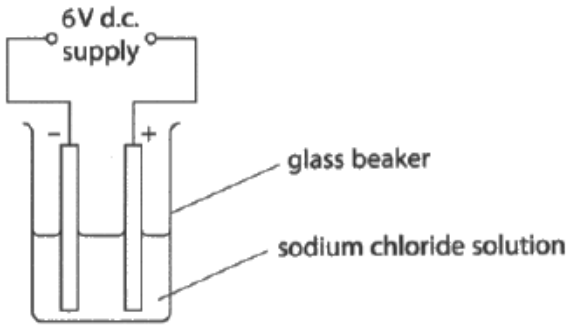


Figure 8

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

(1)

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

Results Plus: Examiner Comments

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

Solid sodium chloride is dissolved in water.

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

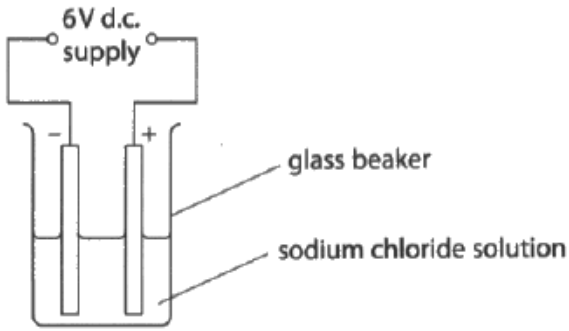


Figure 8

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

(1)

So the electrons can move freely

Results Plus: Examiner Comments

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

(iii)

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

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

Solid sodium chloride is dissolved in water.

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

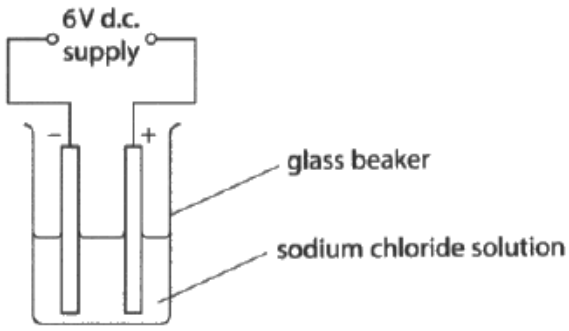


Figure 8

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

(1)

It has to be a liquid to work for electrolysis

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

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

Circle the ions that would be attracted to the anode.

(1)

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

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

(2)

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

Results Plus: Examiner Comments

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

Solid sodium chloride is dissolved in water.

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

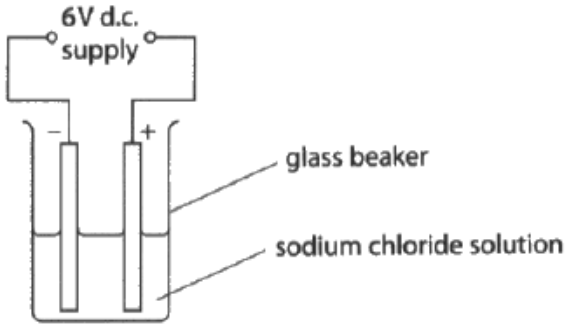


Figure 8

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

(1)

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

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

Na^+ (Cl^-) H^+ (OH^-)

Circle the ions that would be attracted to the anode.

(1)

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

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

(2)

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

Results Plus: Examiner Comments

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

Solid sodium chloride is dissolved in water.

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

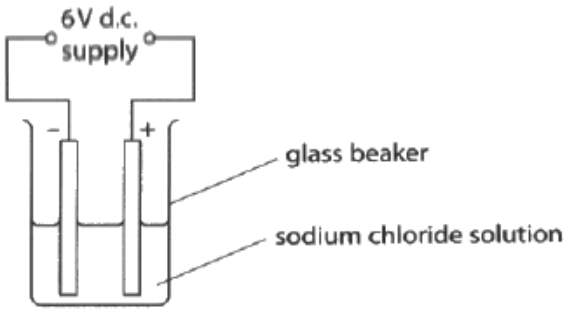


Figure 8

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

(1)

because sodium chloride solution will have a chemical reaction.

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

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

Circle the ions that would be attracted to the anode.

(1)

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

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

(2)

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

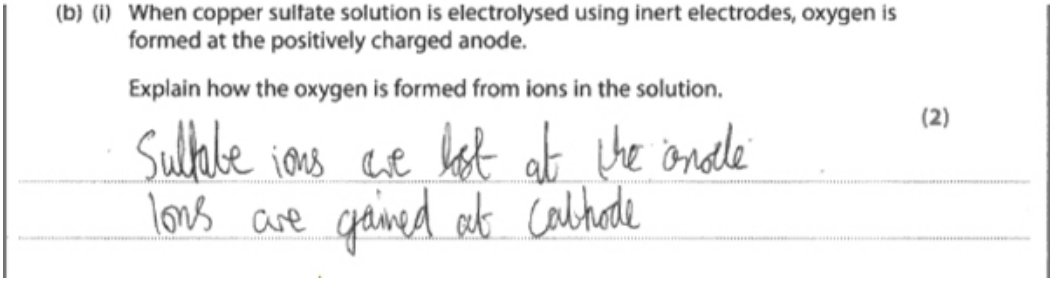
Results Plus: Examiner Comments

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

Q51.

(i)

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



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

Explain how the oxygen is formed from ions in the solution. (2)

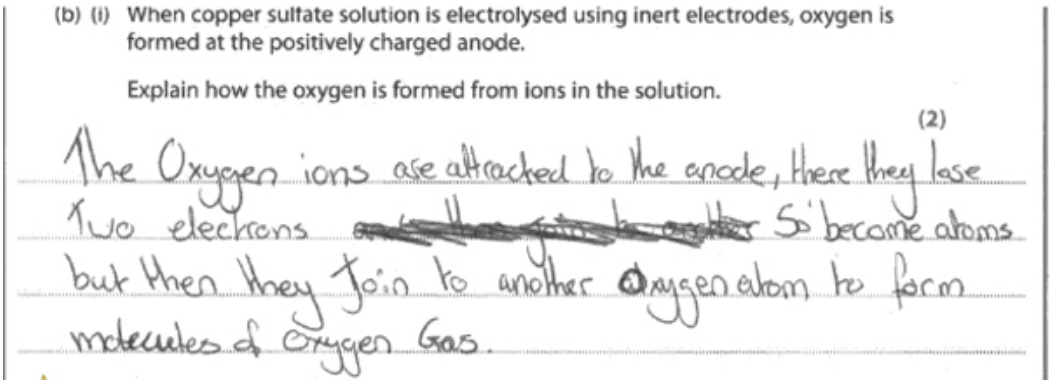
Sulfate ions are lost at the anode
Ions are gained at cathode

Results Plus: Examiner Comments

This candidate did not score any marks.

Results Plus: Examiner Tip

Ions react at the electrodes by gaining or losing electrons.



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

Explain how the oxygen is formed from ions in the solution. (2)

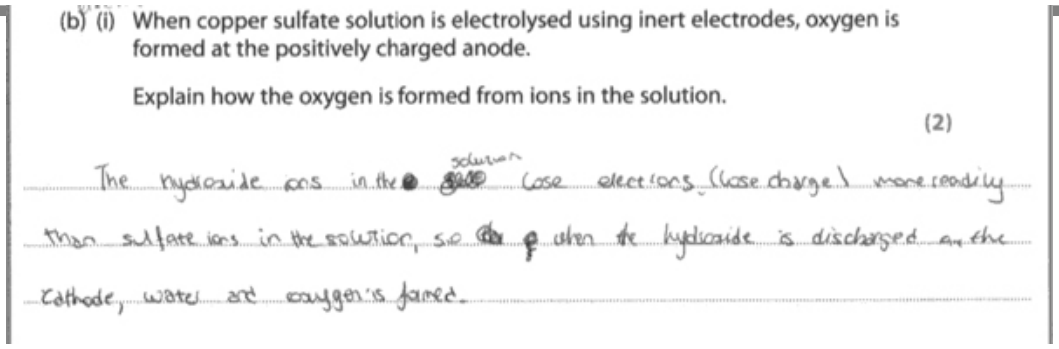
The Oxygen ions are attracted to the anode, there they lose Two electrons [redacted] So become atoms but then they join to another Oxygen atom to form molecules of Oxygen Gas.

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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



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

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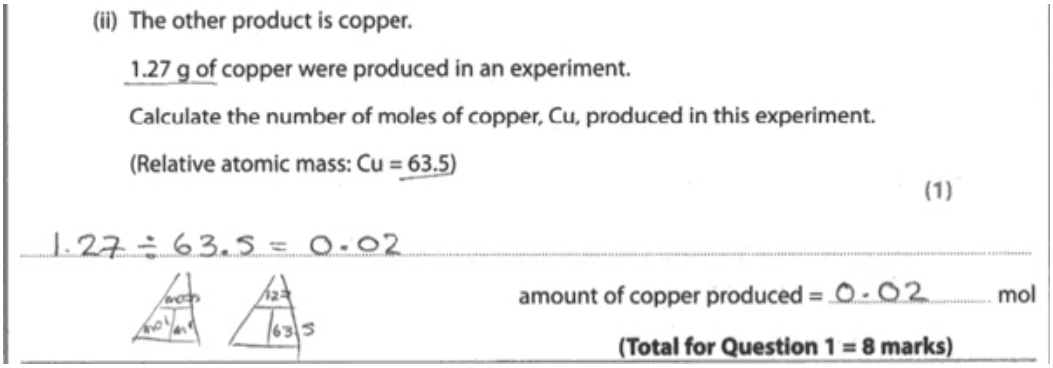
The hydroxide ions in the solution lose electrons (lose charge) more readily than sulfate ions in the solution, so when the hydroxide is discharged at the cathode, water and oxygen is formed.

Results Plus: Examiner Comments

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

(ii)

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



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1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

1.27 ÷ 63.5 = 0.02

amount of copper produced = 0.02 mol

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

This correct answer scored 1 mark.

(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

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

amount of copper produced = 0.2 mol

(Total for Question 1 = 8 marks)

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

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



Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Avoid making careless errors. Read the question carefully.

Q52.

(i)

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

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

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

(2)

Sulfate ions are lost at the anode

Ions are gained at cathode

Results Plus: Examiner Comments

This candidate did not score any marks.

Results Plus: Examiner Tip

Ions react at the electrodes by gaining or losing electrons.

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

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

(2)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

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

(2)

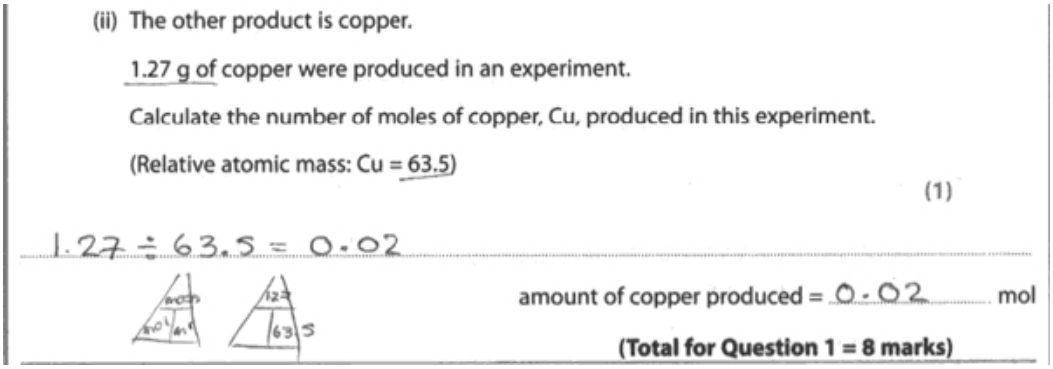
The hydroxide ions in the solution lose electrons (lose charge) more readily than sulfate ions in the solution, so when the hydroxide is discharged at the cathode, water and oxygen is formed.

Results Plus: Examiner Comments

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

(ii)

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



(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

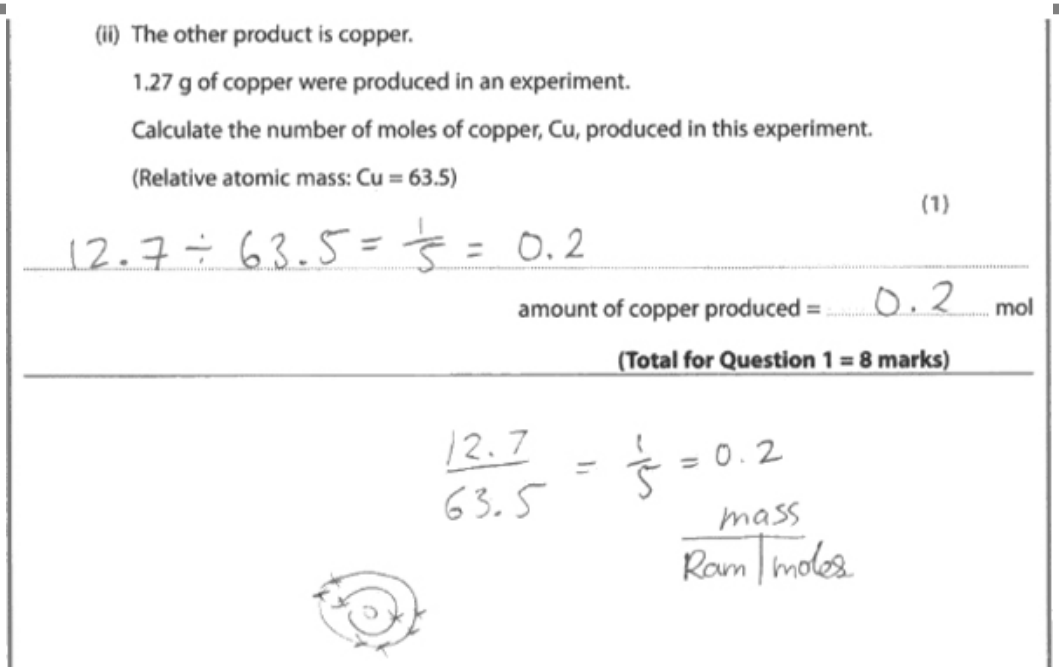
1.27 ÷ 63.5 = 0.02

amount of copper produced = 0.02 mol

(Total for Question 1 = 8 marks)

Results Plus: Examiner Comments

This correct answer scored 1 mark.



(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

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

(Relative atomic mass: Cu = 63.5)

(1)

12.7 ÷ 63.5 = 1/5 = 0.2

amount of copper produced = 0.2 mol

(Total for Question 1 = 8 marks)

12.7 / 63.5 = 1/5 = 0.2

mass / Ram | moles

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Avoid making careless errors. Read the question carefully.

Q53.

Candidates made a good attempt at this question and could explain how alloying changed the pure metals to make the alloys more suitable.

Good answers explained how the structure of the pure metal is changed when alloyed and how this changed the properties of the metal to make it more suitable for the uses given.

* Pure metals are often converted into more useful alloys.
For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery.
These processes of alloying change the structures of the metals.

Some properties of pure aluminium, iron and gold are shown in Figure 12.

	density in g cm^{-3}	malleability	relative strength
aluminium	2.70	easy to bend	low
iron	7.75	easy to bend	low
gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(6)

An alloy is where atoms of another metal or gas are added to another metal. Pure metals only contain one kind of atom, leaving them to have an arranged and neat structure where the atoms can slide. When the atoms can slide this means the metal is weaker and more malleable (as evident in figure 12).

Alloys are made by adding other atom of another element to the pure metal which helps to make it stronger and less malleable. Adding other atoms disrupts the neat and ordered lattice structure of the metal atoms so which decreases the capability for the atoms to slide. By stopping the many layers of atoms to slide, it makes them remain in the same position and overall makes the the metal harder and stronger now it's an alloy.

By alloying aluminium, it will make it more suitable for it's function by being able to withstand the high temperature changes as it's used on aircraft (different altitudes have different temperatures). It would also mean it would be strong but could potentially allow it to be malleable allowing it to be easily fitted. As well as the density could remain low allowing the aircraft to go faster than if the aluminium was more dense.

Making iron into an alloy allows it to have an increased strength, decreased malleability, meaning it can't be bent easily, and the density could be lowered making it more light weight. ~~the~~ This would allow the alloy of iron to be suitable for cutlery as it's light weight but strong and can't bend.

Lastly changing gold into an alloy makes it more durable, have an increased strength and decreased malleability making it less likely to break. It would decrease ~~the~~ the density as well making it more portable and easier to carry around as an accessory. Although it would decrease the value, which makes ~~it~~ it more ~~easy~~ easier for people to buy.

~~Overall~~

Overall showing how alloying these pure metals can help make them more adapted to their functions. or given uses.

Results Plus: Examiner Comments

In this example the candidate starts by explaining how alloying increases the properties of metals. The discussion of alloying in general here is detailed, the candidate then goes onto discuss each metal and its properties and how alloying them improves the properties specific to that use. The discussions are not perfect but do not have to be. There is discussion of the metals and how alloying changes the properties and therefore a mark of 6 in level 3 is awarded.

* Pure metals are often converted into more useful alloys.
For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery.
These processes of alloying change the structures of the metals.

Some properties of pure aluminium, iron and gold are shown in Figure 12.

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gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(6)

All three metals are changed to suit their purposes. Aluminium is used in aircraft meaning it can not be malleable whatsoever. It also needs to be very strong to take the weight of the ~~at~~ passengers etc

Iron is used in ~~cutlet~~ cutlery, therefore it needs to be strong so that it doesn't snap while ~~picking~~ cutting food. It also needs to not be malleable as we would not be able to cut or pick food up with bendy cutlery.

Lastly, Gold. As it is used in jewellery, it needs to ~~be~~ be strong so that it doesn't break. They also need to be less dense or else it would be extremely ~~heavy~~ heavy to carry around. The gold would need to be changed to make it less malleable because nobody wants bendy jewellery.

Results Plus: Examiner Comments

In this example, the candidate has discussed all three metals and why they would not be suitable for their given uses if a pure metal was used. They have not stated how they alloy would make a difference or given any general ideas about alloys. Therefore this was awarded level 2 - 4 marks.

* Pure metals are often converted into more useful alloys.
For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery.
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gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(6)

- Relative strength become high (so aircraft doesn't fall apart)
- Density ~~is~~ ~~becomes~~ in g cm^{-3} stays the same?
- Malleability goes from easy to bend to hard to bend as the aircraft should be stable.
- ~~It~~ Doesn't conduct ~~energy~~ electricity.
- ~~Conducts~~
- Doesn't dissolve in water?

Results Plus: Examiner Comments

In this example, only one metal has been discussed. There is some correct science. However, there is no discussion of why alloying might change the properties.

Only 1 metal has been discussed and not in great detail, therefore there is not sufficient for level 2. If a very detailed discussion of 1 metal was given, it could be possible to reach level 2.

A mark of 2 in level 1 was awarded.

* Pure metals are often converted into more useful alloys. For example, aluminium is converted into an alloy used in aircraft, iron is converted into an alloy used in cutlery and gold alloys are used in jewellery. These processes of alloying change the structures of the metals.

Some properties of pure aluminium, iron and gold are shown in Figure 12.

	density in g cm^{-3}	malleability	relative strength
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gold	19.3	easy to bend	low

Figure 12

Explain how alloying changes these pure metals to make the alloys more suitable for the given uses.

(6)

Gold alloys are suitable ~~from~~ to be used in jewellery because they are ~~een~~ malleable and have a high density. Aluminium is a good alloy to be used in aircraft parts because it has a low density and is easy to bend while gold would not be suitable for aircraft parts because it has a high density. Iron is a good alloy to use for cutlery because it is easy to bend into shapes and has a low relative strength.

A low relative strength is good for cutlery so it isn't to hard to cut things.

Results Plus: Examiner Comments

In this example. the candidate has not understood the question correctly and tried to explain thinking that the data is the data for the alloy not the pure metal, this does not answer the question and therefore 0 marks were awarded.

Q54. No Examiner's Report available for this question

Q55.

(i)

This dot-and-cross diagram was not well known. Some candidates were able to produce a well-drawn diagram, mostly with circles representing electron shells, but these were not essential to score the marks. As expected, there were many candidates who made the usual errors: drawing ions, or drawing a single atom with all electrons combined in its shells. Those that did at least draw a covalent structure often showed single bonds between carbon and oxygen.

Once the candidate had worked out there were four electrons shared between an oxygen atom and a carbon atom they seemed to get the rest of the dot and cross diagram correct. Other candidates seemed to draw a single shared pair of electrons between each oxygen and carbon atom as if they were unfamiliar with double bonds.

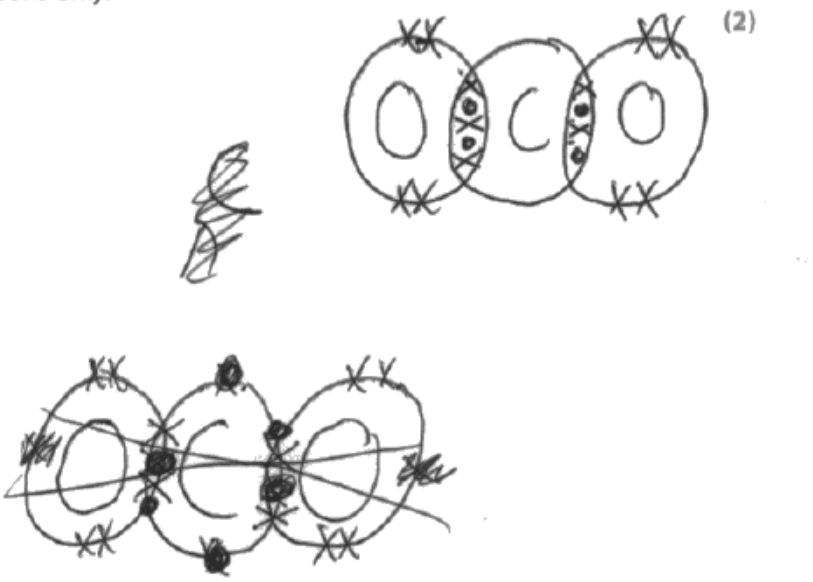
Considering the difficulty of this example, a surprisingly large number of candidates got the bonding in CO_2 perfectly correct. A few scored only the first mark, for showing at least one set of four bonding electrons, but the majority of candidates who failed to score two marks ended up with zero.

There were some issues with the clarity of the diagrams: dots looking like a slightly darker point on line, rubbing out poorly done, dots drawn over crosses. Some pages were covered in crossed-out attempts at different diagrams but many were left completely blank. A small number of ionic structures were drawn by candidates.

(i) Draw a dot and cross diagram to show the covalent bonding in a molecule of carbon dioxide, CO_2.

Show outer electrons only.

(2)



Results Plus: Examiner Comments

At first sight this answer looked fine, until it is realised that the bond between the carbon atom and each oxygen atom contains 5 electrons. This answer scored 0 marks.

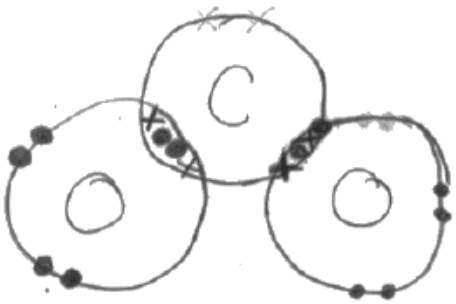
Results Plus: Examiner Tip

Practice drawing dot and cross diagrams for a variety of substances.

Show outer electrons only.

(2)

16 - 2 = 14 - 8 = 6



Results Plus: Examiner Comments

This example is a good answer with both double bonds being correct along with the remaining electrons around each oxygen atom.

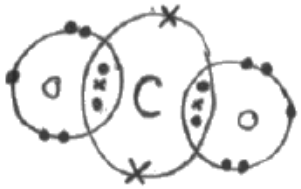
Results Plus: Examiner Tip

Dot and cross diagram could be asked for a wide variety of substances e.g. PCl_3, and is not limited to just those listed in the specification. However, sufficient information would be provided to allow candidates to answer the question.

(i) Draw a dot and cross diagram to show the covalent bonding in a molecule of carbon dioxide, CO_2.

Show outer electrons only.

(2)



4 = C 6 2, 8,

Results Plus: Examiner Comments

Although there were correct numbers of electrons around each atom, there were not double bonds between the carbon atom and the oxygen atoms.

Results Plus: Examiner Tip

It's not necessary to show the circles, but many candidates find it helpful to use them.

(ii)

Only a minority of the candidates scored both marks on this question. A few more scored 1 mark usually for a comment about the strong covalent bonds.

Unfortunately, candidates used the terms 'high heat', 'heat' or 'high temperature' rather than 'energy 'so lost out on the second point through poor use of scientific terminology.

Some of the more common errors included diamond '... is a strong element', '... is tightly packed', '... takes longer to heat', '...

is bonded to 4 carbon atoms' (rather than 'each carbon atom is bonded to four other carbon atoms'), and '... is a strong bond' (rather than 'diamond contains strong bonds'). Those that did give a correct reference to the structure did not all go on to justify the explanation by reference to needing a large amount of energy to break the bonds, instead, saying that 'diamond is hard to melt.'

A surprising number of responses thought that diamond has a high melting point because it is formed in volcanoes. Other errors seen by examiners included linking to intermolecular forces or 'bonds between molecules' and so lost both marks. A large minority of students mixed up the ideas of covalent and ionic bonding.

Explain why the melting point of diamond is very high.

(2)

There are four strong covalent bonds, there are no free electrons. There are strong electrostatic forces of attraction between each bond which requires alot of energy to change the bonds causing the diamond to melt.

(Total for Question = 10 marks)

Results Plus: Examiner Comments

This was a very good answer with marks been credited for strong covalent bonds and requiring a lot energy to change the bonds (taken as being broken).

Explain why the melting point of diamond is very high.

(2)

Each Carbon atom is Covalently bonded to 4 others, Covalent bonds are strong and require alot of heat to break apart. It has alot of Covalent bonds.

(Total for Question = 10 marks)

Results Plus: Examiner Comments

Another answer being credited for strong covalent bonds, but the answer does not refer to the amount of energy needed to break the bonds. Heat needs to be qualified as 'heat energy' or as 'thermal energy' to score for the second marking point.

Explain why the melting point of diamond is very high.

(2)

Because a diamond is created by heat just like crystals which means that they can't melt in medium temperatures, they get created by volcanoes, and the lava is over 150°C so they can't melt in lower than that. temperature

(Total for Question = 10 marks)

Results Plus: Examiner Comments

This answer does not refer to anything about the structure of diamond, nor to the amount of energy required to change the physical state.

Results Plus: Examiner Tip

When asked to explain a change of state temperature:

• part of the answer requires some reference to the structure of the substance

• part of the reason will require some reference to the energy required to break the bonds.

Q56.

In general, candidates did not perform well in this question, finding it hard to draw the dot and cross diagram for a molecule of water. Many repeated the stem of the question and redrew the hydrogen and oxygen circles next to one another. Some scored 1 mark as they knew that a covalent bond was involved and drew a shared pair of electrons between a hydrogen atom and an oxygen atom.

Draw a dot and cross diagram for a molecule of water.

(2)

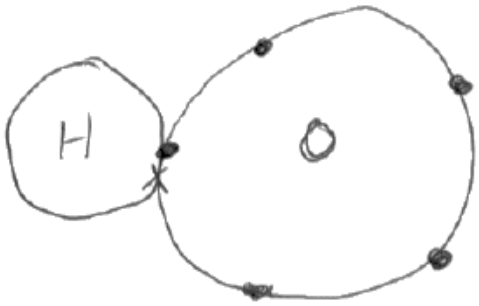


Results Plus: Examiner Comments

This example is a correct answer that scored both marks.

Draw a dot and cross diagram for a molecule of water.

(2)



Results Plus: Examiner Comments

Many candidates did not know the formula of water and drew a dot and cross diagram consisting of 1 atom of hydrogen and 1 atom of oxygen.

Mark Scheme

Q1.

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

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

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

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

Q2.

Question number	Answer	Additional guidance	Mark
	molecular formula: C_2H_4 (1) empirical formula: CH_2 (1)	allow H_4C_2 allow H_2C allow use of small letter / superscripts / non-subscripts	(2) AO2

Q3.

Question number	Answer	Additional guidance	Mark
	molecular formula: C_2H_4 (1) empirical formula: CH_2 (1)	allow H_4C_2 allow H_2C allow use of small letter / superscripts / non-subscripts	(2) AO2

Q4.

Question number	Answer	Additional guidance	Mark
(i)	any two from **E**, **G** and **X**	allow mark if all three given for E allow B / boron for G allow O / O_2 / oxygen for X allow Ar / argon allow use of lower case letters reject answers with any other letters / element names	(1)
(ii)	any two from **A**, **E** and **G**	allow mark if all three given for A allow Li / lithium for E allow B / boron for G allow O / O_2 / oxygen allow use of lower case letters reject answers with any other letters / element names	(1)
(iii)	**A** / **J**	allow mark if both given for A allow Li / lithium for J allow Na / sodium allow use of lower case letters reject answers with any other letters / element names reject answers with + or – charges	(1)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	any two from E, G and X	allow mark if all three given for E allow B / boron for G allow O / O_2 / oxygen for X allow Ar / argon allow use of lower case letters reject answers with any other letters / element names	(1)
(ii)	any two from A, E and G	allow mark if all three given for A allow Li / lithium for E allow B / boron for G allow O / O_2 / oxygen allow use of lower case letters reject answers with any other letters / element names	(1)
(iii)	A / J	allow mark if both given for A allow Li / lithium for J allow Na / sodium allow use of lower case letters reject answers with any other letters / element names reject answers with + or – charges	(1)

Q6.

Question number	Answer	Additional guidance	Mark
	Na^+ 2.8 (1) Cl^- 2.8.8 (1)	allow any separator e.g. 2,8 send any atom diagrams to review allow Na^+ 2.8.0 (1) Cl^- 2.8.8.0 (1)	**(2)**

Q7.

Question number	Answer	Additional guidance	Mark
(i)	**2.8.8.1**	allow any separator including gaps *e.g.* 2 8 8 1 send to review any diagrams	**(1)**

Question number	Answer	Mark
(ii)	**B** 19 (protons) 20 (neutrons) is the only correct answer. **A** is incorrect because there are 20 neutrons in the ion **C** is incorrect because there are 19 protons and 20 neutrons **D** is incorrect because there are 19 protons in the ion	**(1)**

Q8.

Question number	Answer	Mark
	D	**(1)**

Q9.

Question number	Answer	Additional guidance	Mark
(i)	2.8.8.1	allow any separator including gaps *e.g.* 2 8 8 1 send to review any diagrams	**(1)**

Question number	Answer	Mark
(ii)	**B** 19 (protons) 20 (neutrons) This is the only correct answer. **A** is incorrect because there are 20 neutrons in the ion **C** is incorrect because there are 19 protons and 20 neutrons **D** is incorrect because there are 19 protons in the ion	**(1)**

Q10.

Question Number	Answer	Additional guidance	Mark
	high melting point / high boiling point / hard / insoluble (in water) / does not conduct (electricity)	ignore strong bonds ignore strong ignore values given ignore any other properties but reject contradictions to allowed answers	**(1)** AO 1 1

Q11.

	Answer	Acceptable answers	Mark
(a)(i)	fractional distillation		**(1)**
(a)(ii)	to make it liquid	liquefy/condense to remove water (vapour) to remove carbon dioxide	**(1)**
(b)	D weak forces of attraction between the oxygen molecules		**(1)**
(c)(i)	An description including • shared (electrons) (1) • pair(s) of electrons (between atoms) (1)	Ignore reference to complete/full shells Ignore reference to between two metals Ignore reference to between metal	**(2)**

		and non-metal Ignore reference to between molecules Any reference to between ions scores 0	
(c)(ii)	2.4		**(1)**
(c)(iii)	diagram showing • any shared pair of electrons between a carbon and oxygen atom in CO_2 molecule (1) • rest of molecule correct (1)	Must have O C O arrangement If any atom labelled must be correct Ignore inner electrons even if wrong electrons can be on/in ring or no ring Ignore intersecting circles Accept all permutations of dots and crosses	**(2)**

Q12.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	fractional distillation		**(1)**
(a)(ii)	to make it liquid	liquefy/condense to remove water (vapour) to remove carbon dioxide	**(1)**
(b)	D weak forces of attraction between the oxygen molecules		**(1)**
(c)(i)	An description including • shared (electrons) (1) • pair(s) of electrons (between atoms) (1)	Ignore reference to complete/full shells Ignore reference to between two metals Ignore reference to between metal and non-metal Ignore reference to between molecules Any reference to between ions scores 0	**(2)**
(c)(ii)	2.4		**(1)**
(c)(iii)	diagram showing • any shared pair of electrons between a carbon and oxygen atom in CO_2 molecule (1) • rest of molecule correct (1)	Must have O C O arrangement If any atom labelled must be correct Ignore inner electrons even if wrong electrons can be on/in ring or no ring Ignore intersecting circles	**(2)**

		Accept all permutations of dots and crosses	

Q13.

Question Number	Answer	Mark
	• Ca^{2+} (1) • NO_3^- (1)	(2)

Q14.

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

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

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

Q15.

Question Number	Answer	Mark
(i)	**C** iron oxide is reduced **The only correct answer is C** ***A*** *is not correct because carbon gains oxygen* ***B*** *is not correct because it is not an acid-base reaction* ***D*** *is not correct because iron oxide loses oxygen*	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	final answer of 168 (tonnes) with or without working (3) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) 160 tonnes Fe_2O_3 produces {2x56 / 112} tonnes Fe (1) 240 tonnes Fe_2O_3 produces $\frac{2x56}{160}$ x 240 (1) = 168 (tonnes) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) $\frac{240}{160}$ (1) = 1.5 1.5 x 112 (1) = 168 (tonnes) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) $\frac{112}{160}$ (1) = 0.7 0.7 x 240 (1) = 168 (tonnes)	allow ECF throughout M_r $[Fe_2O_3]$= 160 seen without working (1) allow 320 tonnes : 224 tonnes (1) final answer 84 (tonnes) with or without working (2) Note : final answer 1.5 scores 2 overall	**(3)** AO 2 1

Q16.

Question Number	Answer	Mark
(i)	**C** iron oxide is reduced **1. The only correct answer is C** ***A*** *is not correct because carbon gains oxygen* ***B*** *is not correct because it is not an acid-base reaction* ***D*** *is not correct because iron oxide loses oxygen*	**(1)** AO 1 1

Question Number	Answer		Mark
(ii)	final answer of 168 (tonnes) with or without working (3) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) 160 tonnes Fe_2O_3 produces {2x56 / 112} tonnes Fe (1) 240 tonnes Fe_2O_3 produces $\frac{2x56}{160}$ x 240 (1) = 168 (tonnes) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) $\frac{240}{160}$ (1) = 1.5 1.5 x 112 (1) = 168 (tonnes) OR relative formula mass Fe_2O_3 = 2x56 + 3x16 (= 160) (1) $\frac{112}{160}$ (1) = 0.7 0.7 x 240 (1) = 168 (tonnes)	allow ECF throughout M_r [Fe_2O_3]= 160 seen without working (1) allow 320 tonnes : 224 tonnes (1) final answer 84 (tonnes) with or without working (2) Note : final answer 1.5 scores 2 overall	**(3)** AO 2 1

Q17.

Question number	Answer	Additional guidance	Mark
	An explanation linking • (intermolecular) forces are weak (1) • little **energy** needed (to overcome forces) (1)	 allow intermolecular bonds / weak bonds between molecules ignore needs a low temperature to break	**(2)**

Q18.

Question number	Answer	Additional guidance	Mark
	An explanation linking • (intermolecular) forces are weak (1) • little **energy** needed (to overcome forces) (1)	 allow intermolecular bonds / weak bonds between molecules ignore needs a low temperature to break	**(2)**

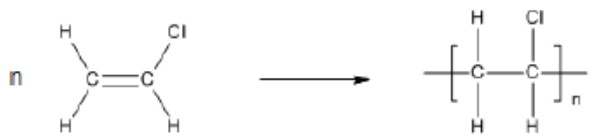
Q19.

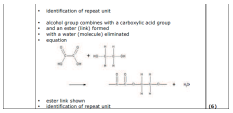
Question number	Answer	Additional guidance	Mark
	An explanation linking • outer (electron) shell (1) • (both have) {same number / 1} electron(s) (1)	 allow both lose 1 electron (to form ion / to form noble gas configuration) reject same number of outer shells / same number of electrons MP2 depends on MP1	**(2)**

Q20.

Question number	Answer	Additional guidance	Mark
	An explanation linking • outer (electron) shell (1) • (both have) {same number / 1} electron(s) (1)	 allow both lose 1 electron (to form ion / to form noble gas configuration) reject same number of outer shells / same number of electrons MP2 depends on MP1	**(2)**

Q21.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Candidates choose appropriate monomers to illustrate the formation of different polymers. • polymer molecules are long chains • made up of simple repeating units • use chloroethene (only) • to form poly(chloroethene) • which is addition polymerisation • use ethane-1,2-diol and ethanedioic acid • to form a polyester • which is condensation polymerisation • one of the bonds in the double bond in chloroethene molecule breaks • and chloroethene molecules join together to form a long chain molecule • equation 	



Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q22.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **A01 (3 marks) and A02 (3 marks)** STRUCTURE • calcium chloride is an ionic compound with lattice of positive and negative ions • calcium is a metal and so has a metallic structure of delocalised electrons and {calcium/Ca^{2+} ions} • chlorine is a simple molecular covalent compound MELTING POINT • there are strong electrostatic forces of attraction/ionic bonds between the ions in calcium chloride • a large amount of heat energy is required to break the electrostatic forces (so calcium chloride has a high melting point) • strong electrostatic forces between ions and delocalised electrons in calcium • a large amount of heat energy is required to break the electrostatic forces (so calcium has a high melting point) • chlorine has weak forces of attraction between its molecules and these weak forces only take a small amount of energy to break down (so chlorine has a low melting point)	**(6)**

	CONDUCTIVITY WHEN SOLID • ions are fixed in a lattice and so cannot move (therefore calcium chloride cannot conduct a current) • delocalised electrons in metallic structure can move to carry a current (so calcium can conduct a current) • there are no delocalised electrons/ions/charged particles/overall charges in chlorine molecules and (so chlorine cannot conduct a current) CONDUCTIVITY WHEN MOLTEN • however, when molten ions are free to move (and therefore molten calcium chloride can conduct a current) • delocalised electrons in metallic structure can move to carry a current (so calcium can conduct a current) • there are no delocalised electrons/ions/charged particles/overall charges in chlorine molecules and (so chlorine cannot conduct a current) all incorrect information/explanations should be ignored reject contradictory explanations	

Level	Mark	Additional Guidance	General additional guidance Eg - At each level, as well as content, the scientific coherency of what is stated backed up by planning detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Three structures named OR one structure described OR one property explained for one substance	Possible candidate responses • calcium is metallic, chlorine is a molecule (1) • calcium chloride is ionic with positive calcium ions and negative chloride ions (2) • calcium is metallic, chlorine is covalent, calcium chloride is ionic (2) • calcium is metallic it conducts when solid as it has mobile electrons (2)
Level 2	3–4	Additional guidance Three structures described or three properties explained.	Possible candidate responses • calcium has a metallic lattice of cations and delocalised electrons. Chlorine is made of simple molecules with weak intermolecular forces between them (3) • calcium has a metallic lattice of cations and delocalised electrons. Chlorine is made of simple molecules with weak intermolecular forces between them, this means that chlorine has a low melting point because little energy is needed to overcome these forces. (4)
Level 3	5–6	Additional guidance Six properties explained.	Possible candidate responses • calcium chloride has strong electrostatic forces between the ions so a high melting point and these ions are fixed in a lattice so the solid does not conduct. When melted, the ions are free to move and so the liquid does conduct. There are weak intermolecular forces between chlorine molecules so the melting point is low.(5) • calcium chloride has strong electrostatic forces between the ions so a high melting point and these ions are fixed in a lattice so the solid does not conduct. When melted, the ions are free to move and so the liquid does conduct. There are weak intermolecular forces between chlorine molecules so the melting point is low and molecules are uncharged so chlorine does not conduct electricity when solid or liquid (6)

Q23.

Question number	Answer	Additional Guidance	Mark
(i)	An explanation to include • a solid/ precipitate **(1)** • of sulfur **(1)**		**(2)**

Question number	Answer	Additional Guidance	Mark
(ii)	A description to include • flask placed {over/in front of} cross **(1)** • measure time **(1)** • when cross is obscured **(1)**	MP2 dependent on MP1 allow measure how long reaction takes for MP2	**(3)**

Question number	Answer	Mark
(iii)	**B** 150 cm^3 is the only correct answer. **A** is incorrect because this makes 16.7 g dm^{-3} HCl **C** is incorrect because this makes 25.0 g dm^{-3} HCl **D** is incorrect because this makes 33.3 g dm^{-3} HCl	**(1)**

Q24.

Question number	Answer	Additional guidance	Mark
	An explanation linking **weak** {forces between molecules / intermolecular forces} (1) (intermolecular forces need) little {heat/energy} required (1)	reject weak covalent bond for both mark points allow **weak** intermolecular bonds / **weak** bonds **between molecules** ignore easy to break ignore 'easier to separate molecules' ignore needs a low temperature to break	**(2)**

Q25.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • same number of electrons and protons (1) • so charges {cancel / balance one another} (1)	allow same number of positive and negative charges	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	37 – 17 (1) (= 20) (neutrons)	allow 20 without working reject '– 20'	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking • atoms {of same element / with same number of protons} / same atomic number (1) • different number of neutrons / different mass number (1)	 ignore electrons reject neutrons reject protons /electrons	(2)

Q26.

Question number	Answer	Additional guidance	Mark
(i)	**A 20 20 is the only correct answer** **B, C** and **D** are incorrect because calcium does not have 40 protons; calcium does not have 60 neutrons; calcium does not have 60 protons		(1)

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking • period 4 (1) • four shells of electrons (1)	 reject four outer shells	(2)

Q27.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking: • (atoms with) same (number of) protons (1) • (atoms with) different (number of) neutrons (1)	ignore any mention of electrons reject answers in terms of element**s** (plural) but allow element (singular) if no other mark: allow same atomic number **and** different mass number (1)	(2)

Question number	Answer	Mark
(ii)	**A** 5 protons is the only correct answer **B** is not correct because there are 5 or 6 neutrons **C** is not correct because the atomic number is 5 **D** is not correct because there are 5 or 6 neutrons	(1)

Q28.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking: • (atoms with) same (number of) protons (1) • (atoms with) different (number of) neutrons (1)	ignore any mention of electrons reject answers in terms of elements (plural) but allow element (singular) if no other mark: allow same atomic number **and** different mass number (1)	(2)

Question number	Answer	Mark
(ii)	**A** 5 protons is the only correct answer **B** is not correct because there are 5 or 6 neutrons **C** is not correct because the atomic number is 5 **D** is not correct because there are 5 or 6 neutrons	(1)

Q29.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • {rate/ mass loss} is slowing down (1) • as amount of reactant falls (1) OR • mass decreases (1) • as further decomposition occurs/ reaction continues / {gas/CO_2} {is produced/ escapes/ lost} (1)	allow amount of calcium carbonate decreases do not allow 'as time goes on' for MP2; must explain in terms of a reaction	(2)
(ii)	mass may decrease further / not heated to constant mass / last two figures not the same	allow mass is still decreasing reject mass not gone to 0 ignore there is still 5.2g solid	(1)

Q30.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • {rate/ mass loss} is slowing down (1) • as amount of reactant falls (1) OR • mass decreases (1) • as further decomposition occurs/ reaction continues / {gas/CO_2} {is produced/ escapes/ lost} (1)	allow amount of calcium carbonate decreases do not allow 'as time goes on' for 2nd mark: must explain in terms of a reaction	(2)
(ii)	mass may decrease further / not heated to constant mass / last two mass figures not the same	allow mass is still decreasing ignore there is still 5.2g solid reject mass has not gone to zero	(1)

Q31.

Question number	Answer	Additional guidance	Mark
	An explanation linking • ammonium chloride solution conducts electricity and solid ammonium chloride does not conduct electricity (1) • ammonium chloride contains **ions** (1) • in solution **ions** can move / in solid **ions** cannot move (1)	Answer must refer to both solid and solution for full marks	**(3)** **AO3**

Q32.

Question number	Answer	Additional guidance	Mark
	An explanation linking • ammonium chloride solution conducts electricity and solid ammonium chloride does not conduct electricity (1) • ammonium chloride contains **ions** (1) • in solution **ions** can move / in solid **ions** cannot move (1)	Answer must refer to both solid and solution for full marks	**(3)** **AO3**

Q33.

Question number	Answer	Additional guidance	Mark
	An explanation linking: • (calcium) nitrate {is soluble/ dissolves}/ (calcium) carbonate {is insoluble/ does not dissolve} (1) • so **ions** {free to move in solution / not free in solid} (1)	calcium nitrate dissolves so ions can move (2) or reverse argument for calcium carbonate	**(2)**

Q34.

Question number	Answer	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant.	**(6)** **exp**

	AO2 (6 marks) Simple molecular substances have low melting points because • molecules (have) • weak (forces between molecules) • intermolecular forces • little energy needed to {separate the molecules / overcome the forces between molecules} (hence liquid at room temperature) they do not conduct whether solid or molten because • they do not contain any charged particles/ ions/ {delocalised/ free} electrons (hence does not conduct electricity) therefore • substance A is covalent Ionic substances have high melting points because • {charged particles/ ions} • strong (forces between ions) • electrostatic forces of attraction • a lot of (heat) energy is needed to {separate the ions / overcome the forces between ions} (hence high melting point) they conduct electricity when molten because • {ions/ charged particles} are present • free to move but they do not conduct when solid as • {ions/ charged particles} are present • not free to move therefore • substance B is ionic	

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q35.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • sodium atoms lose electrons • each sodium atom loses one electron • to obtain electronic configuration 2.8 • which is that of sodium ions, Na^+ • electrons transfer to chlorine atoms • chlorine atoms gain electrons • each chlorine atom gains one electron • to obtain electronic configuration 2.8.8 • which is that of chloride ions, Cl^- • sodium ions attract chloride ions • because of opposite charges • ions pack close together • ratio of ions 1:1 • ions arranged in lattice • giant (ionic) (structure)	**(6)**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q36.

Question number	Answer	Mark
	An explanation linking • number of electrons on outer shell gives the group number / 1 electron on outer shell so group 1 (1) • number of electron shells gives the period number / 4 electron shells so period 4 (1)	**(2)** **AO1**

Q37.

Question number	Answer	Additional guidance	Mark
	An explanation linking • electrons (1) • can move / are delocalised (1)	MP2 depends on MP1 allow charged particles can move / are delocalised (1)	**(2)**

Q38.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (1 mark): • {delocalised/free} electrons (1) • (electrons) move (between the layers) (1)	 ignore 'spare electrons' allow sea of electrons ignore 'carry the charge' / 'current to flow' reject between molecules free flowing electrons (2) electrons free to move (1)	**(2)** **EXP**

Q39.

Question Number	Answer	Mark
	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark) • water (vapour) is in excess (1) • same volume of product formed because same volume of ethene reacts (1)	**(2)**

Q40.

Question Number	Answer	Mark
	B CH_2 **1. The only correct answer is B** ***A*** *is not correct because there are not equal C and H* ***C*** *is not correct because it is not simplest ratio* ***D*** *is not correct because it is not simplest ratio*	**(1)** AO 2 1

Q41.

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

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

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

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

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

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

(Total for Question = 8 marks)

Q42.

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

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

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

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

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

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

(Total for Question = 8 marks)

Q43.

Question Number	Answer	Additional guidance	Mark
	barium and sulfur	both elements must be present for the mark allow Ba and S reject sulfide/sulfate reject if any other elements included	**(1)** AO 2 1

Q44.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A metal		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	Any one of Li B C N O F Ne Ignore numbers with the symbols eg $^{7}_{3}Li$		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	4 (protons) (1) 4 (electrons) (1) 5 (neutrons) (1)		**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	C -1		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	An explanation linking 5 electrons (1) (in the) {outer/last/final/end} {shell/energy level} (1)	 it has 5 {outer/valence} electrons fully correct diagram showing electronic configuration **and** electron(s) labelled the group (number) is the number of electrons in the outer shell orbit/ring for shell fully correct diagram showing electronic configuration without labelled electron **OR** 5 in the {outer/last} {shell / energy level} do not allow just '5 at the end' do not award the first mark if proton/neutron/atom (in the outer shell)	**(2)**

(Total for Question 2 = marks)

Q45.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A metal		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	Any one of Li B C N O F Ne Ignore numbers with the symbols eg $^{7}_{3}Li$		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	4 (protons) (1) 4 (electrons) (1) 5 (neutrons) (1)		**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	C -1		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	An explanation linking 5 electrons (1) (in the) {outer/last/final/end} {shell/energy level} (1)	it has 5 {outer/valence} electrons fully correct diagram showing electronic configuration **and** electron(s) labelled the group (number) is the number of electrons in the outer shell orbit/ring for shell fully correct diagram showing electronic configuration without labelled electron **OR** 5 in the {outer/last} {shell / energy level} do not allow just '5 at the end' do not award the first mark if proton/neutron/atom (in the outer shell)	**(2)**

(Total for Question 2 = marks)

Q46.

		Indicative Content	
QWC	*	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions • due to opposite charges	

		• ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • 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. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • 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. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O^{2-}) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q47.

		Indicative Content	
QWC	*	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions	

		• due to opposite charges • ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • 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. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • 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. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O^{2-}) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q48.

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

	(1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	allow no hydrogen ions left/acidic **ions**removed	
(a)(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**
(b)(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	**(2)**
(b)(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

Q49.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	B H^+ and Na^+ ions		**(1)**
(a)(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	**(2)**
(a)(iii)	Any one from • it contains (excess) {hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1)	ignore solution has pH greater than 7 allow no hydrogen ions left/acidic	**(1)**

	• {hydrogen/H^+} ions have been removed (at the cathode) (1)	**ions**removed	
(a)(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**
(b)(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	 half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	**(2)**
(b)(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

Q50.

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

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

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

Q51.

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

Q52.

	Answer	Acceptable answers	Mark
(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	(2)

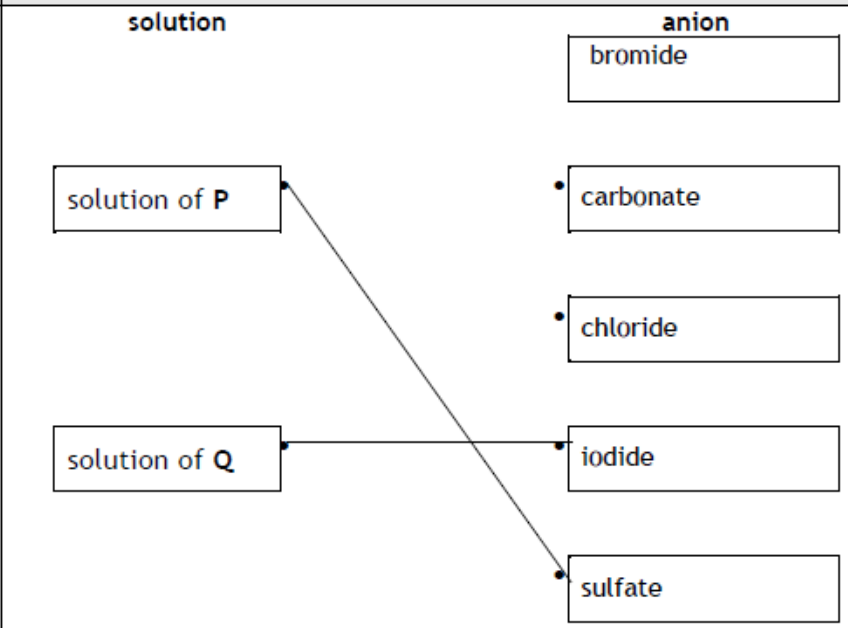
(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

Q53.

Question Number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • an alloy is a mixture of metals • because larger/different sized atoms introduced in alloying, • stop layers moving easily over one another • therefore individual alloy is stronger/harder • an aluminium alloy is magnalium • pure aluminium is not suitable for making aircraft as it bends too easily / too weak • aluminium alloy stronger • magnesium atoms lighter than aluminium atoms, • therefore alloy still low density / lower density than aluminum alone • an iron alloy is stainless steel • pure iron is not suitable for cutlery as it bends too easily / too weak • iron corrodes, • corrosion would contaminate food • stainless steel does not corrode • gold alloy harder • therefore more hard wearing • gold alloys less likely to change shape when worn • alloying can change the colour of the gold	**(6)** AO 2 1 AO 3 1a AO 3 1b

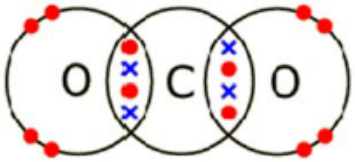
Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3-4	• The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5-6	• The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Q54.

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

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

Q55.

Question number	Answer	Additional guidance	Mark
(i)	 • {2 pairs of/four} electrons shared between an oxygen atom and the carbon atom (1) • rest of structure correct (1)	ignore any inner electrons shown remaining electrons on oxygen either singly or paired allow all dots or all crosses 2nd mark dependent on 1st	(2) EXP

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • diamond has a giant (covalent) structure / strong (covalent) bonds / each carbon atom is bonded to four other carbon atoms / all carbon atoms in diamond are bonded together (1) • large amount of (heat) energy is needed to {separate the carbon atoms / break the bonds / break up lattice} (1)	reject ionic lattice reject layers reject bonds between molecules reject intermolecular forces being broken ignore just high heat mark independently	(2) GRAD

Q56.

Question number	Answer		Mark
	shared pair of electrons between a hydrogen atom and an oxygen atom (1) rest of molecule correct (1)	ignore any inner shells drawn ignore symbols	(2)