PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 1: KEY CONCEPTS IN CHEMISTRY (PACK 1)

SCORE	PERCENTAGE
/64	%

STEMUP

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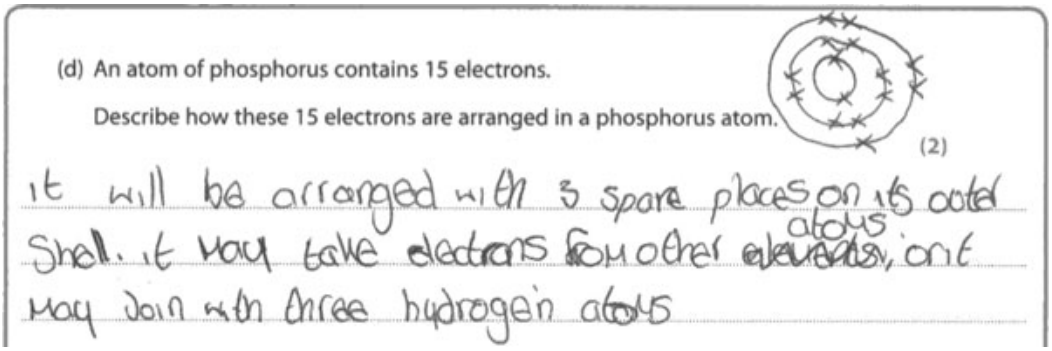
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Q1.

Generally, this question was answered well; most candidates scored both marks sometimes by the inclusion of a correct electronic configuration diagram. Occasionally seen was references to shells of atoms e.g. 2 atoms on first shell. There were some vague responses such as the electrons were 'around the nucleus' or 'in circles dotted around the nucleus'. Some candidates gave incorrect shells such as 2, 10, 5 with incorrect numbers of electrons that the shells could hold.

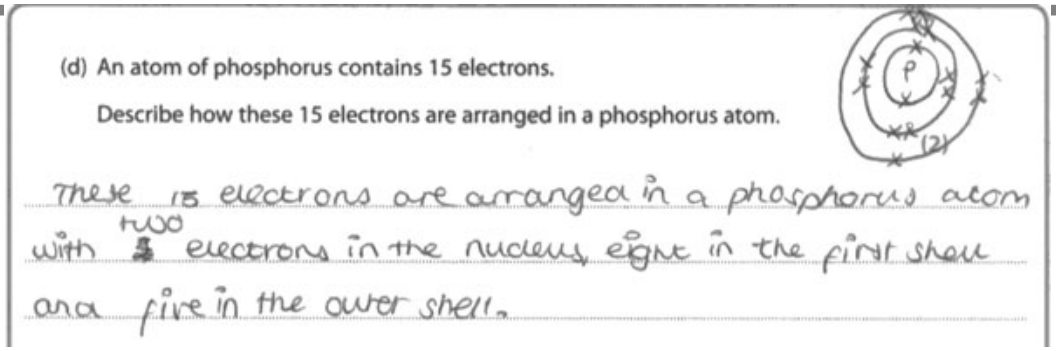

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom. (2)

it will be arranged with 3 spare places on its outer shell. it may take electrons from other atoms, or it may join with three hydrogen atoms

Results Plus: Examiner Comments

The answer was helped with the inclusion of the electronic configuration diagram. This was given 2 marks.


(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom. (2)

These 15 electrons are arranged in a phosphorus atom with two electrons in the nucleus, eight in the first shell and five in the outer shell.

Results Plus: Examiner Comments

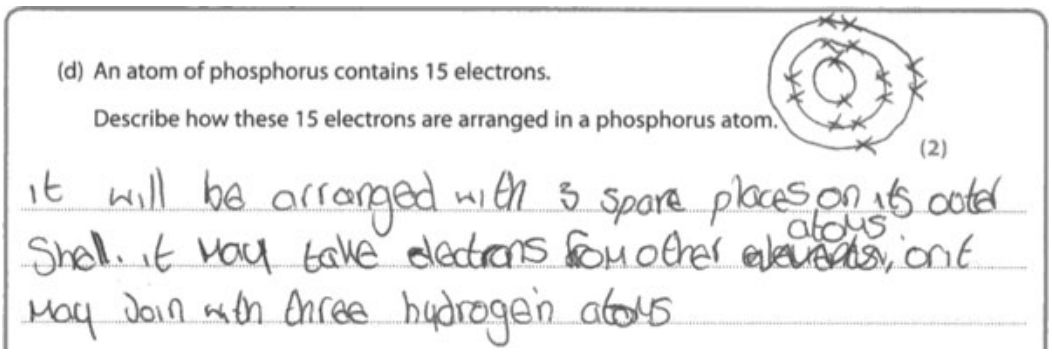
Although there was a clear electronic configuration diagram to aid this answer, there was some confusion as to where the electrons were located. Unfortunately the candidate had thought the inner circle of the diagram was part of the nucleus, and so only the mark for the correct number of electrons in the outer shell could be given.

Results Plus: Examiner Tip

Learn the maximum number of electrons that can be held in an electron shell and how the electronic configuration can be worked out.

Q2.

Generally, this question was answered well; most candidates scored both marks sometimes by the inclusion of a correct electronic configuration diagram. Occasionally seen was references to shells of atoms e.g. 2 atoms on first shell. There were some vague responses such as the electrons were 'around the nucleus' or 'in circles dotted around the nucleus'. Some candidates gave incorrect shells such as 2, 10, 5 with incorrect numbers of electrons that the shells could hold.



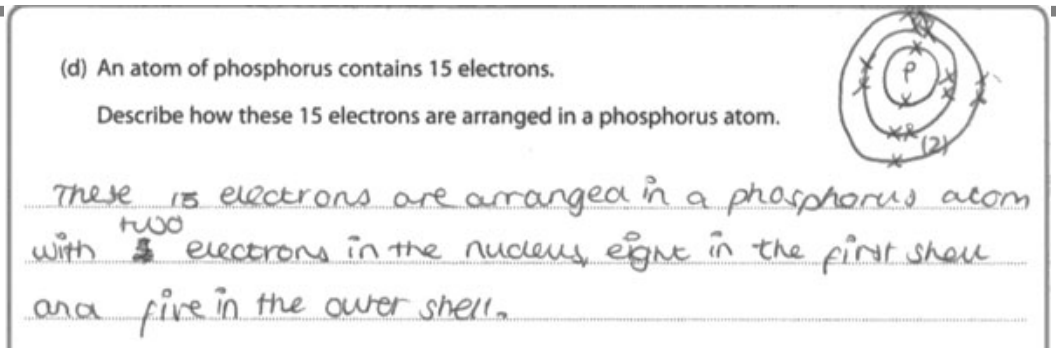
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Describe how these 15 electrons are arranged in a phosphorus atom. (2)

These 15 electrons are arranged in a phosphorus atom with two electrons in the nucleus, eight in the first shell and five in the outer shell.

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Results Plus: Examiner Tip

Learn the maximum number of electrons that can be held in an electron shell and how the

electronic configuration can be worked out.

Q3.

(a) (i)

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

(b) (i-ii)

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

(b) A solution of sodium hydroxide is prepared.

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

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

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

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

(1)

17·12 − 7·02 = 10·1

mass of solid sodium hydroxide = 10·1 g

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

(1)

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

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

Results Plus: Examiner Comments

A very good example of rarely seen full marks answer, for part (i) - the correct subtraction, namely '17.12 - 7.02' and for part (ii) - the correct calculation of the concentration, namely

(17.12 - 7.02)/2. The candidate has also written the correct formula for calculating the mass concentration.

(b) A solution of sodium hydroxide is prepared.

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

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

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

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

(1)

17.12
7.02
10.10

mass of solid sodium hydroxide = 10.1 g

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

(1)

10.1 ÷ 1000 = 0.0101

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

Results Plus: Examiner Comments

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

(b) A solution of sodium hydroxide is prepared.

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

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mass of container + solid sodium hydroxide = 17.12 g
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The results are used to calculate the concentration of the sodium hydroxide solution.

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

(1)

17.12 g ÷ 7.02 g =

mass of solid sodium hydroxide = ... g

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

(1)

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

Results Plus: Examiner Comments

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

Q4.

(a) (i)

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

(b) (i-ii)

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

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

(1)

17·12 − 7·02 = 10·1

mass of solid sodium hydroxide = 10·1 g

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

(1)

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

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

Results Plus: Examiner Comments

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

(b) A solution of sodium hydroxide is prepared.

The mass of a container with solid sodium hydroxide is determined.
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7.02
10.10

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

(1)

10.1 ÷ 1000 = 0.0101

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

Results Plus: Examiner Comments

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

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

(1)

17.12 g ÷ 7.02 g =

mass of solid sodium hydroxide = ... g

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

(1)

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

Results Plus: Examiner Comments

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

Q5. No Examiner's Report available for this question

Q6. No Examiner's Report available for this question

Q7.

(a)

This was very poorly answered on the whole. Most candidates failed to score or had no idea what was required for the 2 marks available. Many simply repeated the stem of the question or confused the reaction for a precipitation reaction and incorrectly suggested filtering the product. The reaction of acids and bases is clearly covered in the specification. However, from the vast majority of responses seen, it was clear that candidates from most centres may neither have carried out this particular practical nor that of the preparation of a similar soluble salt.

Aqueous Solutions

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

The word equation for the reaction is

magnesium oxide + sulfuric acid → magnesium sulfate + water

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

(2)

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

Results Plus: Examiner Comments

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

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The word equation for the reaction is

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

They are mixed together and then heated and filtered.

Results Plus: Examiner Comments

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

(b)

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

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

Write the balanced equation for this reaction.

(2)

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

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

Results Plus: Examiner Comments

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

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

Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

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

(c)

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

(d)

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

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

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

(6)

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

Results Plus: Examiner Comments

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

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

Results Plus: Examiner Comments

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

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

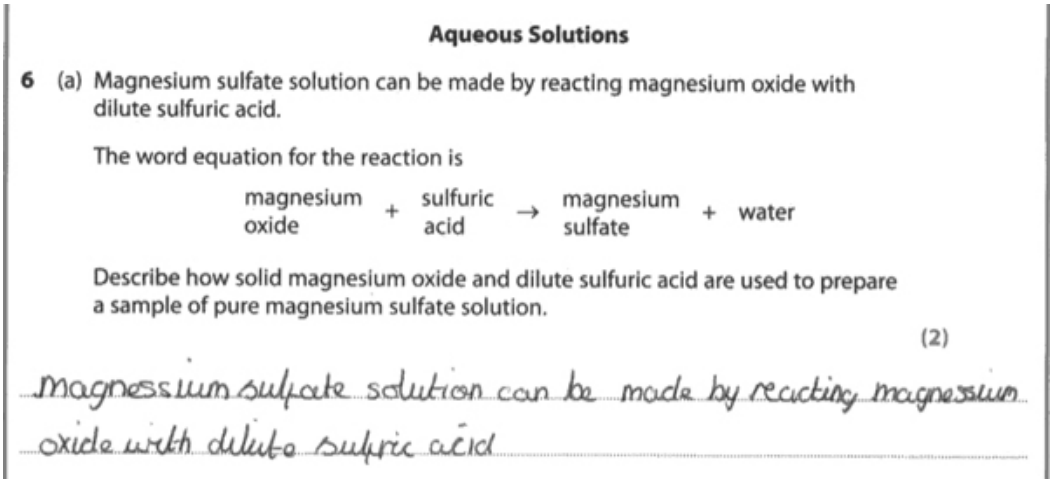
Results Plus: Examiner Comments

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

Q8.

(a)

This was very poorly answered on the whole. Most candidates failed to score or had no idea what was required for the 2 marks available. Many simply repeated the stem of the question or confused the reaction for a precipitation reaction and incorrectly suggested filtering the product. The reaction of acids and bases is clearly covered in the specification. However, from the vast majority of responses seen, it was clear that candidates from most centres may neither have carried out this particular practical nor that of the preparation of a similar soluble salt.



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

(2)

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Results Plus: Examiner Comments

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

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

(2)

The magnesium oxide is mixed with the sulfuric acid, ace mixed you filter out the excess water and are left with pure magnesium sulfate

Results Plus: Examiner Comments

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

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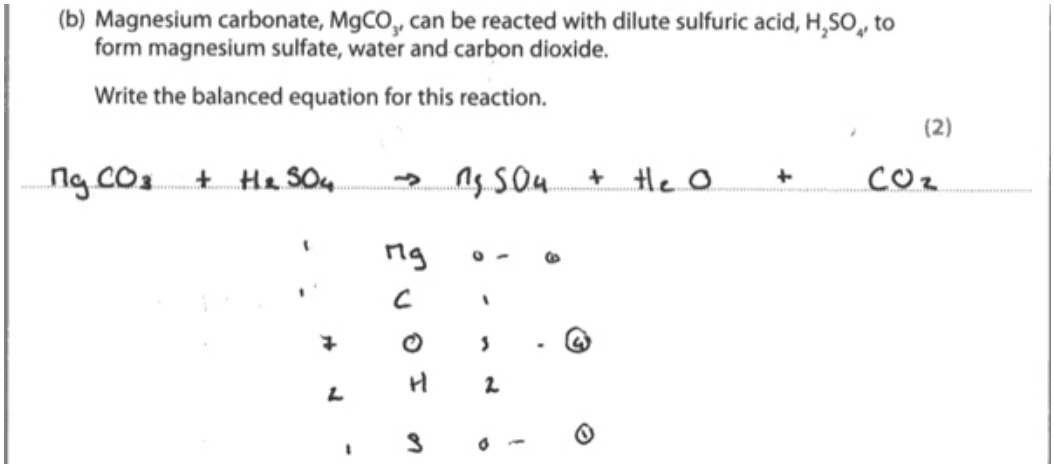
They are mixed together and then heated and filtered.

Results Plus: Examiner Comments

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

(b)

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


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

Write the balanced equation for this reaction.

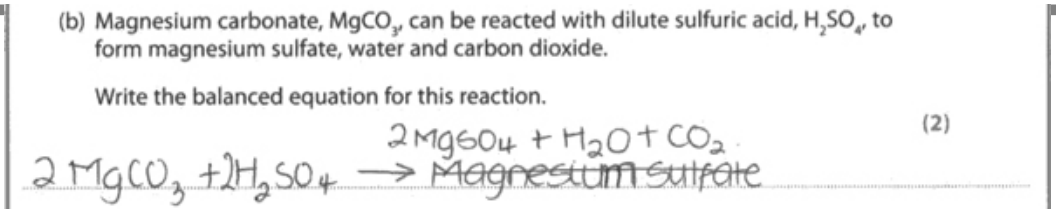
(2)

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

Mg 0 - 0
C 1
3 O 3 - ③
2 H 2
1 S 0 - ①

Results Plus: Examiner Comments

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


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

Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

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

(c)

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

(d)

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

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

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Results Plus: Examiner Comments

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

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

Results Plus: Examiner Comments

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

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

Results Plus: Examiner Comments

This response makes a reference to the removal of temporary hardness by boiling and the use of ion exchange resin for the removal of permanent hardness, with boiling not being enough for

permanent hardness removal. This description is detailed and is sufficient for Level 2, so was awarded 4 marks. There is no explanation given to support a higher Level 3 (5-6 marks) answer.

Q9. No Examiner's Report available for this question

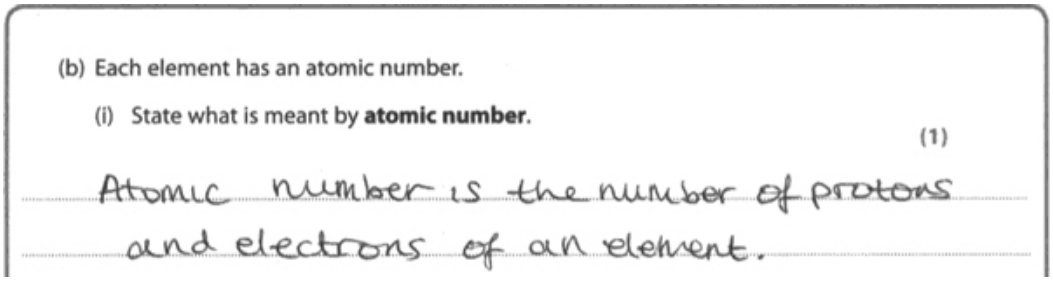
Q10. No Examiner's Report available for this question

Q11. No Examiner's Report available for this question

Q12.

(i)

The definition of atomic number was well known by most candidates although many needed the benefit of 'the number of protons and electrons' being accepted. Of the incorrect responses, some confused atomic number with mass number and a few lost the mark by saying it was the number of electrons without referring to protons and a minority suggested it meant the number of atoms.


(b) Each element has an atomic number.

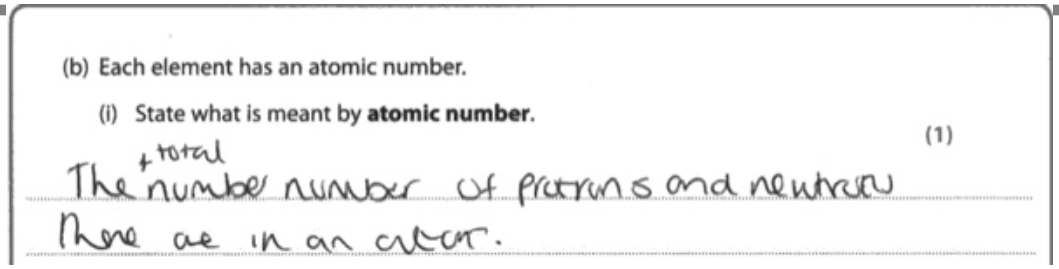
(i) State what is meant by **atomic number**.

(1)

Atomic number is the number of protons and electrons of an element.

Results Plus: Examiner Comments

This was given the benefit of the doubt and accepted for a mark.


(b) Each element has an atomic number.

(i) State what is meant by **atomic number**.

(1)

The + total number number of protons and neutrons there are in an atom.

Results Plus: Examiner Comments

Some confused it with mass number.

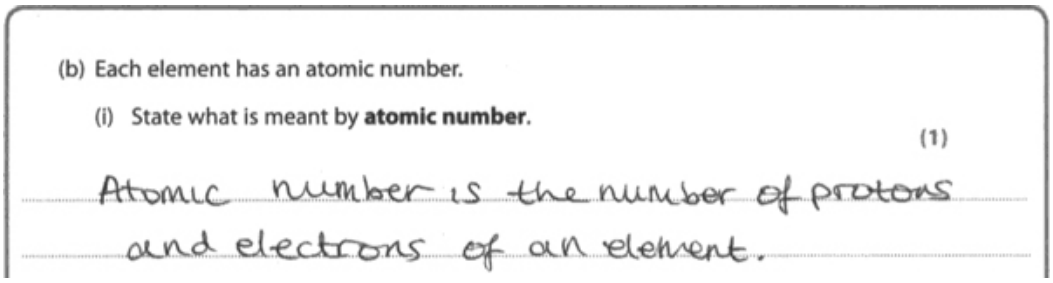
(ii)

The definition of an isotope was well known by many who gave the more generic answer involving atoms having the same number of protons but different number of neutrons, rather than referring specifically to boron. Some lost one mark as they did not refer to protons in their answer.

Q13.

(i)

The definition of atomic number was well known by most candidates although many needed the benefit of 'the number of protons and electrons' being accepted. Of the incorrect responses, some confused atomic number with mass number and a few lost the mark by saying it was the number of electrons without referring to protons and a minority suggested it meant the number of atoms.


(b) Each element has an atomic number.

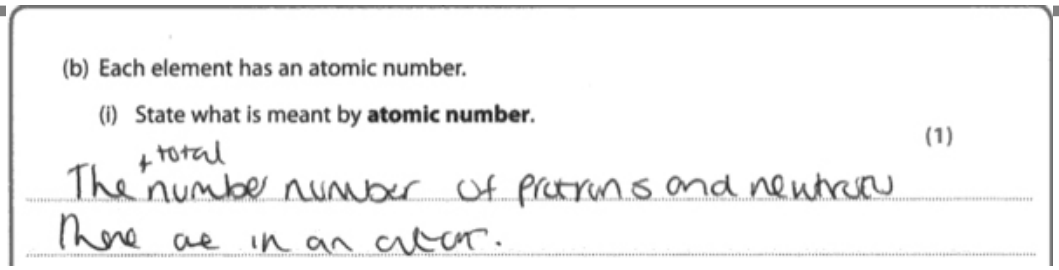
(i) State what is meant by **atomic number**.

(1)

Atomic number is the number of protons and electrons of an element.

Results Plus: Examiner Comments

This was given the benefit of the doubt and accepted for a mark.


(b) Each element has an atomic number.

(i) State what is meant by **atomic number**.

(1)

The total number number of protons and neutrons there are in an atom.

Results Plus: Examiner Comments

Some confused it with mass number.

(ii)

The definition of an isotope was well known by many who gave the more generic answer involving atoms having the same number of protons but different number of neutrons, rather than referring specifically to boron. Some lost one mark as they did not refer to protons in their

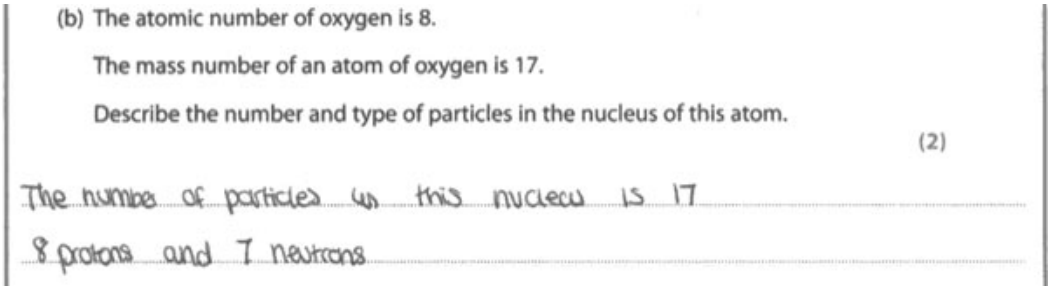
answer.

Q14.

(b)

Many candidates answered this question very well giving the expected answer of 8 protons and 9 neutrons in the nucleus. Candidates sometimes just stated 8 protons, 9 neutrons and 8 electrons, implying, probably without intending to do so as they did not make a clear enough distinction between the nucleus and the rest of the atom, that the nucleus contained all three sub-atomic particles. Poor maths was evident in the processing of the numbers of particles: candidates also confused atomic number and mass number and therefore obtained incorrect values for the numbers of protons and of neutrons.

Unfortunately in this question, many candidates had not comprehended the significance of the information about the oxygen atom given in the question. This question was about the oxygen-17 isotope and was deliberately chosen so it was clear how the numbers of protons and neutrons had been obtained. Some candidates thought they should point out what they perceived as an error and gave the answer of 8 protons and 8 neutrons – they achieved one mark for this. Doing this they showed that they did not understand the difference between the terms 'relative atomic mass' (as given on the periodic table) and 'mass number' (as referred to in the question), since only the mass number could give the total number of protons and neutrons.



(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

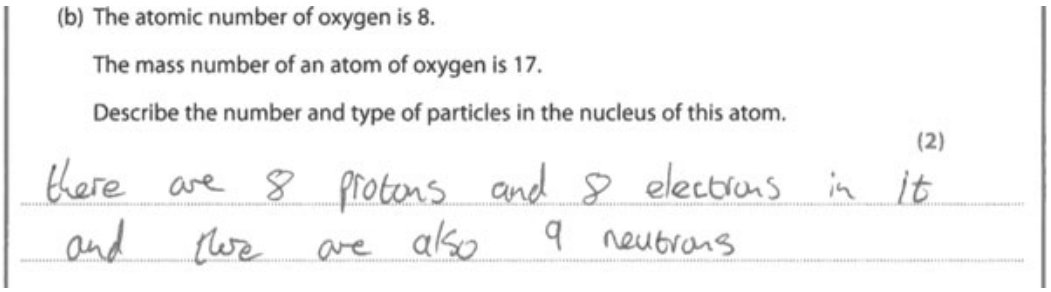
(2)

The numbe of particles in this nucleus is 17

8 protons and 7 neutrons

Results Plus: Examiner Comments

Evidence of poor maths skills. One mark scored for the correct number of protons.



(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

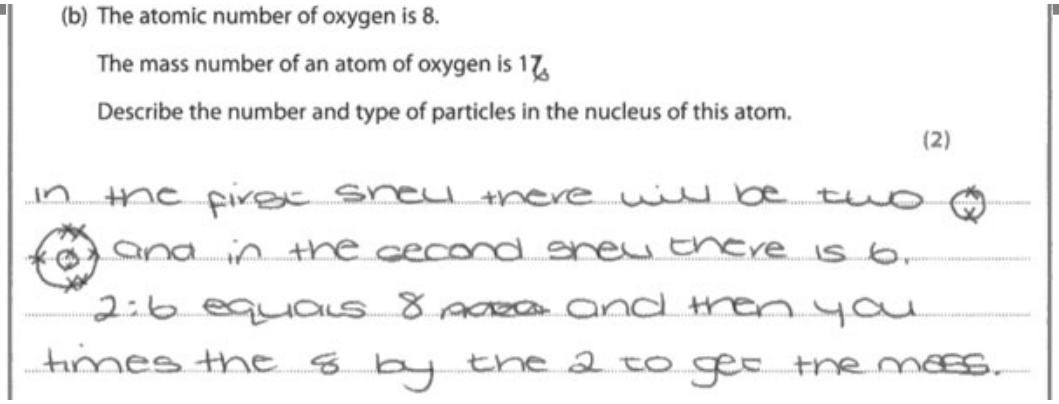
Describe the number and type of particles in the nucleus of this atom.

(2)

there are 8 protons and 8 electrons in it and there are also 9 neutrons

Results Plus: Examiner Comments

Several answers were seen like this. It was not clear if they understood where the electrons were located in an atom. Answers like this scored one mark, as the presence of the electrons stopped the awarding of the second mark.


(b) The atomic number of oxygen is 8.

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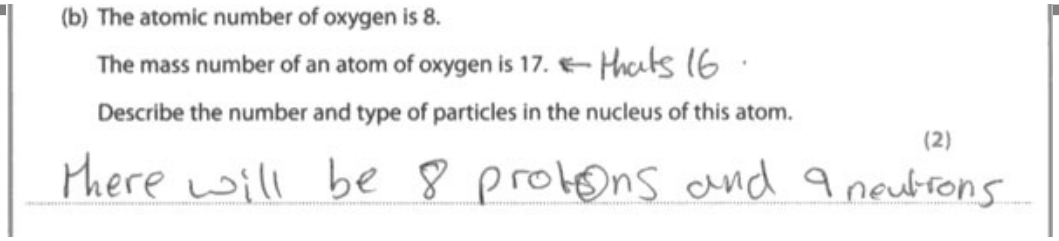
Describe the number and type of particles in the nucleus of this atom.

(2)

In the first shell there will be two and in the second shell there is 6. 2:6 equals 8 and then you times the 8 by the 2 to get the mass.

Results Plus: Examiner Comments

Here is an example of an answer where the candidate had wrongly corrected the mass number of the oxygen atom. In this case the answer then went on to describe the electron arrangement and showed they did not understand the arrangement of particles in an atom. This answer scored 0 marks.


(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17. ← Thats 16.

Describe the number and type of particles in the nucleus of this atom.

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There will be 8 protons and 9 neutrons

Results Plus: Examiner Comments

Although here the candidate pointed out a perceived error, they then chose to ignore it and obtained two marks for the correct answer.

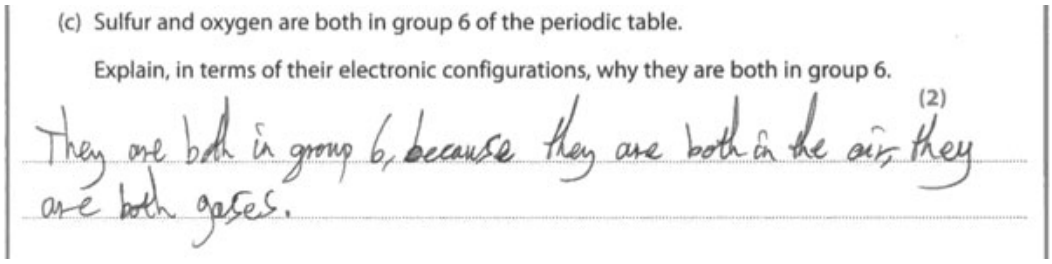
Results Plus: Examiner Tip

Learn the difference between relative atomic mass and mass number. Learn the basic properties of the sub-atomic particles - mass, relative charge and location.

(c)

This question was answered generally well, with many scoring 2 marks. Of the correct answer the majority were of the type stating that both oxygen and sulfur were in group 6 because their atoms had 6 electrons in the outer shell and the minority were of the type where their atoms both needed two more electrons to fill the outer shell.

Common errors included references to them being in group 6 as they were both gases or noble/Nobel [sic] gases. There was frequent reference to the atomic number and mass number e.g. those of sulfur being double that of oxygen: 8 → 16 or 16 → 32. Often a reference was made to oxygen and sulfur having same properties, qualities or reactivity or to them both being non-metals, gases or non-conductors. In these instances, the candidates were not answering the question as given.


(c) Sulfur and oxygen are both in group 6 of the periodic table.

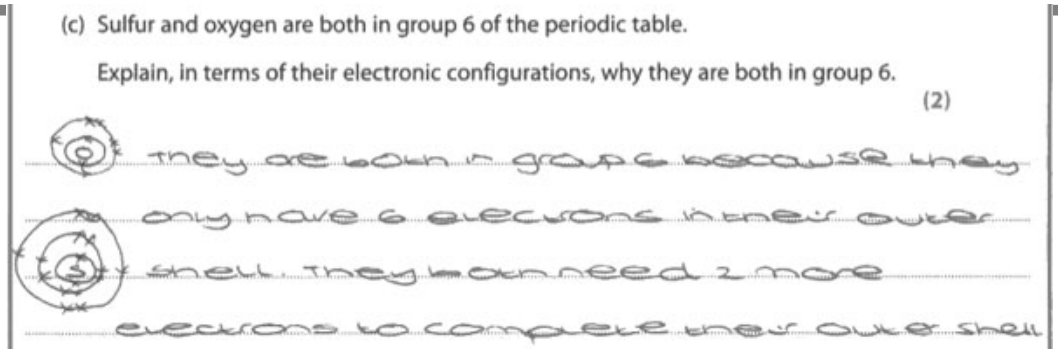
Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

They are both in group 6, because they are both in the air, they are both gases.

Results Plus: Examiner Comments

This did not answer the question and scored 0 marks.


(c) Sulfur and oxygen are both in group 6 of the periodic table.

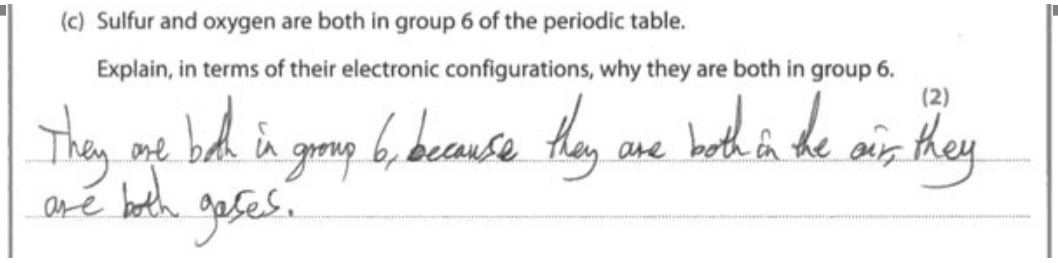
Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

They are both in group 6 because they only have 6 electrons in their outer shell. They both need 2 more electrons to complete their outer shell

Results Plus: Examiner Comments

This was a very good answer scoring 2 marks.


(c) Sulfur and oxygen are both in group 6 of the periodic table.

Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

They are both in group 6, because they are both in the air, they are both gases.

Results Plus: Examiner Comments

One of a number of common errors seen in the marking of this question. 0 marks given.

Results Plus: Examiner Tip

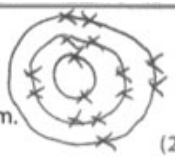
Understand how the electronic configuration of an atom of an element is related to the position of that element in the periodic table.

(d)

Generally, this question was answered well; most candidates scored both marks sometimes by the inclusion of a correct electronic configuration diagram. Occasionally seen was references to shells of atoms e.g. 2 atoms on first shell. There were some vague responses such as the electrons were 'around the nucleus' or 'in circles dotted around the nucleus'. Some candidates gave incorrect shells such as 2, 10, 5 with incorrect numbers of electrons that the shells could hold.

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom. (2)



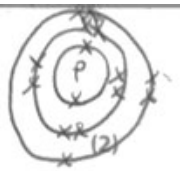
it will be arranged with 3 spare places on its outer shell. it may take electrons from other elements atoms, or it may join with three hydrogen atoms

Results Plus: Examiner Comments

The answer was helped with the inclusion of the electronic configuration diagram. This was given 2 marks.

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom. (2)



These 15 electrons are arranged in a phosphorus atom with two electrons in the nucleus, eight in the first shell and five in the outer shell.

Results Plus: Examiner Comments

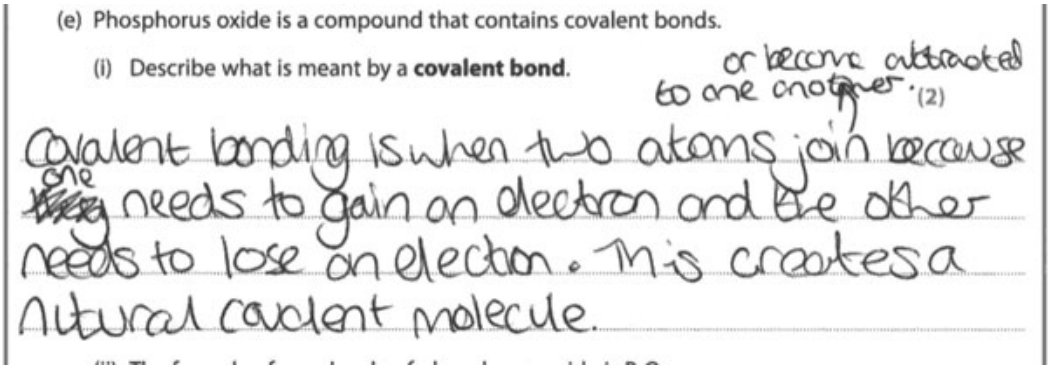
Although there was a clear electronic configuration diagram to aid this answer, there was some confusion as to where the electrons were located. Unfortunately the candidate had thought the inner circle of the diagram was part of the nucleus, and so only the mark for the correct number of electrons in the outer shell could be given.

Results Plus: Examiner Tip

Learn the maximum number of electrons that can be held in an electron shell and how the electronic configuration can be worked out.

(e) (i)

Of the candidates who scored at least one mark for this question, the greater majority obtained 1 mark for the idea of sharing electrons between two atoms. Only a few indicated that a pair of / two electrons were shared. Many others had indicated a sharing of electrons, but between elements rather than between atoms and so could not be given that mark. A number of candidates had confused ionic with covalent bonding and wrote about electrons being transferred.

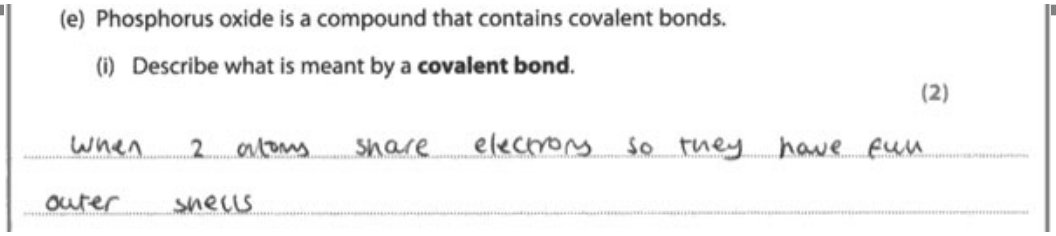

(e) Phosphorus oxide is a compound that contains covalent bonds.

(i) Describe what is meant by a **covalent bond**. or become attracted to one another. (2)

Covalent bonding is when two atoms join because one needs to gain an electron and the other needs to lose an electon. This creates a natural covalent molecule.

Results Plus: Examiner Comments

There is confusion here between ionic and covalent bonding. This answer was given 0 marks.


(e) Phosphorus oxide is a compound that contains covalent bonds.

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

When 2 atoms share electrons so they have full outer shells

Results Plus: Examiner Comments

One mark was given for the sharing of electrons. No mention was made of the number of electrons in the covalent bond.

Results Plus: Examiner Tip

Know the difference between covalent and ionic bonding and how the two types of bonding are formed.

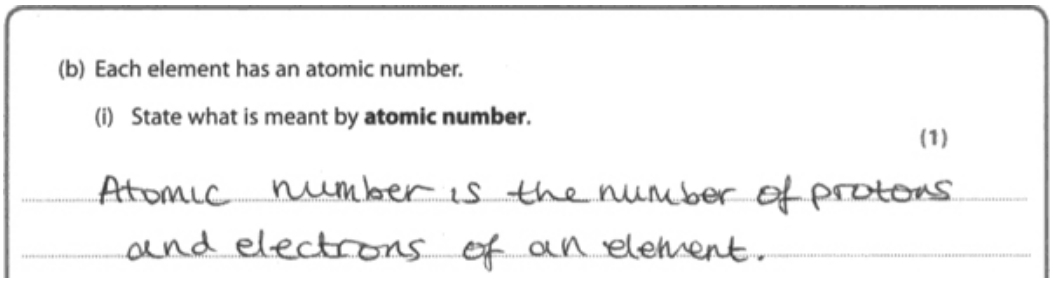
(e) (ii)

Only a small number of candidates knew that the empirical formula meant the simplest ratio of the atoms in the formula of a substance. Many calculated the formula mass or contrived some other form of response, but most left this question unanswered.

Q15.

(b) (i)

The definition of atomic number was well known by most candidates although many needed the benefit of 'the number of protons and electrons' being accepted. Of the incorrect responses, some confused atomic number with mass number and a few lost the mark by saying it was the number of electrons without referring to protons and a minority suggested it meant the number of atoms.


(b) Each element has an atomic number.

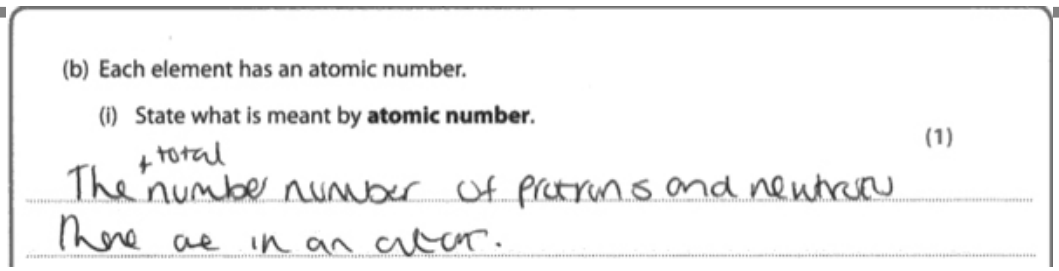
(i) State what is meant by **atomic number**.

(1)

Atomic number is the number of protons and electrons of an element.

Results Plus: Examiner Comments

This was given the benefit of the doubt and accepted for a mark.


(b) Each element has an atomic number.

(i) State what is meant by **atomic number**.

(1)

The total number number of protons and neutrons there are in an atom.

Results Plus: Examiner Comments

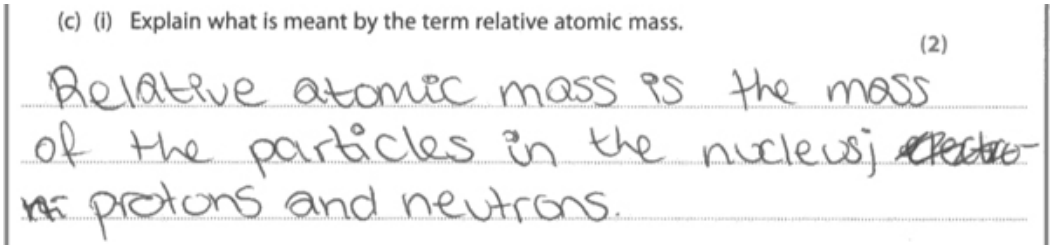
Some confused it with mass number.

(b) (ii)

The definition of an isotope was well known by many who gave the more generic answer involving atoms having the same number of protons but different number of neutrons, rather than referring specifically to boron. Some lost one mark as they did not refer to protons in their answer.

(c) (i)

This proved to be a very difficult question for all except the very strongest candidates. Even of those, very few candidates scored both marks. Most answers seen referred to "the number of protons and neutrons added together" without any mention of relative atomic mass being an average. Very few referred to carbon-12. A quite frequently seen incorrect answer was a reference to "the top number on the symbol in the periodic table".


(c) (i) Explain what is meant by the term relative atomic mass.

(2)

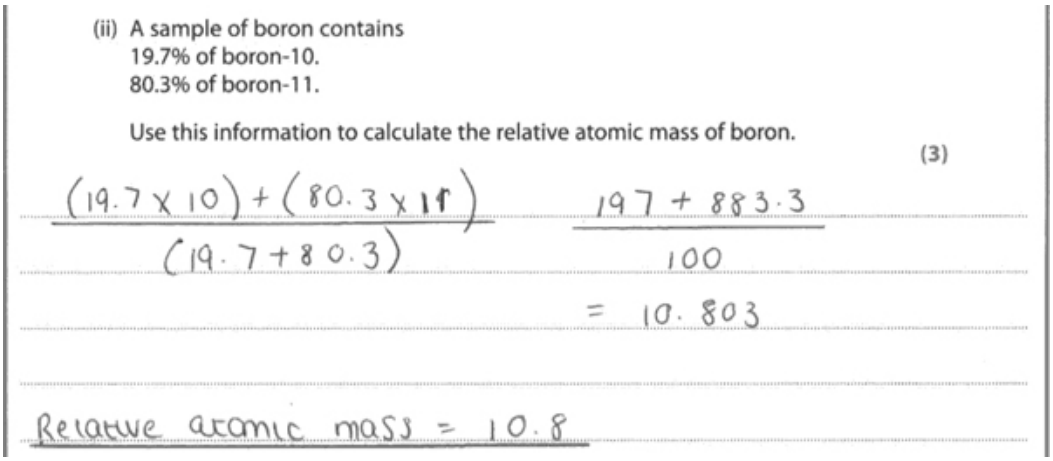
Relative atomic mass is the mass of the particles in the nucleus; ~~electro~~ protons and neutrons.

Results Plus: Examiner Comments

An all too common answer which did not gain any marks.

(c) (ii)

Many of the stronger candidates knew how to do this calculation and scored full marks with ease. A few scored the first two method marks but then failed to divide by 100 or divided by 21 so lost the third mark. Those who did not know the method required, either used the numbers in a random manner or did not attempt the question at all.


(ii) A sample of boron contains
19.7% of boron-10.
80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

$\frac{(19.7 \times 10) + (80.3 \times 11)}{(19.7 + 80.3)}$ $\frac{197 + 883.3}{100}$

$= 10.803$

Relative atomic mass = 10.8

Results Plus: Examiner Comments

A well-presented answer for full marks.

(ii) A sample of boron contains
19.7% of boron-10.
80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

Boron - 10 = 19.7 %

Boron - 11 = 80.3 %

(10 × 19.7) + (11 × 80.3)

197 + 883.3

Results Plus: Examiner Comments

This candidate gained the first two marks but did not divide by 100 so did not gain the third mark.

Q16.

(b)

Many candidates answered this question very well giving the expected answer of 8 protons and 9 neutrons in the nucleus. Candidates sometimes just stated 8 protons, 9 neutrons and 8 electrons, implying, probably without intending to do so as they did not make a clear enough distinction between the nucleus and the rest of the atom, that the nucleus contained all three sub-atomic particles. Poor maths was evident in the processing of the numbers of particles: candidates also confused atomic number and mass number and therefore obtained incorrect values for the numbers of protons and of neutrons.

Unfortunately in this question, many candidates had not comprehended the significance of the information about the oxygen atom given in the question. This question was about the oxygen-17 isotope and was deliberately chosen so it was clear how the numbers of protons and neutrons had been obtained. Some candidates thought they should point out what they perceived as an error and gave the answer of 8 protons and 8 neutrons – they achieved one mark for this. Doing this they showed that they did not understand the difference between the terms 'relative atomic mass' (as given on the periodic table) and 'mass number' (as referred to in the question), since only the mass number could give the total number of protons and neutrons.

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

The number of particles in this nucleus is 17

8 protons and 7 neutrons

Results Plus: Examiner Comments

Evidence of poor maths skills. One mark scored for the correct number of protons.

(b) The atomic number of oxygen is 8.

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Describe the number and type of particles in the nucleus of this atom.

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there are 8 protons and 8 electrons in it and there are also 9 neutrons

Results Plus: Examiner Comments

Several answers were seen like this. It was not clear if they understood where the electrons were located in an atom. Answers like this scored one mark, as the presence of the electrons stopped the awarding of the second mark.

(b) The atomic number of oxygen is 8.

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Describe the number and type of particles in the nucleus of this atom.

(2)

in the first shell there will be two  and in the second shell there is 6. 2:6 equals 8 and then you times the 8 by the 2 to get the mass.

Results Plus: Examiner Comments

Here is an example of an answer where the candidate had wrongly corrected the mass number of the oxygen atom. In this case the answer then went on to describe the electron arrangement and showed they did not understand the arrangement of particles in an atom. This answer scored 0 marks.

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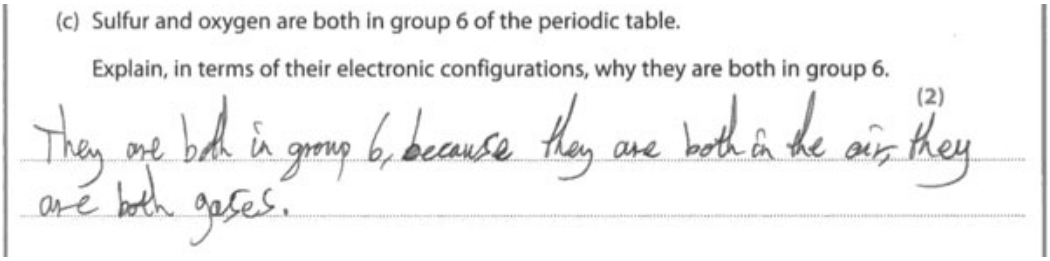
Results Plus: Examiner Tip

Learn the difference between relative atomic mass and mass number. Learn the basic properties of the sub-atomic particles - mass, relative charge and location.

(c)

This question was answered generally well, with many scoring 2 marks. Of the correct answer the majority were of the type stating that both oxygen and sulfur were in group 6 because their atoms had 6 electrons in the outer shell and the minority were of the type where their atoms both needed two more electrons to fill the outer shell.

Common errors included references to them being in group 6 as they were both gases or noble/Nobel [sic] gases. There was frequent reference to the atomic number and mass number e.g. those of sulfur being double that of oxygen: 8 → 16 or 16 → 32. Often a reference was made to oxygen and sulfur having same properties, qualities or reactivity or to them both being non-metals, gases or non-conductors. In these instances, the candidates were not answering the question as given.


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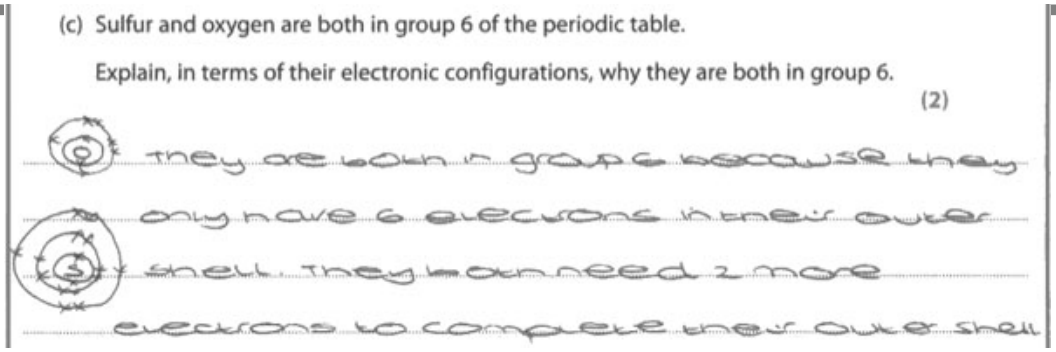
Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

They are both in group 6, because they are both in the air, they are both gases.

Results Plus: Examiner Comments

This did not answer the question and scored 0 marks.


(c) Sulfur and oxygen are both in group 6 of the periodic table.

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Results Plus: Examiner Comments

This was a very good answer scoring 2 marks.

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Explain, in terms of their electronic configurations, why they are both in group 6.

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They are both in group 6, because they are both in the air, they are both gases.

Results Plus: Examiner Comments

One of a number of common errors seen in the marking of this question. 0 marks given.

Results Plus: Examiner Tip

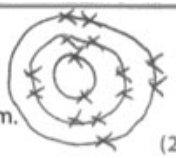
Understand how the electronic configuration of an atom of an element is related to the position of that element in the periodic table.

(d)

Generally, this question was answered well; most candidates scored both marks sometimes by the inclusion of a correct electronic configuration diagram. Occasionally seen was references to shells of atoms e.g. 2 atoms on first shell. There were some vague responses such as the electrons were 'around the nucleus' or 'in circles dotted around the nucleus'. Some candidates gave incorrect shells such as 2, 10, 5 with incorrect numbers of electrons that the shells could hold.

(d) An atom of phosphorus contains 15 electrons.

Describe how these 15 electrons are arranged in a phosphorus atom.



(2)

it will be arranged with 3 spare places on its outer shell. it may take electrons from other atoms, or it may join with three hydrogen atoms

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The answer was helped with the inclusion of the electronic configuration diagram. This was given 2 marks.

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These 15 electrons are arranged in a phosphorus atom with ~~3~~ two electrons in the nucleus, eight in the first shell and five in the outer shell.

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Although there was a clear electronic configuration diagram to aid this answer, there was some confusion as to where the electrons were located. Unfortunately the candidate had thought the inner circle of the diagram was part of the nucleus, and so only the mark for the correct number of electrons in the outer shell could be given.

Results Plus: Examiner Tip

Learn the maximum number of electrons that can be held in an electron shell and how the electronic configuration can be worked out.

(e) (i)

Of the candidates who scored at least one mark for this question, the greater majority obtained 1 mark for the idea of sharing electrons between two atoms. Only a few indicated that a pair of / two electrons were shared. Many others had indicated a sharing of electrons, but between elements rather than between atoms and so could not be given that mark. A number of candidates had confused ionic with covalent bonding and wrote about electrons being transferred.

(e) Phosphorus oxide is a compound that contains covalent bonds.

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

or become attracted to one another. (2)

Covalent bonding is when two atoms join because ~~they~~ one needs to gain an electron and the other needs to lose an electron. This creates a natural covalent molecule.

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There is confusion here between ionic and covalent bonding. This answer was given 0 marks.

(e) Phosphorus oxide is a compound that contains covalent bonds.

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When 2 atoms share electrons so they have full outer shells

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One mark was given for the sharing of electrons. No mention was made of the number of electrons in the covalent bond.

Results Plus: Examiner Tip

Know the difference between covalent and ionic bonding and how the two types of bonding are formed.

(e) (ii)

Only a small number of candidates knew that the empirical formula meant the simplest ratio of the atoms in the formula of a substance. Many calculated the formula mass or contrived some other form of response, but most left this question unanswered.

Q17.

(b) (i)

The definition of atomic number was well known by most candidates although many needed the benefit of 'the number of protons and electrons' being accepted. Of the incorrect responses, some confused atomic number with mass number and a few lost the mark by saying it was the number of electrons without referring to protons and a minority suggested it meant the number of atoms.

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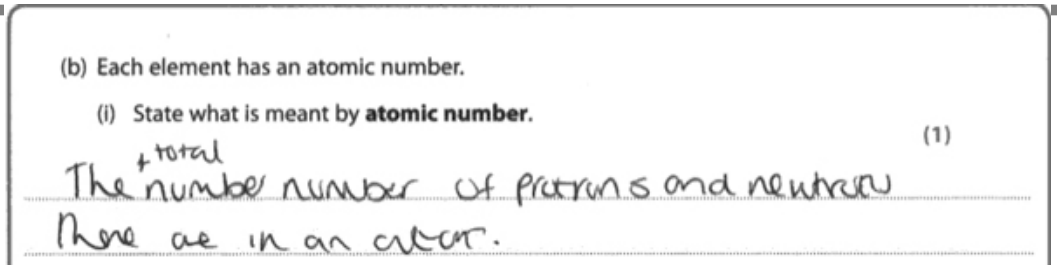
(i) State what is meant by **atomic number**.

(1)

Atomic number is the number of protons and electrons of an element.

Results Plus: Examiner Comments

This was given the benefit of the doubt and accepted for a mark.


(b) Each element has an atomic number.

(i) State what is meant by **atomic number**. (1)

The total number number of protons and neutrons there are in an atom.

Results Plus: Examiner Comments

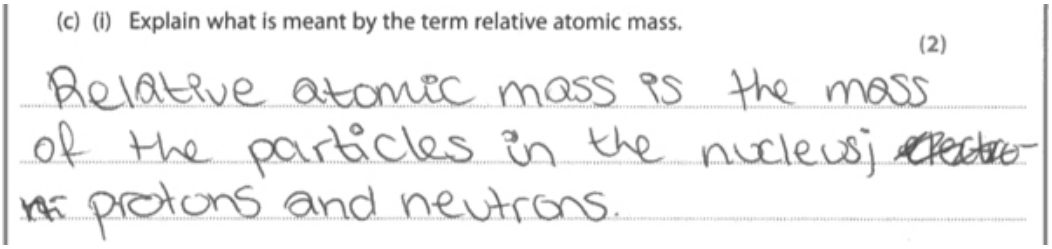
Some confused it with mass number.

(b) (ii)

The definition of an isotope was well known by many who gave the more generic answer involving atoms having the same number of protons but different number of neutrons, rather than referring specifically to boron. Some lost one mark as they did not refer to protons in their answer.

(c) (i)

This proved to be a very difficult question for all except the very strongest candidates. Even of those, very few candidates scored both marks. Most answers seen referred to "the number of protons and neutrons added together" without any mention of relative atomic mass being an average. Very few referred to carbon-12. A quite frequently seen incorrect answer was a reference to "the top number on the symbol in the periodic table".


(c) (i) Explain what is meant by the term relative atomic mass. (2)

Relative atomic mass is the mass of the particles in the nucleus ~~electrons~~ protons and neutrons.

Results Plus: Examiner Comments

An all too common answer which did not gain any marks.

(c) (ii)

Many of the stronger candidates knew how to do this calculation and scored full marks with ease. A few scored the first two method marks but then failed to divide by 100 or divided by 21 so lost the third mark. Those who did not know the method required, either used the numbers in a random manner or did not attempt the question at all.

(ii) A sample of boron contains
19.7% of boron-10.
80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

$\frac{(19.7 \times 10) + (80.3 \times 11)}{(19.7 + 80.3)}$ $\frac{197 + 883.3}{100}$

$= 10.803$

Relative atomic mass = 10.8

Results Plus: Examiner Comments

A well-presented answer for full marks.

(ii) A sample of boron contains
19.7% of boron-10.
80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

Boron - 10 = 19.7 %

Boron - 11 = 80.3 %

$(10 \times 19.7) + (11 \times 80.3)$

$197 + 883.3$

Results Plus: Examiner Comments

This candidate gained the first two marks but did not divide by 100 so did not gain the third mark.

Q18.

(a)

A large number of candidates failed to score marks here because they gave answers which clearly referred to the relative charges rather than the relative masses which were asked for.

Atoms and the periodic table

5 (a) Complete the table to show the relative mass of a neutron and of an electron.

(2)

particle	relative mass
proton	1
neutron	0
electron	-1

Results Plus: Examiner Comments

Responses like this were very common. The candidate has answered in terms of the relative charge of the particles when the question asked for relative masses.

Atoms and the periodic table

5 (a) Complete the table to show the relative mass of a neutron and of an electron.

(2)

particle	relative mass
proton	1
neutron	1
electron	Negligible

Results Plus: Examiner Comments

This response was worth both marks.

(c)

It was evident that there was some confusion about the meaning of atomic number and mass number with many getting the numbers of protons and neutrons mixed up. Many candidates also listed electrons in their answer but did not clarify they were not in the nucleus.

(c) The atomic number of lithium is 3.
The mass number of an atom of lithium is 7.

State the name and number of each of the particles in the nucleus of this atom.

(2)

In lithium it has 3 protons and electrons and it has 4 neutrons.

Results Plus: Examiner Comments

This candidate has correctly stated 3 protons and 4 neutrons but has also mentioned electrons so was only awarded 1 mark.

(c) The atomic number of lithium is 3.
The mass number of an atom of lithium is 7.

State the name and number of each of the particles in the nucleus of this atom.

(2)

It has 3 protons (in the nucleus) and electrons (not in the nucleus) whereas it has 4 neutrons (in the nucleus)

Results Plus: Examiner Comments

This answer was given both marks because although electrons were mentioned, the candidate made it clear that they were not in the nucleus.

Q19.

(a)

A large number of candidates failed to score marks here because they gave answers which clearly referred to the relative charges rather than the relative masses which were asked for.

Atoms and the periodic table

5 (a) Complete the table to show the relative mass of a neutron and of an electron.

(2)

particle	relative mass
proton	1
neutron	1
electron	−1

Results Plus: Examiner Comments

Responses like this were very common. The candidate has answered in terms of the relative charge of the particles when the question asked for relative masses.

5 (a) Complete the table to show the relative mass of a neutron and of an electron.

(2)

particle	relative mass
proton	1
neutron	1
electron	Negligible

Results Plus: Examiner Comments

This response was worth both marks.

(c)

It was evident that there was some confusion about the meaning of atomic number and mass number with many getting the numbers of protons and neutrons mixed up. Many candidates also listed electrons in their answer but did not clarify they were not in the nucleus.

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Results Plus: Examiner Comments

This answer was given both marks because although electrons were mentioned, the candidate made it clear that they were not in the nucleus.

Q20.

Many candidates answered this question very well giving the expected answer of 8 protons and 9 neutrons in the nucleus. Candidates sometimes just stated 8 protons, 9 neutrons and 8 electrons, implying, probably without intending to do so as they did not make a clear enough distinction between the nucleus and the rest of the atom, that the nucleus contained all three sub-atomic particles. Poor maths was evident in the processing of the numbers of particles: candidates also confused atomic number and mass number and therefore obtained incorrect values for the numbers of protons and of neutrons.

Unfortunately in this question, many candidates had not comprehended the significance of the information about the oxygen atom given in the question. This question was about the oxygen-17 isotope and was deliberately chosen so it was clear how the numbers of protons and neutrons had been obtained. Some candidates thought they should point out what they perceived as an error and gave the answer of 8 protons and 8 neutrons – they achieved one mark for this. Doing this they showed that they did not understand the difference between the terms 'relative atomic mass' (as given on the periodic table) and 'mass number' (as referred to in the question), since only the mass number could give the total number of protons and neutrons.

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

The numbe of particles in this nucleus is 17

8 protons and 7 neutrons

Results Plus: Examiner Comments

Evidence of poor maths skills. One mark scored for the correct number of protons.

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

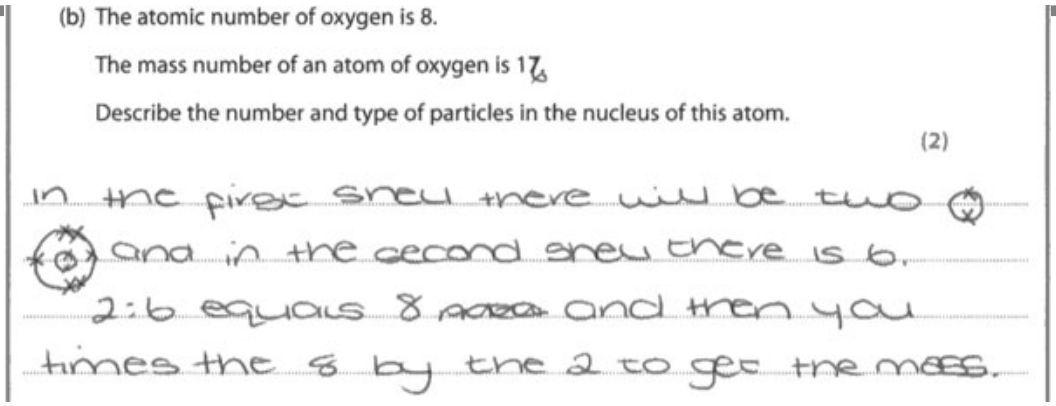
(2)

there are 8 protons and 8 electrons in it

and there are also 9 neutrons

Results Plus: Examiner Comments

Several answers were seen like this. It was not clear if they understood where the electrons were located in an atom. Answers like this scored one mark, as the presence of the electrons stopped the awarding of the second mark.



(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

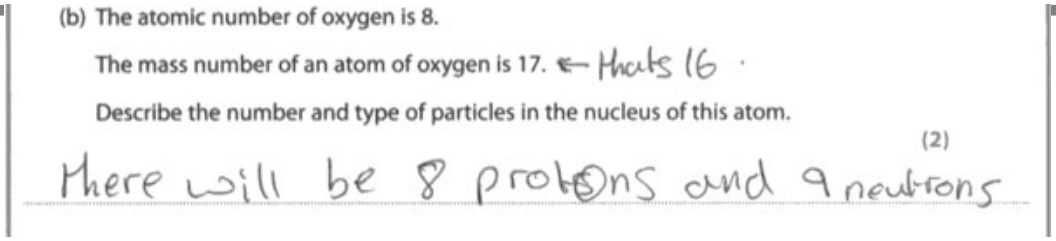
Describe the number and type of particles in the nucleus of this atom.

(2)

In the first shell there will be two ⊗ and in the second shell there is 6. 2:6 equals 8 and then you times the 8 by the 2 to get the mass.

Results Plus: Examiner Comments

Here is an example of an answer where the candidate had wrongly corrected the mass number of the oxygen atom. In this case the answer then went on to describe the electron arrangement and showed they did not understand the arrangement of particles in an atom. This answer scored 0 marks.



(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17. ← Thats 16.

Describe the number and type of particles in the nucleus of this atom.

(2)

There will be 8 protons and 9 neutrons

Results Plus: Examiner Comments

Although here the candidate pointed out a perceived error, they then chose to ignore it and obtained two marks for the correct answer.

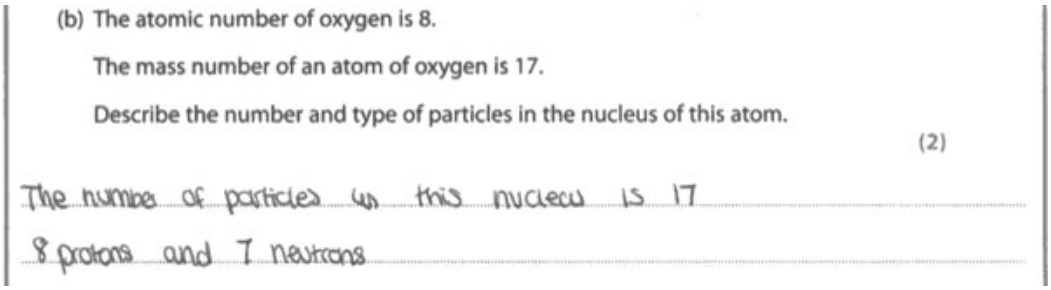
Results Plus: Examiner Tip

Learn the difference between relative atomic mass and mass number. Learn the basic properties of the sub-atomic particles - mass, relative charge and location.

Q21.

Many candidates answered this question very well giving the expected answer of 8 protons and 9 neutrons in the nucleus. Candidates sometimes just stated 8 protons, 9 neutrons and 8 electrons, implying, probably without intending to do so as they did not make a clear enough distinction between the nucleus and the rest of the atom, that the nucleus contained all three sub-atomic particles. Poor maths was evident in the processing of the numbers of particles: candidates also confused atomic number and mass number and therefore obtained incorrect values for the numbers of protons and of neutrons.

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The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

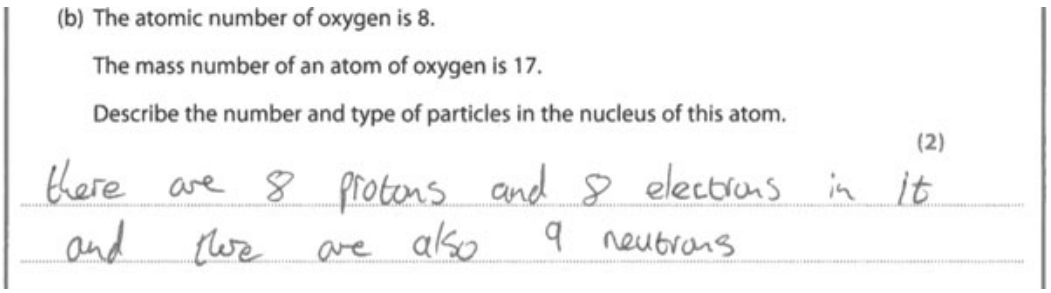
(2)

The numbe of particles in this nucleus is 17

8 protons and 7 neutrons

Results Plus: Examiner Comments

Evidence of poor maths skills. One mark scored for the correct number of protons.



(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

there are 8 protons and 8 electrons in it

and there are also 9 neutrons

Results Plus: Examiner Comments

Several answers were seen like this. It was not clear if they understood where the electrons were located in an atom. Answers like this scored one mark, as the presence of the electrons stopped the awarding of the second mark.

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17.

Describe the number and type of particles in the nucleus of this atom.

(2)

in the first shell there will be two  and in the second shell there is 6. 2:6 equals 8 and then you times the 8 by the 2 to get the mass.

Results Plus: Examiner Comments

Here is an example of an answer where the candidate had wrongly corrected the mass number of the oxygen atom. In this case the answer then went on to describe the electron arrangement and showed they did not understand the arrangement of particles in an atom. This answer scored 0 marks.

(b) The atomic number of oxygen is 8.

The mass number of an atom of oxygen is 17. ← Thats 16.

Describe the number and type of particles in the nucleus of this atom.

(2)

There will be 8 protons and 9 neutrons

Results Plus: Examiner Comments

Although here the candidate pointed out a perceived error, they then chose to ignore it and obtained two marks for the correct answer.

Results Plus: Examiner Tip

Learn the difference between relative atomic mass and mass number. Learn the basic properties of the sub-atomic particles - mass, relative charge and location.

Q22.

(i)

This was not well answered on the whole, with less than half responses scoring the 1 mark available for correctly calculating the number of moles of magnesium. The most common response seen was 0.00416 (dot over 6). Relatively few rounded to 0.0042, most that rounded

going to 0.004. Very few answers were given in standard form.

There were many candidates who used the two numbers of 0.1 and 24 in various other ways such as 24/0.1 or 0.1 × 24.

Of those who had the numbers in a correct fraction, some spoilt their answers by an incorrect approximation – 0.0416 is incorrect. Equally, leaving the answer as 0.1/24 was not accepted, the evaluation of the fraction is expected as the answer.

The balanced equation for this reaction is

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(i) In another experiment, 0.1 moles of hydrochloric acid, HCl, were reacted with 0.1 g of magnesium ribbon.

Calculate the number of moles of magnesium, Mg, in the 0.1 g sample of magnesium ribbon.
(relative atomic mass: Mg = 24)

(1)

Moles = $\frac{\text{mass}}{Mr}$ $\frac{0.1}{24} = 0.00416$

number of moles = 0.00416

Results Plus: Examiner Comments

This response scored the 1 mark available.

The candidate has recalled and used the correct formula needed to calculate the number of moles. Importantly, this has been correctly evaluated to give 0.00416 (with dot over the 6), which scores the mark.

The balanced equation for this reaction is

0.1g 0.1moles

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

(i) In another experiment, 0.1 moles of hydrochloric acid, HCl, were reacted with 0.1 g of magnesium ribbon.

Calculate the number of moles of magnesium, Mg, in the 0.1 g sample of magnesium ribbon.
(relative atomic mass: Mg = 24)

moles = mass / mr

(1)

= 0.1 / 24 =

number of moles = 4.17

Results Plus: Examiner Comments

This response did not score the 1 mark available.

The correct calculation has been shown, namely 0.1 / 24. This has not been evaluated and consequently cannot score the mark.

(ii)

Generally very poorly answered, with very few responses scoring the 1 mark available.

Only a few candidates understood the question as evidenced by how many scored the one mark. Many just left a blank space or rewrote the equation. Many tried to justify their answer by use of relative atomic masses.

(ii) In a further experiment, 0.5 mol of hydrochloric acid, HCl, were mixed with 0.5 mol of magnesium, Mg.

Use the equation to show that, in this experiment, the magnesium is in excess.

(1)

Ratio of Mg : HCl = 1 : 2

= 0.25 : 0.5

The magnesium is 0.25 mol in excess.

Results Plus: Examiner Comments

This response scored the 1 mark available.

The candidate correctly identifies the ratio of magnesium : hydrochloric acid and then goes on to show how much excess magnesium is present.

(ii) In a further experiment, 0.5 mol of hydrochloric acid, HCl, were mixed with 0.5 mol of magnesium, Mg.

Use the equation to show that, in this experiment, the magnesium is in excess.

(1)

0.5 mol of Mg = 12g ✓ HCl needs to be
∴ 0.5 mol of HCl = 18.25g ✓ twice as abundant as Magnesium.

Results Plus: Examiner Comments

This response was not creditworthy.

The candidate is attempting to use a ratio of masses to explain why hydrochloric acid is not in excess. However, this is incorrect as the stoichiometric coefficients in the equation are a ratio of moles.

Q23. No Examiner's Report available for this question

Q24.

(a) (i)

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

(a) (ii)

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

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

(1)

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

Results Plus: Examiner Comments

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

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

(1)

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

Results Plus: Examiner Comments

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

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

(1)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

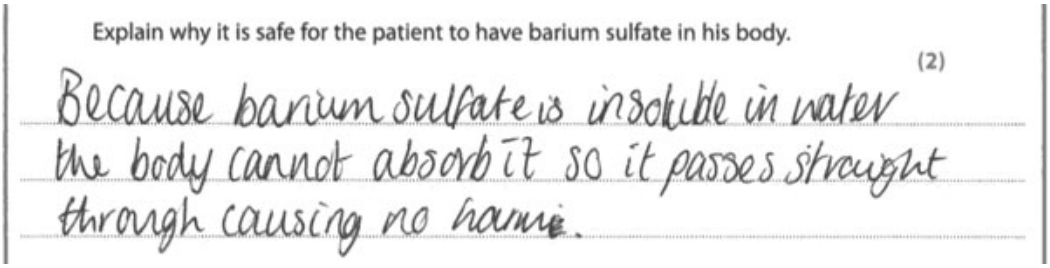
Know how ions are formed and know how to use the formulae of ions to be able to work out the formula of an ionic compound.

(b)

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

majority of those that did score a mark here was for indicating that the barium sulfate could not be absorbed into the blood system.

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

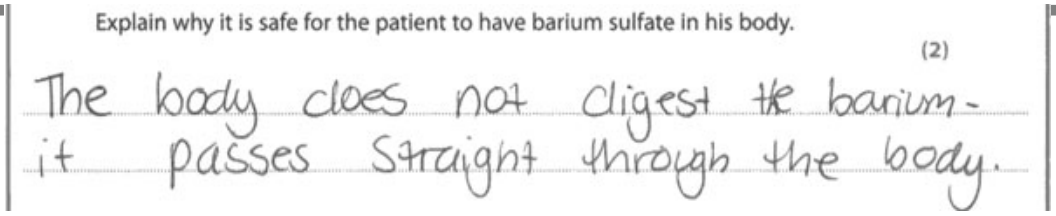

Explain why it is safe for the patient to have barium sulfate in his body.

(2)

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

Results Plus: Examiner Comments

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

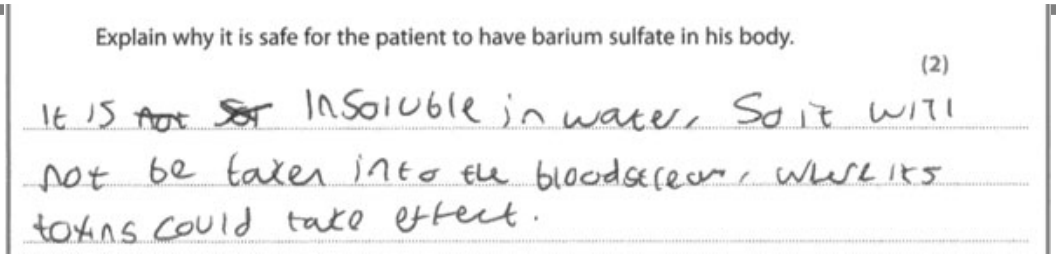

Explain why it is safe for the patient to have barium sulfate in his body.

(2)

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

Results Plus: Examiner Comments

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


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

(2)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

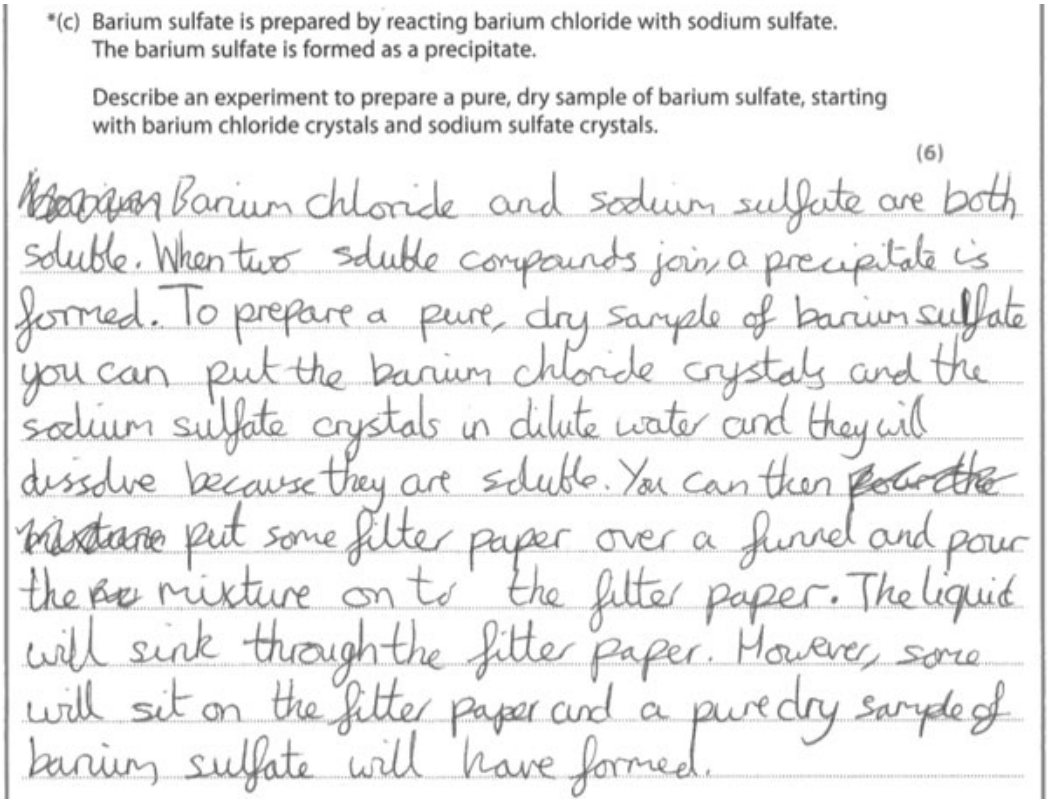
Rewriting part of the question does not gain credit. Take care to use scientific terminology in a correct context.

(c)

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

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

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



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

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

(6)

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

Results Plus: Examiner Comments

This was judged to be a level 2 answer. The candidate had indicated how the precipitate of barium sulfate could be made, but lacked detail. The precipitate was then filtered to obtain a

'pure dry sample', but the washing and drying parts of the process were not detailed. Overall a good answer at this level and 4 marks were given to this answer.

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

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

(6)

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

Results Plus: Examiner Comments

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

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

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

(6)

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

Results Plus: Examiner Comments

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

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

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

(6)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(d)

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

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

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

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

Write the balanced equation for this reaction.

(2)

$Ba_2 + Cl_2 \rightarrow BaCl_2$

Results Plus: Examiner Comments

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

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

Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

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

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

Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

Word equations do not score when asked for balanced equations.

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

Write the balanced equation for this reaction.

(2)

$Ba + 2Cl \rightarrow BaCl_2$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Spend time making sure you can balance simple equations.

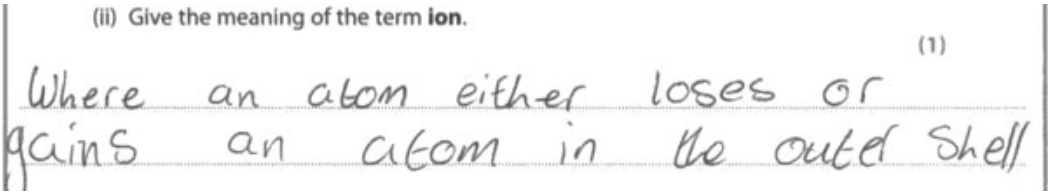
Q25.

(a) (i)

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

(a) (ii)

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

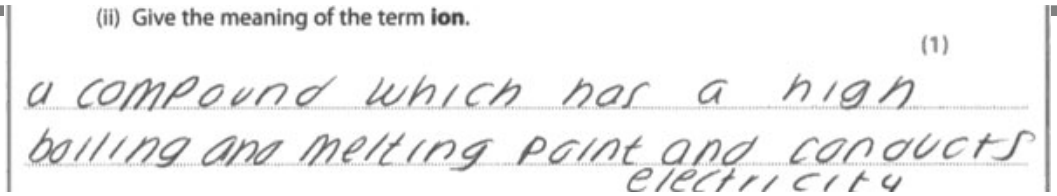

(ii) Give the meaning of the term **ion**.

(1)

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

Results Plus: Examiner Comments

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


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

(1)

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

Results Plus: Examiner Comments

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

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

(1)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(b)

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

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

(c)

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

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

A level 2 answer developed this a little further by filtering off the precipitate. Candidates'

explanations of filtration and drying were generally good if unsupported by a wider grasp of practical chemistry. A level 3 answer required the idea of drying the precipitate, hopefully having washed it with water before drying.

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

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

(6)

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

Results Plus: Examiner Comments

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

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

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

(6)

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

Results Plus: Examiner Comments

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

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

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

(6)

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

Results Plus: Examiner Comments

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

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

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

(6)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(d)

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

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

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

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

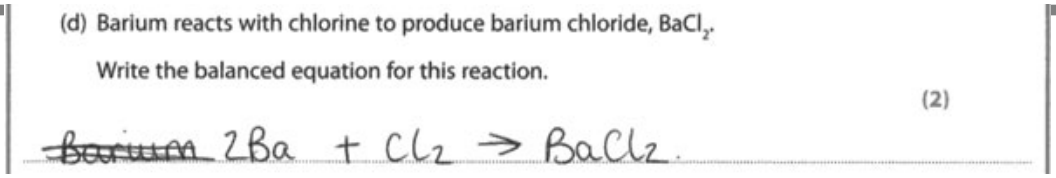
Write the balanced equation for this reaction.

(2)

$Ba_2 + Cl_2 \rightarrow BaCl_2$

Results Plus: Examiner Comments

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


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

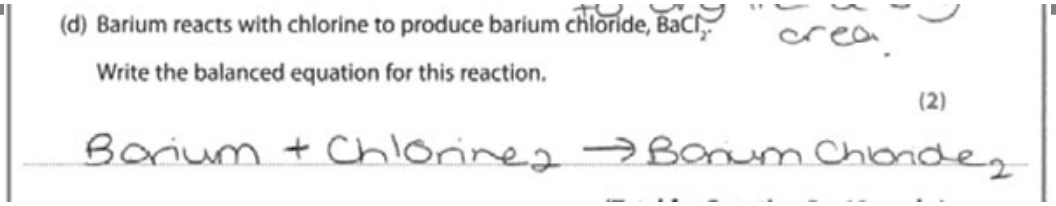
Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

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


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

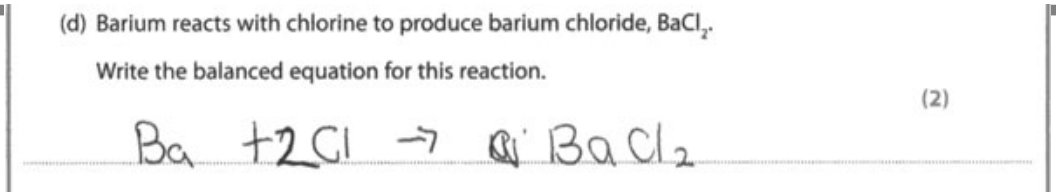
Write the balanced equation for this reaction.

(2)

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

Results Plus: Examiner Comments

Word equations do not score when asked for balanced equations.


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

Write the balanced equation for this reaction.

(2)

$Ba + 2Cl \rightarrow BaCl_2$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

Spend time making sure you can balance simple equations.

Q26. No Examiner's Report available for this question

Q27. No Examiner's Report available for this question

Q28.

(a)(i)

It was disappointing to see few candidates who understood that the dots in the diagram of diamond represented carbon atoms. There were many incorrect answers, including electrons and bonds.

(a)(ii)

The majority of candidates did know that diamond has covalent bonding.

(b)

Some candidates knew that fractional distillation is used to obtain oxygen from liquid air, but there were a lot of different incorrect answers including evaporation, oxidation, condensation, separation, respiration and photosynthesis.



Results Plus: Examiner Comments

Oxygen is obtained using a separation technique, but this did not score a mark as the specific separation process was required.

Results Plus: Examiner Tip

Learn the different processes that are used to separate the different types of mixtures in the specification.



Results Plus: Examiner Comments

This candidate scored 1 mark for distillation.



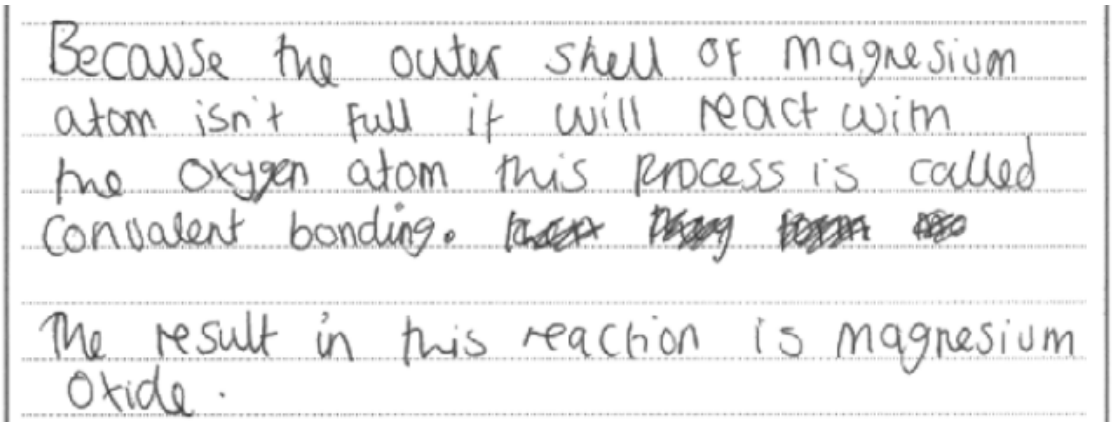
Results Plus: Examiner Comments

This is an example of a correct answer that scored 2 marks.

(d)

This question produced a good spread of marks. It could be answered at different levels from a simple description of an experiment to burn magnesium up to a detailed account of what happens to magnesium and oxygen atoms when they react. However, it was only possible to achieve level 3 if some description of the bonding was included in the answer. It was encouraging to read many excellent answers explaining the bonding in magnesium oxide. Some of the best answers included the use of dot and cross diagrams to explain the bonding.

Unfortunately some candidates were confused about the bonding. The question stated that magnesium oxide is an ionic compound but some candidates included sharing electrons, molecules or covalent bonding in their answers. These candidates received a maximum of 4 marks for their answer.



Results Plus: Examiner Comments

This answer did not score any marks. The candidate has the idea that the magnesium atom doesn't have a full outer shell, but that is not quite enough for a mark. If the candidate had added that magnesium has 2 electrons in the outer shell, it would have scored marks.

R4 when magnesium is heated up it reacts with oxygen from the air to form MgO. While they form MgO. Magnesium and oxygen share the electrons to fill in the outer^ shells. This is going to cause a reaction as now the outer shell is full.

Results Plus: Examiner Comments

The first sentence in this answer is just repeating information in the question so it does not receive any credit.

Although this candidate mentioned covalent bonding, which is incorrect, they were given credit for the idea that the outer shells are full. This is a level 1 answer and scored 2 marks.

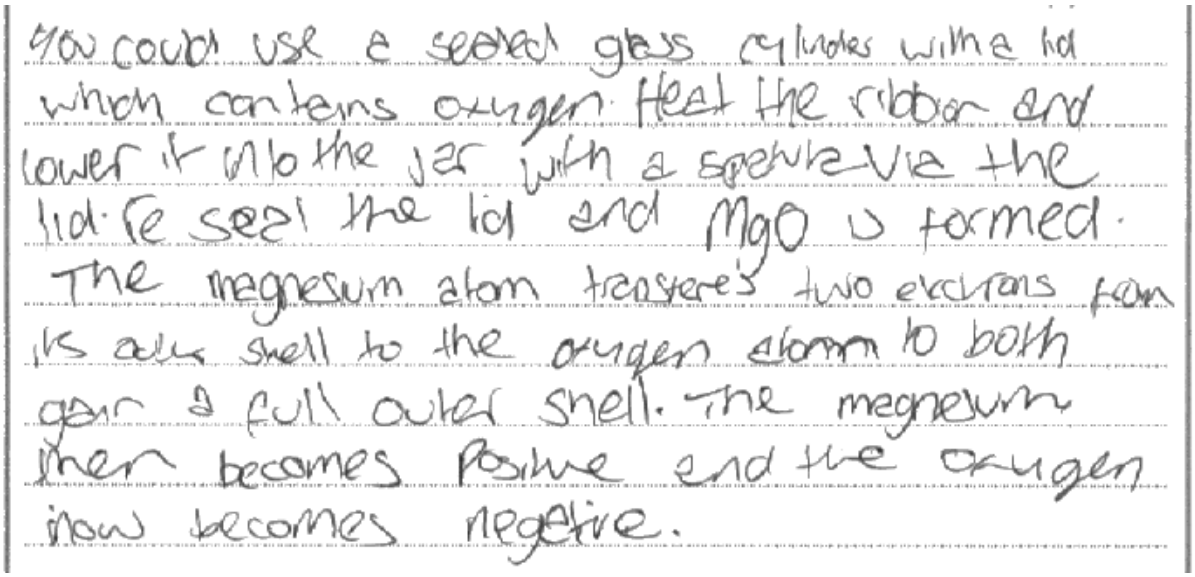

First of all you should wear safety goggles and if you are a girl tie your hair back to avoid your hair becoming singed from a bunsen burner. By using a pair of tongs you can pick up a magnesium ribbon and heat it. As you heat the ribbon the temperature reaches the magnesium atoms to have a lot of energy. These 2 different elements then react with eachother through covalent bonding because it is a strong bond between the 2 non metals. Then atoms share electrons to create a full outer shell.

Results Plus: Examiner Comments

This candidate has given a good description of the experiment to react magnesium with oxygen. However, they have then written about covalent bonding, which is incorrect. This is a level 2 answer, scoring 4 marks.

Results Plus: Examiner Tip

Read the information in the question carefully. If you are told that a substance has ionic bonding, don't write about covalent bonding in your answer.


You could use a sealed glass cylinder with a lid which contains oxygen. Heat the ribbon and lower it into the jar with a spatula via the lid. Re seal the lid and MgO is formed. The magnesium atom transfers two electrons from its outer shell to the oxygen atom so both gain a full outer shell. The magnesium then becomes positive and the oxygen now becomes negative.

Results Plus: Examiner Comments

This is a good level 3 answer that scored 6 marks. The candidate has written a description of an experiment to burn magnesium in oxygen and has given a detailed explanation of how magnesium and oxygen atoms form ions.

Q29.

(a)(i)

It was disappointing to see few candidates who understood that the dots in the diagram of diamond represented carbon atoms. There were many incorrect answers, including electrons and bonds.

(a)(ii)

The majority of candidates did know that diamond has covalent bonding.

(b)

Some candidates knew that fractional distillation is used to obtain oxygen from liquid air, but there were a lot of different incorrect answers including evaporation, oxidation, condensation, separation, respiration and photosynthesis.

Seperation

Results Plus: Examiner Comments

Oxygen is obtained using a separation technique, but this did not score a mark as the specific separation process was required.

Results Plus: Examiner Tip

Learn the different processes that are used to separate the different types of mixtures in the specification.

Distillation

Results Plus: Examiner Comments

This candidate scored 1 mark for distillation.

Fractional distillation allows you to obtain oxygen from liquid air.

Results Plus: Examiner Comments

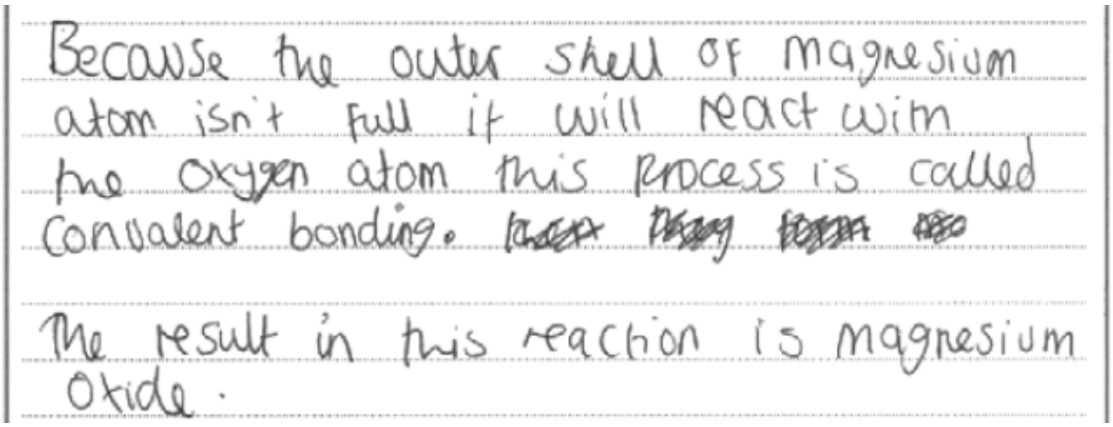
This is an example of a correct answer that scored 2 marks.

(d)

This question produced a good spread of marks. It could be answered at different levels from a simple description of an experiment to burn magnesium up to a detailed account of what happens to magnesium and oxygen atoms when they react. However, it was only possible to achieve level 3 if some description of the bonding was included in the answer. It was encouraging to read many excellent answers explaining the bonding in magnesium oxide. Some of the best answers included the use of dot and cross diagrams to explain the bonding.

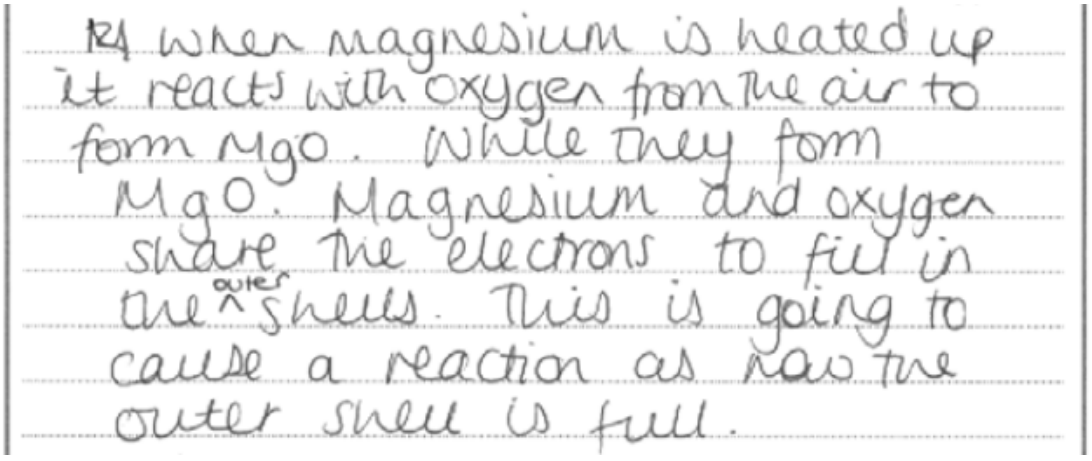
Unfortunately some candidates were confused about the bonding. The question stated that magnesium oxide is an ionic compound but some candidates included sharing electrons, molecules or covalent bonding in their answers. These candidates received a maximum of 4

marks for their answer.



Results Plus: Examiner Comments

This answer did not score any marks. The candidate has the idea that the magnesium atom doesn't have a full outer shell, but that is not quite enough for a mark. If the candidate had added that magnesium has 2 electrons in the outer shell, it would have scored marks.



Results Plus: Examiner Comments

The first sentence in this answer is just repeating information in the question so it does not receive any credit.

Although this candidate mentioned covalent bonding, which is incorrect, they were given credit for the idea that the outer shells are full. This is a level 1 answer and scored 2 marks.

First of all you should wear safety goggles and if you are a girl tie your hair back to avoid your hair becoming singed from a bunsen burner. By using a pair of tongs you can pick up a magnesium ribbon and heat it. As you heat the ribbon the temperature causes the magnesium atoms to have a lot of energy. There 2 different elements then react with eachother through covalent bonding because it is a strong bond between the 2 non metals. Next atoms share electrons to create a full outer shell.

Results Plus: Examiner Comments

This candidate has given a good description of the experiment to react magnesium with oxygen. However, they have then written about covalent bonding, which is incorrect. This is a level 2 answer, scoring 4 marks.

Results Plus: Examiner Tip

Read the information in the question carefully. If you are told that a substance has ionic bonding, don't write about covalent bonding in your answer.

You could use a sealed glass cylinder with a lid which contains oxygen. Heat the ribbon and lower it into the jar with a spatula via the lid. To seal the lid and MgO is formed. The magnesium atom transfers two electrons from its outer shell to the oxygen atom so both gain a full outer shell. The magnesium then becomes positive and the oxygen now becomes negative.

Results Plus: Examiner Comments

This is a good level 3 answer that scored 6 marks. The candidate has written a description of an experiment to burn magnesium in oxygen and has given a detailed explanation of how magnesium and oxygen atoms form ions.

Q30.

A small proportion of candidates were able to fully describe what is meant by a covalent bond to gain both marks.

More knew that a covalent bond involves the sharing of electrons, without stating that it was a shared pair of electrons.

In a few cases this question was answered using a diagram which was accepted if it showed a shared pair.

There were quite a few generalised answers such as 'it is a strong bond holding atoms together'.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

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

(2)

Sharing electrons to complete their outer shell of electrons

Results Plus: Examiner Comments

To score both marks, the number of shared electrons must be stated.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

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

(2)

A single bond joing the 2 atoms together.

Results Plus: Examiner Comments

A common error, not mentioning electrons at all.

(ii)

Explaining why chlorine is a gas rather than a liquid at room temperature was very hard for candidates and few could give an answer that related to the intermolecular forces involved.

Some knew that it had to do with forces between molecules but referred to these as bonds or covalent bonds and so did not gain credit.

Those that did score on this question often did so for showing an understanding that chlorine has a low boiling point, although some did confuse the melting point with the boiling point and so did not score.

When describing forces in between molecules, candidates should take care that they are using the correct scientific language at all times.

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

Chlorine has a low ~~t~~melting point, meaning even at a low temperature it has ~~a~~ ~~b~~ evaporated and turned into a gas.

Results Plus: Examiner Comments

This candidate has mixed melting and boiling.

Q31.

(i)

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

This question has been asked in this format for many years, but it was surprising to see how few candidates scored the two marks. The majority scored just 1 mark for a description involving the 'sharing of an electron or the sharing of electrons'.

Common errors, omissions, misconceptions:

In some responses candidates incorrectly described a covalent bond as being between 'two or more' elements or atoms or molecules.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

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

(2)

A covalent bond is ~~slear~~ where two atoms share a pair of electrons, mainly a gaseous atom and a metal.

Results Plus: Examiner Comments

This response scored 2 marks.

The correct reference to 'atoms share a pair of electrons' scores both marking points.

Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

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

(2)

A covalent bond is the sharing of electrons between two or more non-metals to get a full outer shell.

Results Plus: Examiner Comments

This answer was typical of a 1 mark response.

The reference to' sharing of electrons' is creditworthy. However, there is no reference in this response to the number of electrons shared, namely two.

Results Plus: Examiner Tip

Learn the definitions for the different types of bonding in the specification: covalent, ionic and metallic bonding.

(ii)

Most candidates were able to score only 1 of the 2 marks available by stating that chlorine has a low boiling point as the explanation for chlorine being a gas at room temperature.

Explanations in terms of intermolecular forces being weak were rarely seen; often answers were given in terms of 'bonds' which consequently limited the mark candidates could score.

Common errors, omissions, misconceptions:

Some candidates incorrectly referred to 'a low melting point' rather than the boiling point and consequently did not score here. In some responses, the main misconception was that candidates incorrectly discussed the breaking of weak covalent bonds.

It is important for centres to note that the term '**intermolecular force**' is that used in this specification and that the term intermolecular bond could be confused with a dative covalent bond, so is not acceptable.

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature. **(2)**

The bonds between the chlorine particles break easily, so it doesn't require much energy, such as much energy, to break them.

Results Plus: Examiner Comments

This response is not creditworthy.

The breaking of any type of bond does not score and there is no mention in this response of chlorine having a low boiling point.

Results Plus: Examiner Tip

Make sure that you can explain the low boiling points (and melting points) of typical covalent, simple molecular compounds, such as chlorine, by reference to weak intermolecular **forces**.

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

Chlorine is a gas at room temperature as ~~they~~ it has weak intermolecular forces which are overcome however the covalent bonds between chlorine are not overcome. It is a covalent substance so it has a low boiling point, due to it's weak intermolecular forces.

Results Plus: Examiner Comments

A typical example of fully correct response which scored 2 marks, covering all three possible marking points.

The candidate has mentioned weak intermolecular forces and also the fact that chlorine has a low boiling point.

Q32. No Examiner's Report available for this question

Q33.

(a)

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

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

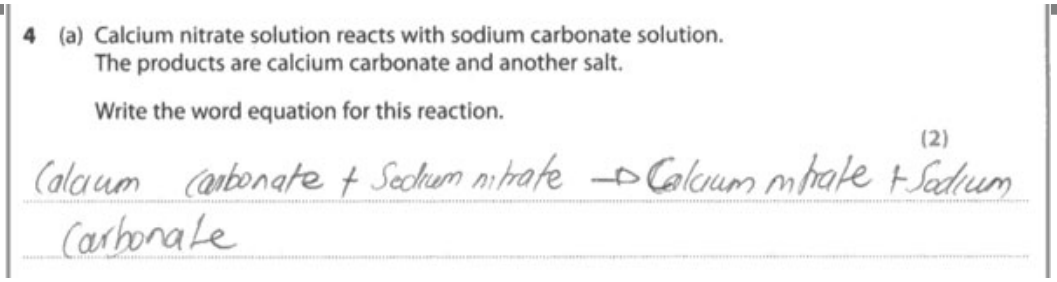
Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

Results Plus: Examiner Comments

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


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

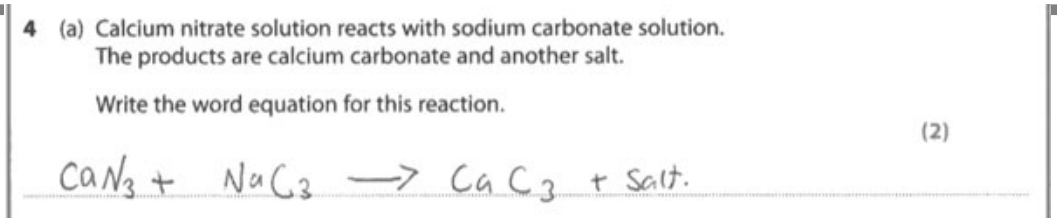
Write the word equation for this reaction.

(2)

Calcium carbonate + Sodium nitrate → Calcium nitrate + Sodium Carbonate

Results Plus: Examiner Comments

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


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

Write the word equation for this reaction.

(2)

$CaN_3 + NaC_3 \longrightarrow CaC_3 + Salt.$

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(b) (ii)

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

The three steps involved in a flame test are:

1. Clean the flame testing rod with hydrochloric acid.

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

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

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

(c) (i)

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

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

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

100% = 40/44 = 0.909 × 100 theoretical

percentage yield of carbon dioxide = 90 %

Results Plus: Examiner Comments

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

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

$$CaCO_3 \rightarrow CaO + CO_2$$

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

44/40 x100

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

Results Plus: Examiner Comments

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

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

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

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

Calculate the percentage yield of carbon dioxide in this reaction.

(2)

100g − 40g = 60g

percentage yield of carbon dioxide = 60 %

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

(c) (ii)

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

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

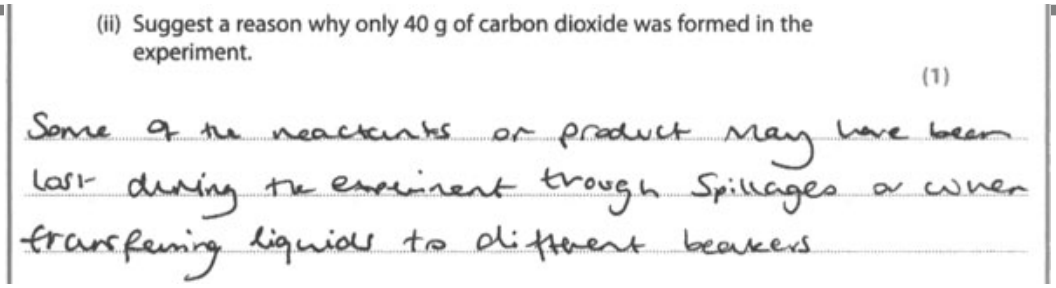
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

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

Results Plus: Examiner Comments

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



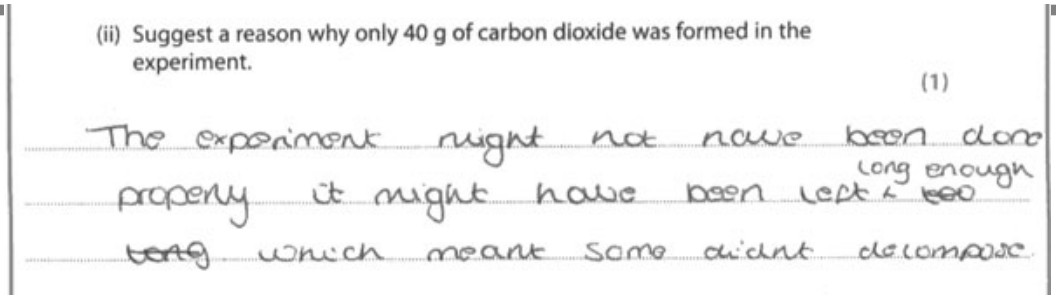
(ii) Suggest a reason why only 40 g of carbon dioxide was formed in the experiment.

(1)

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

Results Plus: Examiner Comments

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



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

(1)

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

a) Incomplete reaction - not all reactants used up.

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

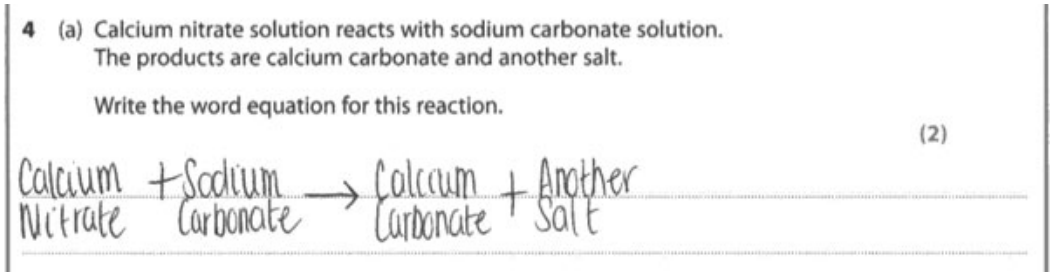
c) Other unwanted reactions - usually to make a different product.

Think about the reaction when applying these ideas.

Q34.

(a)

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


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

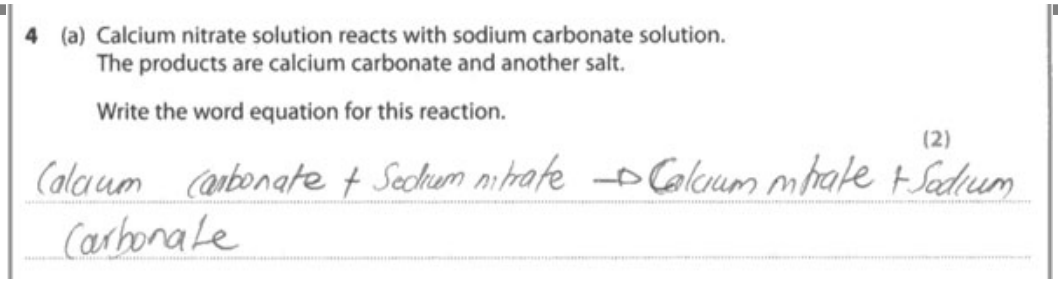
Write the word equation for this reaction.

(2)

Calcium Nitrate + Sodium Carbonate → Calcium Carbonate + Another Salt

Results Plus: Examiner Comments

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


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

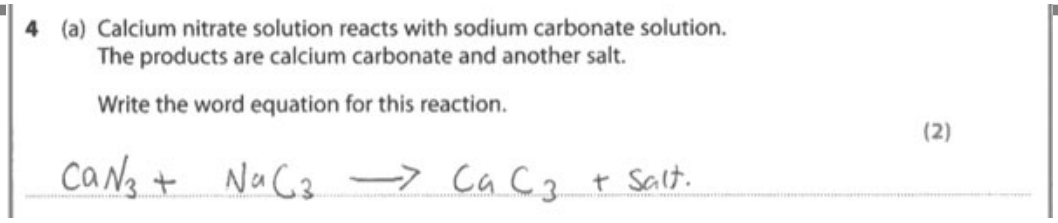
Write the word equation for this reaction.

(2)

Calcium carbonate + Sodium nitrate → Calcium nitrate + Sodium Carbonate

Results Plus: Examiner Comments

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


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

Write the word equation for this reaction.

(2)

$CaN_3 + NaC_3 \longrightarrow CaC_3 + Salt.$

Results Plus: Examiner Comments

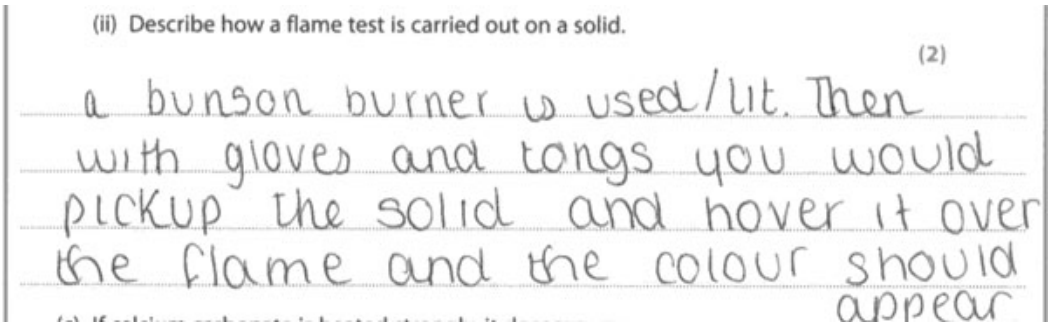
Here is an attempt to write a balanced equation using invented chemical formulae. Answers like this can only be awarded 0 marks.

Results Plus: Examiner Tip

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

(b) (ii)

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

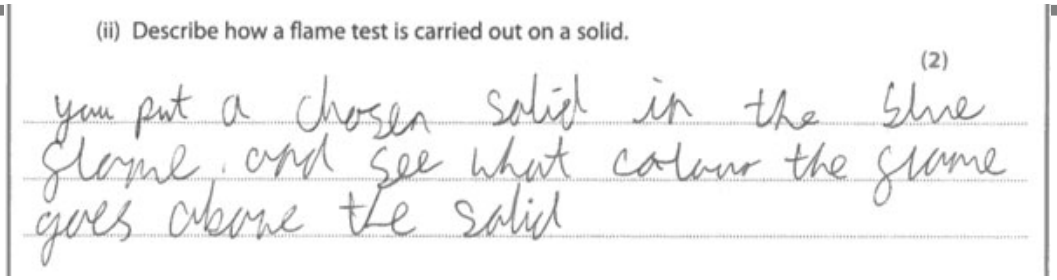

(ii) Describe how a flame test is carried out on a solid.

(2)

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

Results Plus: Examiner Comments

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


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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

Results Plus: Examiner Comments

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

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

(2)

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

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

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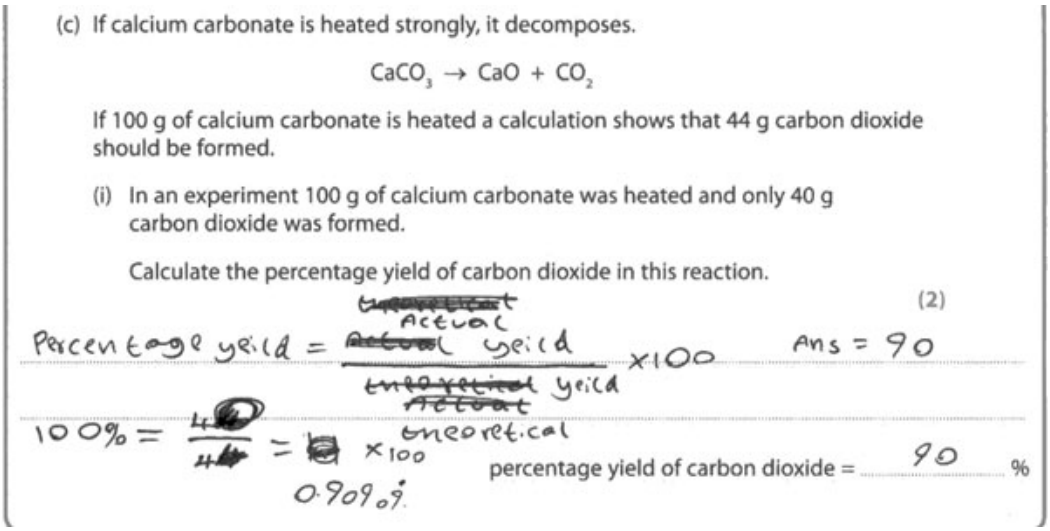
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It was clear that most candidates did not know how to calculate the percentage yield as very few candidates obtained the correct answer, however some achieved only one mark because their answer was approximated to 90% from 90.91%. Some had the ratio of mass inverted and

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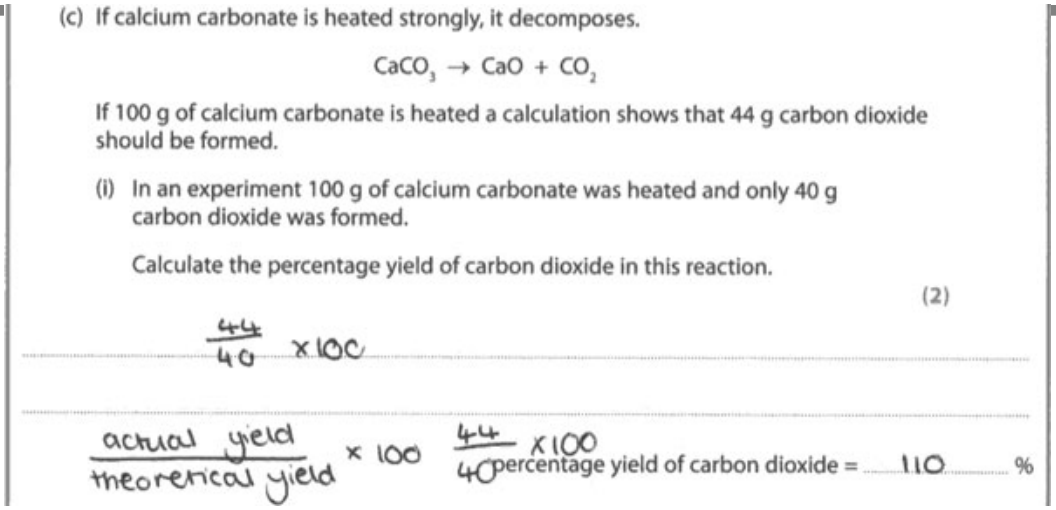
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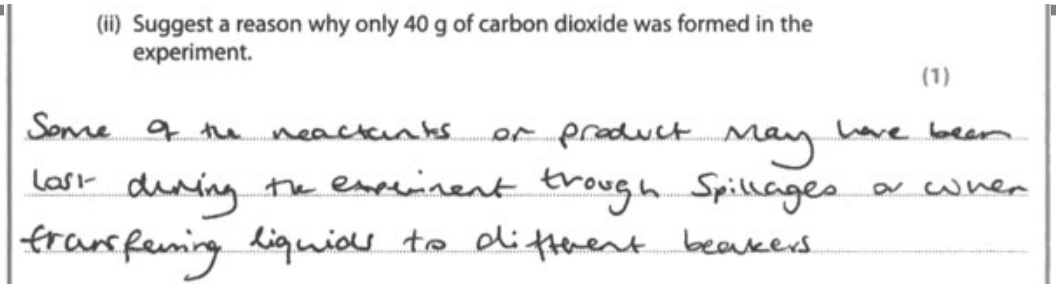
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(1)

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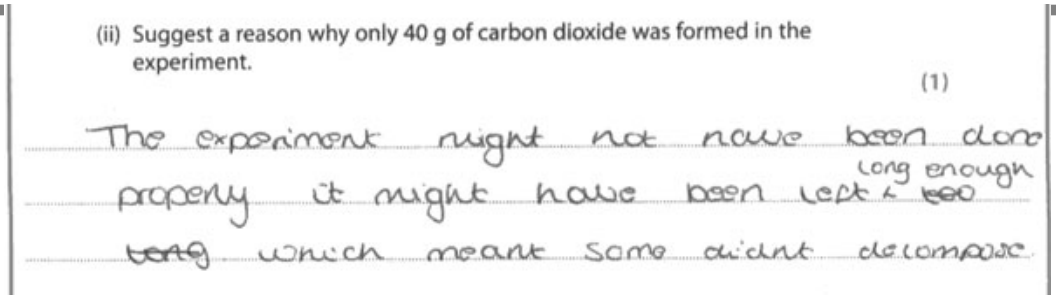
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The experiment might not have been done properly it might have been left long enough ~~for~~ which meant some didnt decompose

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

Results Plus: Examiner Tip

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

a) Incomplete reaction - not all reactants used up.

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

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

Think about the reaction when applying these ideas.

Q35.

(i)

Many candidates could correctly calculate the relative formula mass. However many candidates multiplied, divided, subtracted or doubled the numbers, many did not show their working. Two common incorrect answers were 28 and 56.

(i) Calculate the relative formula mass of carbon dioxide, CO_2.

(relative atomic masses: C = 12, O = 16)

(2)

relative formula mass = 28

Results Plus: Examiner Comments

A significant proportion of candidates simply added the two relative atomic masses and did not show their working.

Results Plus: Examiner Tip

Candidates should be aware of the importance of showing their working in calculations so that partial marks can be awarded where appropriate.

(i) Calculate the relative formula mass of carbon dioxide, CO_2.

(relative atomic masses: C = 12, O = 16)

(2)

12 + 16 + 16 = 44

relative formula mass = 44

Results Plus: Examiner Comments

This example is a good answer that showed working and was credited with both marks.

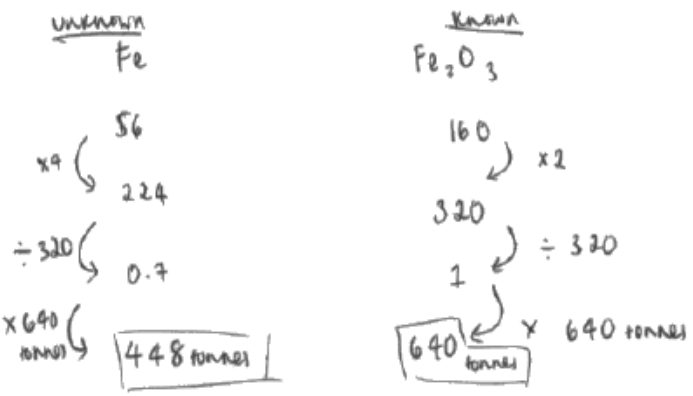
(ii)

Candidates found this question very difficult with few being able to calculate the maximum mass of iron formed from the iron oxide. It appeared that a large number of candidates did not know where to start with the calculation and therefore did not attempt the question at all, leaving the answer space blank. Where candidates did score full marks, it was clear that they had been taught well, their answers were clearly set out and showed good understanding.

Calculate the maximum mass of iron that could be obtained from 640 tonnes of iron oxide, Fe_2O_3.

(relative atomic mass: Fe = 56; relative formula mass Fe_2O_3 = 160)

(3)



mass = 448 tonnes

Results Plus: Examiner Comments

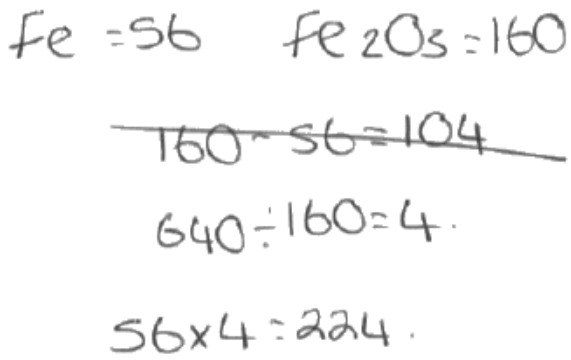
A good answer that clearly shows the candidates chemistry knowledge, scoring the full 3 marks available.

Results Plus: Examiner Tip

Showing the working clearly demonstrates to the examiner the thought processes used so that, if errors are made, part marks may still be awarded.

Calculate the maximum mass of iron that could be obtained from 640 tonnes of iron oxide, Fe_2O_3.
(relative atomic mass: Fe = 56; relative formula mass Fe_2O_3 = 160)

(3)



mass = 224. 104. tonnes

Results Plus: Examiner Comments

In some cases, candidates did not take into account the ratios in the equation and came to an answer of 224 rather than 448, therefore scoring 2 rather than 3 marks.

Q36. No Examiner's Report available for this question

Q37. No Examiner's Report available for this question

Q38.

In this question, the majority of candidates were able to calculate the concentration of the sodium sulfate solution, in some cases candidates lost marks as they did not give their answer to three significant figures.

Q39.

This question tested several criteria: to calculate a concentration in g dm^{-3}, to convert a volume from cm^3 to dm^3, and to approximate an answer to a given number of significant figures. For a viable question at this level, the numbers involved should not be 'straightforward'. A calculator will therefore be required by candidates in future examinations. A candidate without a calculator will be severely disadvantaged.

Overall, there were very few completely correct responses here.

Many candidates incorrectly divided the volume by the mass (250/6.36) or multiplied the two numbers together (6.36 × 250). Only a minority of candidates could successfully convert the volume from cm^3 to dm^3, with many answers that were a factor of 10, 100 or 1000 out.

A high proportion of candidates did not give the answer to 3 significant figures, so with a correct calculation and conversion of volume to dm^3, gave the answer as 25.44 g dm^{-3} and so scored two marks. Many candidates did not convert the volume to dm^3 and had an answer of 0.02544 at this point, for 1 mark, but then wrote the final answer as '0.03 to 3 sig figs', clearly not understanding the concept of significant figures. Some candidates gave this answer as 0.025 so confusing decimal places with significant figures. It was clear that the majority of candidates needed further practice in this type of calculation and the mathematical skills tested.

Several examiners were disappointed by the number of blank responses and suggested that candidates should make an attempt at all calculations as even a valid mathematical step could have been credited with a mark. Equally, just writing an answer without showing any working, was seen several times. For this question a correct answer without working was credited with full marks, but an incorrect answer needed that working to see if any process marks could have been awarded. Candidates are urged to write out the working, preferably annotated.

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

Give your answer to three significant figures.

(3)

$\frac{6.36}{250} = 0.02544 \times 100 = 2.544$

$\frac{250}{6.36} = 39.3$

concentration of copper sulfate solution = 2.54 g dm^{-3}

Results Plus: Examiner Comments

The lower fraction was incorrect but ignored as the candidate didn't use it any further. The top one generated an answer on the answer line, so it was this that was considered.

The first step was correct – dividing the mass by the volume, and was given a mark. The second step: × 100 to convert the volume from cm^3 to dm^3 was incorrect, but the answer to this was then given correctly to 3 significant figures and that was given a mark. Two marks here for this calculation.

Results Plus: Examiner Tip

Conversion of units is a mathematical skill that may be tested in future exams.

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

Give your answer to three significant figures.

(3)

$V = \frac{250}{1000} = 0.25$

N

Ma

C_0 V

Mo Mr

$CuSO_4$

moles = Mass $\frac{6.36}{159.5}$

$63.5 + 32 + 16 \times 4$

$= 159.5$

0.04 moles.

$C = \frac{0.04}{0.25}$

concentration of copper sulfate solution = 0.16 g dm^{-3}

Results Plus: Examiner Comments

Unfortunately the candidate had calculated the concentration of the copper sulfate solution in mol dm^{-3}. A correct calculation of formula mass is shown, but the calculated number of moles was given to only 1 significant figure. The calculated concentration from this was given to only 2 significant figures. A transferred error mark could not be given. To 3 significant figures, the value would be 0.160 (mol dm^{-3}). However, the volume was correctly converted from cm^3 to dm^3 and 1 mark was given for this.

Results Plus: Examiner Tip

Knowing how to approximate an answer to a given number of significant figures is a mathematical skill and could be tested in future examinations.
When performing a multistage calculation, avoid making approximations after each step.

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

Give your answer to three significant figures.

(3)

$C = \frac{m}{V}$

$C = \frac{6.36}{250} = 0.02544\ g dm^{-3}$.

0.025 (3 s.f).

concentration of copper sulfate solution = 0.025 g dm^{-3}

Results Plus: Examiner Comments

A correct first step was carried out, but the conversion from cm^3 to dm^3 was missed and the final answer was approximated to 2 two significant figures as a result of thinking that the 0 after the decimal place counted as a significant figure. This was given 1 mark overall.

Results Plus: Examiner Tip

Leading zeros in a number do not count towards significant figures.

Q40. No Examiner's Report available for this question

Q41. No Examiner's Report available for this question

Q42.

It was a shame that many candidates who performed the first two steps correctly then failed to convert the ratio into a final formula and lost the final mark. Several candidates had their initial division the wrong way up, but were able to gain credit for their final answer of Al_3Cl.

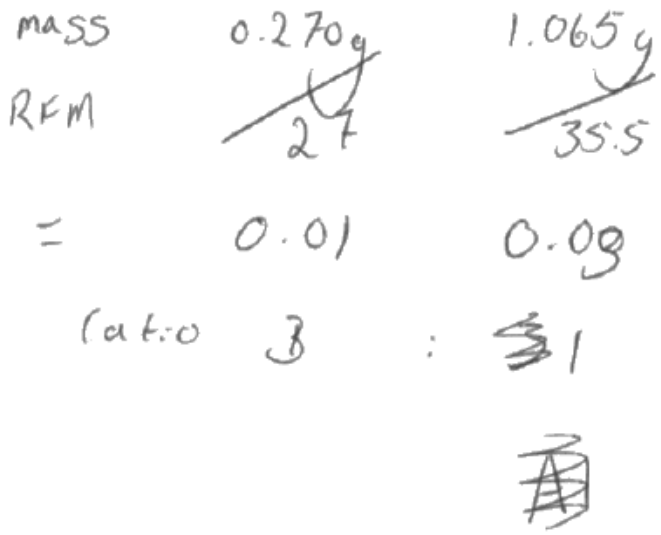
Those candidates who have not seen this type of question manipulated the numbers in a variety of ways. Candidates should be encouraged to practice this type of calculation on a variety of

substances as well as setting out the calculation in a logical manner.A significant minority gave a number as their answer, indicating they had no idea what empirical formula meant. However, there were a pleasing number of correct answers, with the calculations clearly laid out.

Calculate the empirical formula of aluminium chloride.
(relative atomic masses: Al = 27, Cl = 35.5)

You must show your working.

(3)



empirical formula of aluminium chloride = Al_3Cl

Results Plus: Examiner Comments

The first step, dividing the mass of the element by the relative atomic mass, was incorrect. However, from there, allowing for this error, the whole number ratio and the formula based on that were correct. Consequently, 2 marks were awarded.

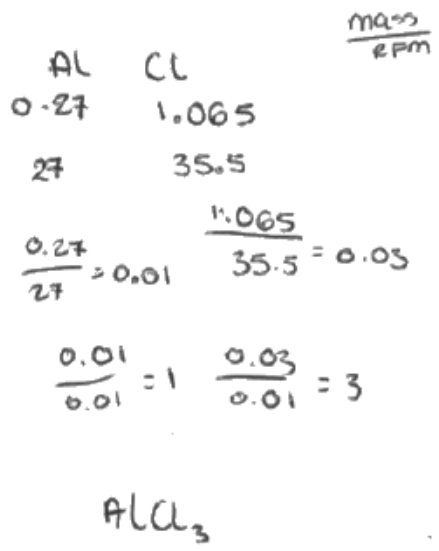
Results Plus: Examiner Tip

Calculators are a necessity for future examinations.

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You must show your working.

(3)



empirical formula of aluminium chloride = AlCl3

Results Plus: Examiner Comments

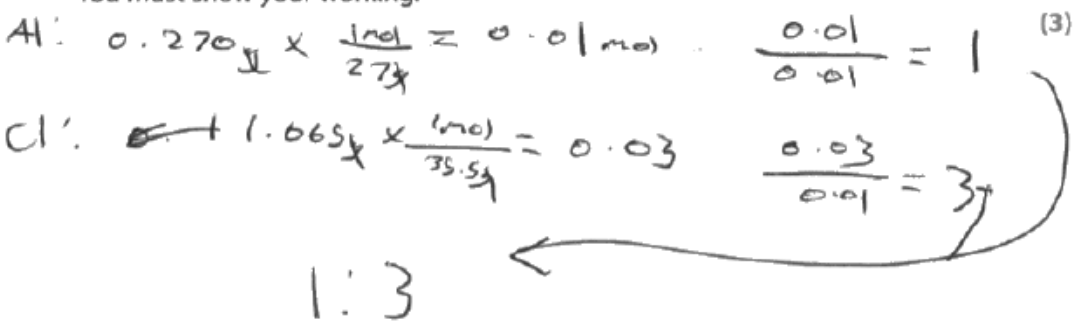
A well laid-out calculation makes it clear to the examiner and so with all the steps correct, this answer was awarded 3 marks.

Results Plus: Examiner Tip

If candidates set the calculation out logically it helps to identify where marks can be awarded.

Calculate the empirical formula of aluminium chloride.
(relative atomic masses: Al = 27, Cl = 35.5)

You must show your working.



(3)

empirical formula of aluminium chloride = 1 : 3

Results Plus: Examiner Comments

A correct ratio was obtained, but no empirical formula was produced. This was given 2 marks.

Results Plus: Examiner Tip

Practice calculating the empirical formula for a variety of substances given the relevant data.

Q43.

This question was poorly answered on the whole with most responses not scoring any of the 3 marks available.

Most candidates struggled with this empirical formula calculation.

The most major and regularly seen misconception was that candidates multiplied the masses and relative formula masses, namely stating 3.5 x 7 = 24.5, followed by 4 x 16 = 64 then adding

them together and arriving at a final answer of 88.5.

In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

A = 7 / 3.5 = 2 / 2 = 1

G / 16 / 4 = 4 / 2 = 2

empirical formula of this compound = AG_2

Results Plus: Examiner Comments

This response scored 2 marks by error carried forward on the first step in the calculation.

In effect, only one error has been made. The ratios have been incorrectly inverted and the ratio stated. This in turn has been converted into an empirical formula based on the error carried forward.

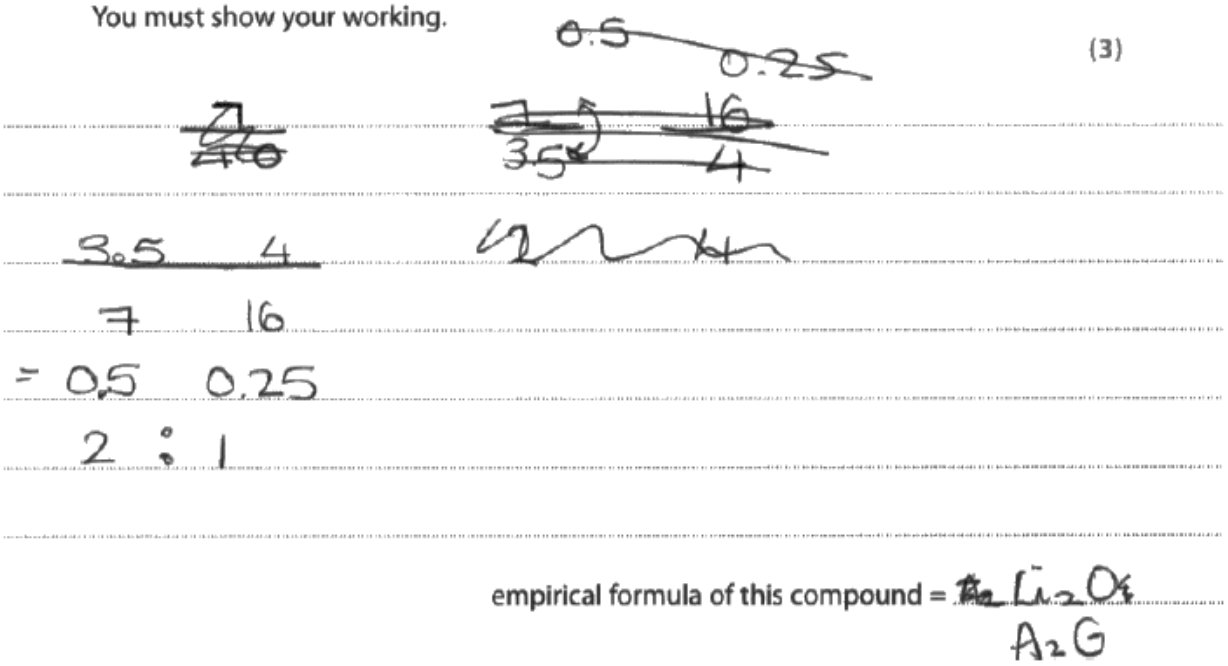
Results Plus: Examiner Tip

Practise laying out empirical formulae calculations – remember to divide the masses by their relative atomic masses.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)



Results Plus: Examiner Comments

A example of a fully correct response scoring 3 marks.

The masses have been divided by the relative atomic masses. The ratio has been derived from these which has been correctly translated into the empirical formula. Note that in this particular case, the candidate has actually determined the symbols of the elements, this is not required, but the formula Li_2O would be credit worthy.

Results Plus: Examiner Tip

Practise empirical formula calculations – they all follow a particular pattern.

Q44. No Examiner's Report available for this question

Q45.

It was pleasing to see many carefully set out answers for this part, giving A_2G (or Li_2O). Only 1

mark was awarded for writing down the correct answer but with no working. A common error was to invert the initial fractions, but if this was followed through carefully to get AG_2 examiners could award some of the marks. Some candidates worked all the way through to the simplest ratio, but did not give a final formula.

In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

A + G → X

Mass = 3.5g Mass = 4.0g

Moles = 0.5 mol Moles = 0.25 mol

$A_r = 7$ $A_r = 16$

Moles: $\frac{3.5}{7} = 0.5$ $\frac{4}{16} = 0.25$

A : G = 0.5 : 0.25

÷0.25

2 : 1

A_2G

empirical formula of this compound = 2:1 (→ A_2G)

Results Plus: Examiner Comments

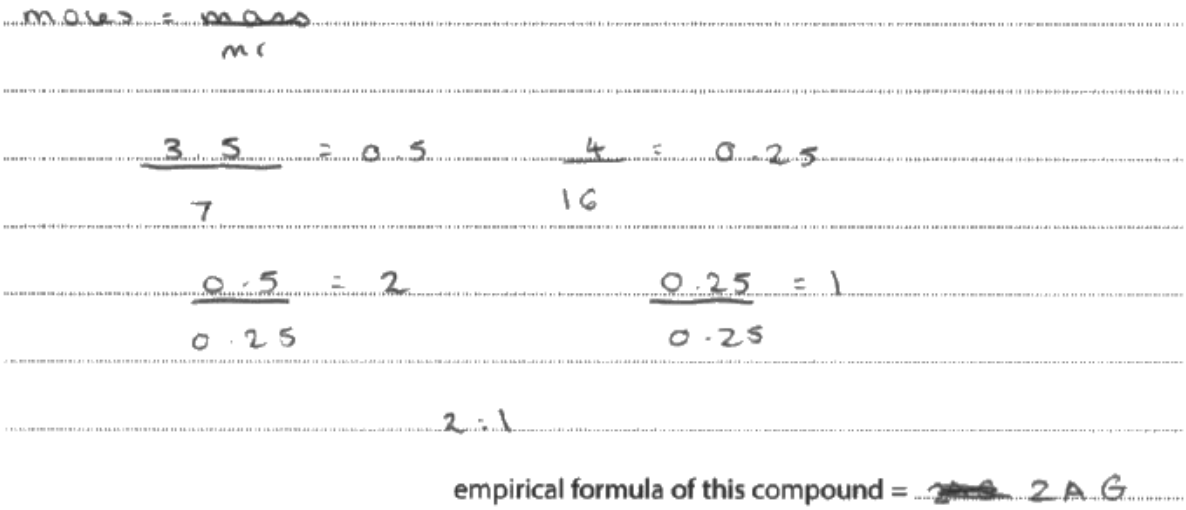
This answer is not perfect (2:1 should not be on the answer line), but it has been set out so that the working can be very clearly followed.

In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)



Results Plus: Examiner Comments

This answer has calculated the correct ratio of 2:1, but unfortunately has not transferred this to the correct empirical formula.

Q46.

Some candidates got the correct response for this question and clearly showed their working out. Candidates that had shown some working out usually scored 1 or 2 marks although they may not have obtained the correct final answer. A number of candidates incorrectly calculated the relative formula mass of water to be 26 – multiplying the H_2 by 5 but not the O. There were a few completely blank responses, although 1 mark was available just for calculating the relative formula mass of water.

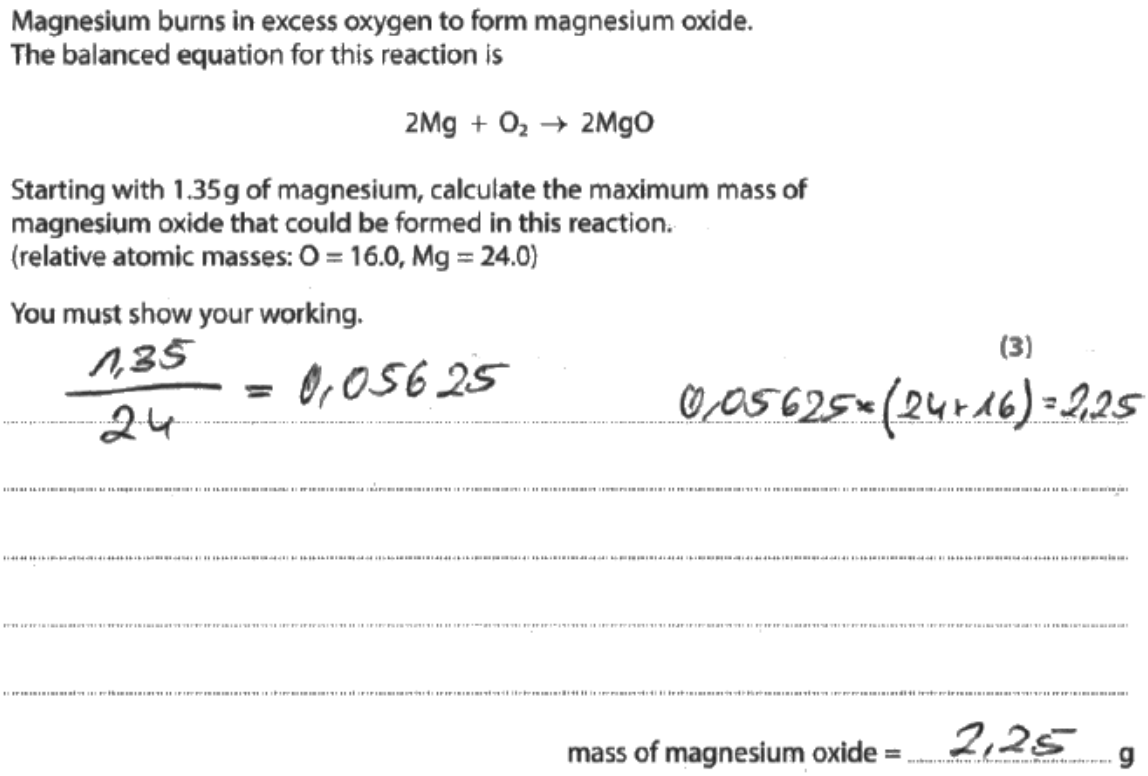
Q47.

This question was very poorly answered with just over a quarter of responses scoring any of the

3 marks available.

Most candidates found this calculation question very challenging. In those responses that scored, it was most usually for 40 (relative formula mass of MgO) or 80 (2 x relative formula mass of MgO). A few candidates were able to develop this further. A few tried combining the 40 or 80 with 1.35 and came up with 54 or 108, which scored the second mark. Far fewer candidates scored the third mark.

Examiners noted that the setting out of many of the candidates' calculations was invariably poor and was often difficult to follow.


Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

$\frac{1,35}{24} = 0,05625$

$0,05625 \times (24+16) = 2,25$

mass of magnesium oxide = 2,25 g

Results Plus: Examiner Comments

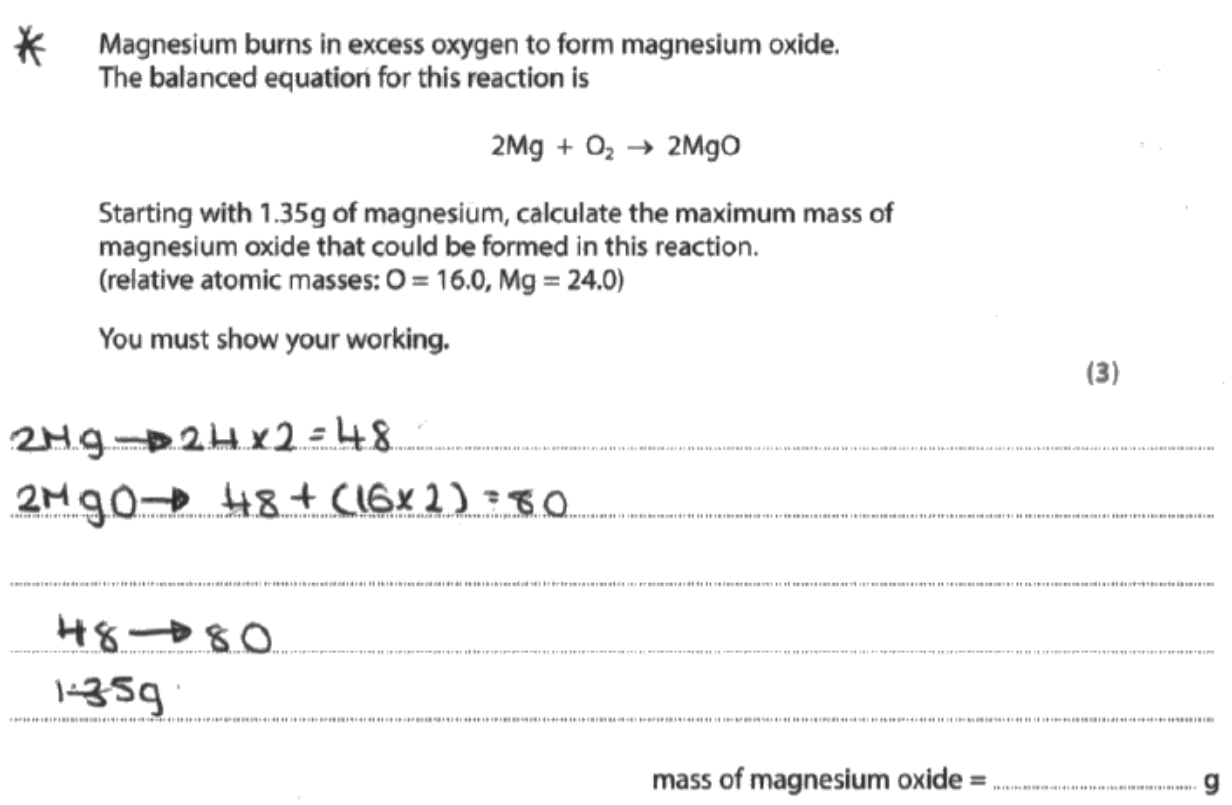
This response scored 3 marks.

This candidate has recognised that the ratio of the magnesium to magnesium oxide from the equation is 1:1. The candidate has very concisely and correctly calculated the number of moles of magnesium. In turn this has been used to calculate the mass of magnesium oxide giving the correct final answer, 2.25 g.

Q48. No Examiner's Report available for this question

Q49.

The calculation of the maximum mass of magnesium oxide formed was also well answered with many being able to score the full 3 marks available.



✱ Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

2Mg → 24 x 2 = 48

2MgO → 48 + (16 x 1) = 80

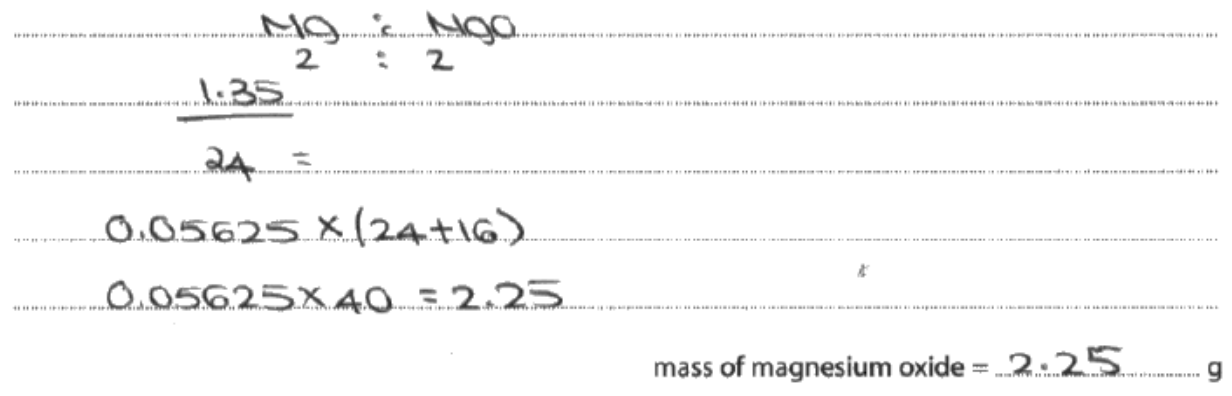
48 → 80

1.35g

mass of magnesium oxide = ... g

Results Plus: Examiner Comments

In some cases, candidates knew that 48g of magnesium forms 80g of magnesium oxide to gain the first marking point, but were not able to take this any further. The presence of the working meant that 1 mark could still be awarded.



Mg : MgO
2 : 2

1.35

24 =

0.05625 x (24+16)

0.05625 x 40 = 2.25

mass of magnesium oxide = 2.25 g

Results Plus: Examiner Comments

Many candidates that scored full marks, used the moles method and showed their working clearly and concisely.

Q50. No Examiner's Report available for this question

Q51. No Examiner's Report available for this question

Q52.

This calculation was well done; the only significant difficulty experienced by some candidates was the move from 1 mol of carbohydrate to 2 mols of carbon dioxide.

Q53.

Just under a third of the candidates scored both marks for the calculation. Those scoring just one mark obtained for the number of moles of sucrose but then missed the ratio of moles of sucrose to moles of ethanol (1:4) from the second step of the calculation. Of the rest, those that attempted some form of calculation appeared not to know what to do.

Q54.

This was mainly worked out correctly but it was disappointing that some candidates lost a mark by failing to give the answer to one decimal place. Another error was to use an Mr of 159.5 rather than 65.

In another experiment, 0.043 mol of copper sulfate, $CuSO_4$, is used.

Calculate, to one decimal place, the minimum mass of zinc that must be added to react with all the copper sulfate.
(relative atomic mass: Zn = 65)

(2)

$\frac{g}{mr \mid mol}$ $65 \times 0.043 = 2.795$.

mass = 2.795 g

Results Plus: Examiner Comments

The answer is correctly calculated, but has not been rounded to one decimal place.

Q55.

(i) Many candidates correctly calculated the relative formula mass and then the number of moles of $TiCl_4$ in the reaction.

(ii) This question was usually left blank or given an answer relating to the observations that would be made if there were excess magnesium. Candidates did not seem to understand what they were being asked to do for this part of the question. Where attempts were made to show the excess of magnesium, students generally did not mention the 2:1 ratio for the reaction and gave an answer with a 1:1 ratio.

Q56.

The use of the Avogadro constant was weak. Common incorrect answers here just gave the Avogadro constant or multiplied it by the relative formula mass of copper iodide.

Q57.

Candidates performed well in this question, with many being able to correctly calculate the number of gold atoms in the ring. Where candidates did not score full marks, if was often because they forgot or made an error in the calculation of the number of moles in step 1.

Q58.

Candidates were able to calculate the number of molecules in 0.11g of carbon dioxide successfully with many gaining 2 or 3 marks.

Calculate the number of molecules in 0.11 g of carbon dioxide.

Give your answer to two significant figures.

(relative formula mass : $CO_2 = 44$
Avogadro constant = 6.02×10^{23})

(3)

moles = mass / RFM

= 0.11 / 44 $\Rightarrow 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times 6.02 \times 10^{23}$

$= 1.505 \times 10^{21}$

$= 1.5 \times 10^{21}$ 2 S.F

number of molecules = 1.5×10^{21}

Results Plus: Examiner Comments

A good, clearly laid out answer that gained 3 marks.

$\frac{44}{0.11} = 400$

$400 \times 6.02 \times 10^{23} = 2.408 \times 10^{26}$

$= 2.40 \times 10^{26}$

$= 2.4 \times 10^{26}$

number of molecules = 2.4×10^{26}

Results Plus: Examiner Comments

In other cases, candidates inverted the fraction to find the number of moles incorrectly. This error was carried forward and so therefore a mark of 2 was still awarded for multiplying by Avogadro's constant and then giving their answer to two significant figures.

$\frac{0.11}{44} = 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times (6.02 \times 10^{23}) = 1.505 \times 10^{21}$

number of molecules = 1.505×10^{21}

Results Plus: Examiner Comments

A common error, as in this case, is where candidates lost marks because they did not give their answer to 2 significant figures.

Q59.

(i)

Most candidates were able to correctly calculate the relative formula mass as 248, although a few made some addition errors.

Errors also included incorrectly calculating the relative formula mass as 12 + 1 + 14 + 16, i.e. just adding the relative atomic masses of the individual elements together.

There were some attempts at summing the number of moles found separately for each element within the formula.

Having obtained a relative formula mass, some then went on to the correct sum of 0.5/248 but then inexplicably multiplied this by 10, 100 or even 1000 to produce an incorrect answer. 248 × 0.5 and 248/ 0.5 were also common mistakes resulting in the answers 124 or 496.

Candidates need to be aware that if information such as the relative atomic masses are given, then it is expected that they are used in the calculation.

In common with other calculations, working was badly set out and often did not follow a logical sequence, and as with the other calculations, there were many blank answers seen and it was rare to award full marks. Clearly some candidates had not come across the mole concept; it now forms part of the Combined Science specification.

(i) Calculate the number of moles of this food colouring, $C_{16}H_{12}N_2O$, in a 0.50 g sample.
(relative atomic masses: H = 1, C = 12, N = 14, O = 16)

(2)

$(12 \times 16) + (1 \times 12) + (14 \times 2) + 16 =$

248

$mol = \frac{\text{mass g}}{M_r}$

$\frac{0.5}{248} = 0.0020161...$

number of moles = 0.002

Results Plus: Examiner Comments

Both steps of the calculation were correct and the response was given 2 marks.

Results Plus: Examiner Tip

Practice calculating the relative formula masses of a wide range of substance using their formulae and the relative atomic masses.

(i) Calculate the number of moles of this food colouring, $C_{16}H_{12}N_2O$, in a 0.50 g sample.
(relative atomic masses: H = 1, C = 12, N = 14, O = 16)

(2)

$(16 \times 12) + (1 \times 12) + (2 \times 14) + 16 = 248$

RFM = 248

$\frac{248}{0.5g} = 496$

number of moles = 496

Results Plus: Examiner Comments

The relative formula mass was calculated correctly and secured a mark, but the step of the calculation was incorrect. Consequently, only 1 mark was awarded for this response.

Results Plus: Examiner Tip

Know how to calculate the number of moles of a substance from its mass and relative formula mass.

(ii)

Many of those that attempted this question tried to incorporate their working from part (i) somehow, with a number giving $2 \times 248 \times 6.02 \times 10^{23}$, for example.

For many candidates, it appeared to be a lot of random numbers just written down. In addition, many did not use the Avogadro constant here and gave the answer as $2 \times 248 = 496$. Examiners also reported that many candidates struggled with using standard form.

This was the least well answered question on the whole examination paper.

(ii) Calculate the number of molecules in 2 moles of the food colouring, $C_{16}H_{12}N_2O$.
(Avogadro constant = 6.02×10^{23})

(1)

$6.02 \times 10^{23} \times 2 = 1.204 \times 10^{24}$

$1.204 \times 10^{24} \times 248 = 2.98592 \times 10^{26}$

number of molecules = 2.99×10^{26}

Results Plus: Examiner Comments

The first line shows the correct calculation with the correct answer. Unfortunately, the candidate added an incorrect step to the calculation that prevented the mark being awarded.

(ii) Calculate the number of molecules in 2 moles of the food colouring, $C_{16}H_{12}N_2O$.
(Avogadro constant = 6.02×10^{23})

(1)

$0.002 \times 6.02 \times 10^{23} =$

1.21×10^{21}

number of molecules = 1.21×10^{21}

Results Plus: Examiner Comments

The candidate had used the number of moles as calculated in the previous question here. This did not score the mark.

Results Plus: Examiner Tip

If the Avogadro constant needs to be used in a calculation it will be given where it is needed, as here. Candidates will not be required to learn it, but will need to know how to use it.

(ii) Calculate the number of molecules in 2 moles of the food colouring, $C_{16}H_{12}N_2O$.
(Avogadro constant = 6.02×10^{23})

(1)

$Mr = 248$

$248 \times 2 = 496$

number of molecules = 496

Results Plus: Examiner Comments

The candidate had misunderstood the question and calculated the mass of 2 moles of the food

colouring rather than the number of molecules. This was seen quite frequently by many examiners.

Results Plus: Examiner Tip

Data, such as the Avogadro constant here, given for a particular part of the question indicates that it needs to be used.

Q60.

Whilst many candidates did achieve full marks, the concept of the mole and molar solutions not fully grasped by many. Most candidates showed full working, therefore increasing the possibility of part marks where an error had occurred. Where candidates scored less than full marks, most managed to calculate the mass of copper sulfate and/or Mr of copper sulfate, therefore scoring 1 or 2 marks for partial completion of the response. Common errors included 159.5/15.95, not dividing the volume by 1000, or dividing 15.95 by 50.

Q61.

Approximately a third of responses scored both marks here, with many of the remaining answers scoring one mark. The most common mistake was not to realise that the information given was about an ion rather than an atom, and so candidates completed the calculation assuming that the element contained 54 protons. A few candidates realised that they had been given information about an ion, but then added two protons to the electron number rather than subtracting it.

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
	A description to include • 2.8 (in 1st and 2nd shell)(1) • 5 (in outer shell)(1)	suitable diagram in place of 2.8(1).5(1) electrons in {shells / orbits / rings}(1)	**(2)**

Q2.

	Answer	Acceptable answers	Mark
	A description to include • 2.8 (in 1st and 2nd shell)(1) • 5 (in outer shell)(1)	suitable diagram in place of 2.8(1).5(1) electrons in {shells / orbits / rings}(1)	**(2)**

Q3.

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

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

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

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

Q4.

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

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

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

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

Q5.

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

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

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

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

Q6.

Question number	Answer	Additional guidance	Mark
(i)	as the number of carbon atoms in the molecule increases, the boiling point increases (1)	accept reverse argument	(1)

Question number	Answer	Additional guidance	Mark
(ii)	relative formula mass = (3 X 12) + (8 X 1) (1) = 44	Award mark if correct answer given with no working	(1)

Question number	Answer	Additional guidance	Mark
(iii)	propane + oxygen → carbon dioxide + water LHS (1) RHS (1)	ignore air allow reactants on LHS and products on RHS in either order allow $C_3H_8 + 5\,O_2 \rightarrow 3CO_2 + 4H_2O$ (2) incorrect balancing of correct species max 1 mark ignore state symbols even if incorrect allow = for →	(2)

Question number	Answer	Additional guidance	Mark
(iv)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): **EITHER** carbon monoxide/CO formed (1) toxic/poisonous/restricts the amount of oxygen carried (by the blood) (1) **OR** carbon/smoke/soot formed (1) damages lungs/chokes people/breathing difficulties /makes things dirty (1)	 ignore carbon dioxide ignore dangerous/harmful allow the second mark if an incorrect gas is given *e.g.* methane allow second mark if 'gas' stated, but no name is given allow less energy released ignore dangerous/harmful allow blocks fuel jets allow less energy released	(2)

Q7.

	Answer	Acceptable answers	Mark
(a)	A description including excess magnesium oxide (1) filter (to remove excess solid / magnesium oxide) (1)		**(2)**
(b)	$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$ (2) left hand side (1) right hand side (1)	max 1 if incorrect balancing	**(2)**
(c)	A calculation involving mass of solid = 258.515 – 258.450 (1) (= 0.065 g) concentration = $0.065 \times {}^{1000}/_{500}$ (1) (= 0.130 (g dm^{-3}))	allow TE from mass of solid for second mark	**(2)**

		Indicative Content	
QWC	***(d)**	A description including some of the following points • hardness caused by dissolved calcium and/or ions • boiling water • removes temporary hardness only / not perma hardness • ions removed • by formation of limescale / calcium carbonate • ion exchange resin • run tap water through resin • calcium and / or magnesium ions are exchang ions • which do not cause hardness allow full credit for use of other correct methods such washing soda	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temporary hardness by boiling water / permanent hardness (& temporary hardness) by ion exchange • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. use of ion exchange and boiling water removes ions causing hardness • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately	

		• spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a simple description and explanation e.g. boiling water removes only temporary hardness, ion exchange resin removes both types of hardness, by removing calcium and/or magnesium ions from hard water • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q8.

	Answer	**Acceptable answers**	**Mark**
(a)	A description including excess magnesium oxide (1) filter (to remove excess solid / magnesium oxide) (1)		**(2)**
(b)	$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$ (2) left hand side (1) right hand side (1)	max 1 if incorrect balancing	**(2)**
(c)	A calculation involving mass of solid = 258.515 – 258.450 (1) (= 0.065 g) concentration = $0.065 \times {}^{1000}/_{500}$ (1) (= 0.130 (g dm^{-3}))	allow TE from mass of solid for second mark	**(2)**

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

		allow full credit for use of other correct methods such as washing soda	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. temporary hardness by boiling water / permanent hardness (& temporary hardness) by ion exchange • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. use of ion exchange and boiling water removes ions causing hardness • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a simple description and explanation e.g. boiling water removes only temporary hardness, ion exchange resin removes both types of hardness, by removing calcium and/or magnesium ions from hard water • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q9.

Question Number	Answer	Mark
	C magnesium **1. The only correct answer is C** ***A*** *is not correct because this element is in period 4* ***B*** *is not correct because this element is in period 4* ***D*** *is not correct because this element is in period 5*	**(1)** AO 3 2b

Q10.

Question number	Answer	Mark
(i)	An answer that provides a description by making reference to: • one electron (transferred) (1) • transferred from sodium to fluorine (1)	(2)

Question number	Answer	Mark
(ii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • (both solid and molten) contained charged particles/ions (1) • (ions) free to move in molten but not in solid (1)	(2)

Q11.

Question number	Answer	Mark
(i)	An answer that provides a description by making reference to: • one electron (transferred) (1) • transferred from sodium to fluorine (1)	(2)

Question number	Answer	Mark
(ii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • (both solid and molten) contained charged particles/ions (1) • (ions) free to move in molten but not in solid (1)	(2)

Q12.

	Answer	Acceptable answers	Mark
(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	(1)
(ii)	An explanation including • (atoms of) both contain 5 /same number of protons/same atomic number (1)	ignore electrons boron-11 atoms contain 1 more	(2)

	• boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	neutron / boron-10 atoms contain 1 less neutron	

Q13.

	Answer	Acceptable answers	Mark
(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	**(1)**
(ii)	An explanation including • (atoms of) both contain 5 /same number of protons/same atomic number (1) • boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	ignore electrons boron-11 atoms contain 1 more neutron / boron-10 atoms contain 1 less neutron	**(2)**

Q14.

	Answer	Acceptable answers	Mark
(a)	C smaller than the mass of a proton		**(1)**
(b)	An description linking • 8 protons (1) • (and) {17-8/9} neutrons (1)	ignore references to electrons in shells / charges on particles if electrons in nucleus max 1 protons and neutrons with incorrect numbers (1)	**(2)**
(c)	Explanation linking	correct electronic configurations or diagrams alone max 1	**(2)**

	• (both have) same number (of electrons) in outer shell(1) • 6 (electrons in outer shell) (consequent on first point) (1)	'they both have 6 in the outer shell' scores both marks allow 'both need 2 (more) (electrons) to fill outer shell' for both marks	
(d)	A description to include • 2.8 (in 1st and 2nd shell)(1) • 5 (in outer shell)(1)	suitable diagram in place of 2.8(1).5(1) electrons in {shells / orbits / rings}(1)	**(2)**
(e)(i)	A description to include • electron(s) shared (1) • {**pair(s) of / two**} (electrons) (1)	can be shown in a diagram of a covalent bond any mention of ions scores zero	**(2)**
(e)(ii)	P_2O_5	Reject P2O5 / P^2O^5	**(1)**

Q15.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	C T		**(1)**
(a)(ii)	C Q and S		**(1)**
(b)(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	**(1)**
(b)(ii)	An explanation including • (atoms of) both contain 5 /same number of protons/same atomic number (1) • boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	ignore electrons boron-11 atoms contain 1 more neutron / boron-10 atoms contain 1 less neutron	**(2)**
(c)(i)	An explanation including the following • M1 {average/mean} mass (of atoms of an element) (1) • M2 compared to {1/12 mass carbon-12 (atom)/ (mass of) carbon-12 (atom) taken as 12} (1)	For M1 reject weight reject if mass of molecule reject if mass of neutrons and protons any reference to carbon-12 scores mark	**(2)**

(c)(ii)	[19.7 × 10] (1) +[80.3 × 11] (1) /100 (1) (=10.8) [0.197 ×10] (1) + [0.803 ×11] (1) = [1.97 + 8.83] (1) (=10.8)	If no working shown 10.8(03) worth 3 marks	**(3)**

Q16.

	Answer	Acceptable answers	Mark
(a)	C smaller than the mass of a proton		**(1)**
(b)	An description linking • 8 protons (1) • (and) {17-8/9} neutrons (1)	 ignore references to electrons in shells / charges on particles if electrons in nucleus max 1 protons and neutrons with incorrect numbers (1)	**(2)**
(c)	Explanation linking • (both have) same number (of electrons) in outer shell(1) • 6 (electrons in outer shell) (consequent on first point) (1)	correct electronic configurations or diagrams alone max 1 'they both have 6 in the outer shell' scores both marks allow 'both need 2 (more) (electrons) to fill outer shell' for both marks	**(2)**
(d)	A description to include • 2.8 (in 1st and 2nd shell)(1) • 5 (in outer shell)(1)	suitable diagram in place of 2.8(1).5(1) electrons in {shells / orbits / rings}(1)	**(2)**
(e)(i)	A description to include • electron(s) shared (1) • {**pair(s) of / two**} (electrons) (1)	can be shown in a diagram of a covalent bond any mention of ions scores zero	**(2)**
(e)(ii)	P_2O_5	Reject P2O5 / P^2O^5	**(1)**

Q17.

	Answer	Acceptable answers	Mark
(a)(i)	C T		**(1)**
(a)(ii)	C Q and S		**(1)**
(b)(i)	number of protons (in nucleus of atom)	ignore number of electrons eg number of protons and electrons worth (1)	**(1)**

(b)(ii)	An explanation including • (atoms of) both contain 5 /same number of protons/same atomic number (1) • boron-10 atoms contain 5 neutrons but boron-11 atoms contain 6 neutrons / different numbers of neutrons/ different mass number (1)	ignore electrons boron-11 atoms contain 1 more neutron / boron-10 atoms contain 1 less neutron	**(2)**
(c)(i)	An explanation including the following • M1 {average/mean} mass (of atoms of an element) (1) • M2 compared to {1/12 mass carbon-12 (atom)/ (mass of) carbon-12 (atom) taken as 12} (1)	For M1 reject weight reject if mass of molecule reject if mass of neutrons and protons any reference to carbon-12 scores mark	**(2)**
(c)(ii)	[19.7 × 10] (1) +[80.3 × 11] (1) /100 (1) (=10.8) [0.197 ×10] (1) + [0.803 ×11] (1) = [1.97 + 8.83] (1) (=10.8)	If no working shown 10.8(03) worth 3 marks	**(3)**

Q18.

Question Number	Answer	Acceptable answers	Mark
(a)	<table><tr><th>particle</th><th>relative mass</th></tr><tr><td>proton</td><td>1</td></tr><tr><td>neutron</td><td>**1** (1)</td></tr><tr><td>electron</td><td>1/1837 / negligible / very small (1)</td></tr></table>	if any minus sign(s) MAX 1 anything less than 1/1500 or 0.00067/(almost) 0	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	**B** the same number of electrons and protons		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	3 protons **(1)** {4/7-3} neutrons **(1)** maximum 1 mark if electrons mentioned	 if numbers incorrect but state both protons and neutrons (and not electrons) allow (1) but can score both marks if clearly stated electrons not in nucleus eg in shells	**(2)**

Q19.

Question Number	Answer	Acceptable answers	Mark
(a)	<table><tr><th>particle</th><th>relative mass</th></tr><tr><td>proton</td><td>1</td></tr><tr><td>neutron</td><td>**1** (1)</td></tr><tr><td>electron</td><td>1/1837 / negligible / very small (1)</td></tr></table>	if any minus sign(s) MAX 1 anything less than 1/1500 or 0.00067/(almost) 0	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	**B** the same number of electrons and protons		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	3 protons **(1)** {4/7-3} neutrons **(1)** maximum 1 mark if electrons mentioned	 if numbers incorrect but state both protons and neutrons (and not electrons) allow (1) but can score both marks if clearly stated electrons not in nucleus eg in shells	**(2)**

Q20.

	Answer	Acceptable answers	Mark
	An description linking • 8 protons (1) • (and) {17-8/9} neutrons (1)	 ignore references to electrons in shells / charges on particles if electrons in nucleus max 1 protons and neutrons with incorrect numbers (1)	**(2)**

Q21.

	Answer	Acceptable answers	Mark
	An description linking • 8 protons (1) • (and) {17-8/9} neutrons (1)	 ignore references to electrons in shells / charges on particles if electrons in nucleus max 1 protons and neutrons with incorrect numbers (1)	**(2)**

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	number of moles = 0.1 /24 = 0.0042 or 4.2 x 10^{-3} (1)	ignore answer left as fraction 1/240 rounding must be correct: reject 0.00416 (no dot) allow 0.00416̇ (with dot above the 6) allow 0.004	**(1)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	the equation shows two HCl reacting with one Mg	allow ratio is 2:1 allow 1 mol HCl reacts with 0.5 mol of Mg allow 0.5 mol HCl reacts with 0.25 mol Mg	**(1)** AO 2 1

Q23.

Question Number	Answer	Mark
	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (2 marks) • (lattice of) positive ions in a sea of electrons (1) • strong forces of attraction (between metal ions and electrons) (1) • therefore large amount of heat energy needed to melt (1)	**(3)**

Q24.

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

		Indicative Content	
QWC	***(c)**	A description including some of the following points **reactants** • dissolve reactants (in water) • mix reactants / solutions • use of appropriate apparatus • stir	

		separate product • filter • use of filter funnel and paper **making pure dry salt** • solid on filter paper • wash with water • dry in oven / leave to dry / in a warm place	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. mix solutions of the reactants in a beaker and then filter. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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

Q25.

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

	/ body (1) • passes through body (unchanged) (1)	allow 'it is insoluble so it is nontoxic' for one mark	

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

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. mix the two reactants in a beaker OR wash solid and leave to dry. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple description e.g. mix solutions of the reactants in a beaker and then filter. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description e.g. mix solutions of the reactants in a beaker then filter, wash solid and leave to dry. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

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

Q26.

	Answer	Acceptable answers	Mark
	D weak forces of attraction between the oxygen molecules		**(1)**

Q27.

	Answer	Acceptable answers	Mark
	D weak forces of attraction between the oxygen molecules		**(1)**

Q28.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A description including carbon (1) atom(s) (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	covalent Ignore giant molecular		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	fractional distillation (2)	distillation fractionation	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	**A** 0.25		**(1)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description/explanation including some of the following points content could be shown in diagram(s) **practical procedure** • ignite magnesium /put magnesium in (Bunsen) flame • use of tongs/crucible / tube or gas jar of {oxygen/air} • lift lid (to let air in)- if crucible used • magnesium burns/oxidises/exothermic reaction • (bright) white {flame/light} • white powder/ash/solid formed **bonding** • magnesium atoms have 2 electrons in the outer shell • magnesium atoms {lose/transfer} electrons • form Mg^{2+}/ions with positive charge • oxygen atoms have 6 electrons in the outer shell • oxygen atoms gain electrons • forms O^{2-}/ions with negative charge • {8 electrons in /full/complete} outer shell • two electrons transferred/gained/lost • ions with opposite charges attract each other/ Mg^{2+} attracts O^{2-} ions	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium burns / magnesium atoms lose electrons • 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 burns with a white flame / magnesium forms positive ions and oxygen forms negative ions • 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 including the experiment and bonding e.g. magnesium burns with a white flame, magnesium atoms give their 2 outer electrons to oxygen atoms • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question = 12 marks)

Q29.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A description including carbon (1) atom(s) (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	covalent Ignore giant molecular		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	fractional distillation (2)	distillation fractionation	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	**A** 0.25		**(1)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description/explanation including some of the following points content could be shown in diagram(s) **practical procedure** • ignite magnesium /put magnesium in (Bunsen) flame • use of tongs/crucible / tube or gas jar of {oxygen/air} • lift lid (to let air in)- if crucible used • magnesium burns/oxidises/exothermic reaction • (bright) white {flame/light} • white powder/ash/solid formed **bonding** • magnesium atoms have 2 electrons in the outer shell • magnesium atoms {lose/transfer} electrons • form Mg^{2+}/ions with positive charge • oxygen atoms have 6 electrons in the outer shell • oxygen atoms gain electrons • forms O^{2-}/ions with negative charge • {8 electrons in /full/complete} outer shell • two electrons transferred/gained/lost • ions with opposite charges attract each other/ Mg^{2+} attracts O^{2-} ions	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium burns / magnesium atoms lose electrons • 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 burns with a white flame / magnesium forms positive ions and oxygen forms negative ions • 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 including the experiment and bonding e.g. magnesium burns with a white flame, magnesium atoms give their 2 outer electrons to oxygen atoms • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question = 12 marks)

Q30.

Question Number	Answer	Additional guidance	Mark
(i)	A description to include • shared **electron**(s) (1) • {a pair of / two} (**electrons**) (1)	allow a diagram for both mark points reference to ionic bonding/ions scores 0 e.g. gains two electrons = 0	**(2)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking any two from • intermolecular forces / forces **between** molecules (1) • (intermolecular) forces {weak / take little energy to break}/ little energy to separate molecules (1) • boiling point is below room temperature / has a low boiling point (1)	if answer relates to the breaking of any type of **bond** first two marking points cannot be scored (but 3rd could) allow "attractions" instead of "forces"	**(2)** AO 1 1

Q31.

Question Number	Answer	Additional guidance	Mark
(i)	A description to include • shared **electron**(s) (1) • {a pair of / two} (**electrons**) (1)	allow a diagram for both mark points reference to ionic bonding/ ions scores 0 *e.g.* gains two electrons = 0	**(2)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking any two from • intermolecular forces / forces **between** molecules (1) • (intermolecular) forces {weak / take little energy to break}/ little energy to separate molecules (1) • boiling point is below room temperature / has a low boiling point (1)	if answer relates to the breaking of any type of **bond** first two marking points cannot be scored (but 3rd could) allow 'attractions' instead of 'forces'	**(2)** AO 1 1

Q32.

Question Number	Answer	Additional guidance	Mark
(i)	calcium + oxygen → calcium oxide LHS (1) RHS (1)	ignore air allow reactants on LHS in either order allow $2Ca + O_2 \rightarrow 2CaO$ (2) incorrect balancing of correct species max 1 mark ignore state symbols allow = for →	(2)

Question number	Answer	Additional guidance	Mark
(ii)	Ca : O 1.05/40 : 0.42/16 (1) 0.026 : 0.026 1 : 1 (1) empirical formula CaO (1)	 allow ecf formula alone scores max 1 mark	(3)

Q33.

	Answer	Acceptable answers	Mark
(a)	sodium carbonate + calcium nitrate → sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	ignore solution / state symbols ignore incorrect attempts at balanced equation ignore mixtures of words and formulae	(2)
(b)(i)	C orange-red		(1)
(b)(ii)	A description including two points from CLEAN • clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• moisten splint • put splint into solid • hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1	(2)
(c)(i)	40/44 (1) (= 0.909) (any fraction) x 100 (1) (= 90.9 / 90.91 / 91(%))	correct answer (2) Ignore 90(%)	(2)
(c)(ii)	reaction is incomplete / not hot enough / not heated for long enough / use of impure calcium carbonate	ignore {gas escaping / not all collected / incorrect measurement}	(1)
(d)	D have high melting points		(1)

Q34.

	Answer	Acceptable answers	Mark
(a)	sodium carbonate + calcium nitrate → sodium nitrate + calcium carbonate (2) LHS (1) RHS (1)	ignore solution / state symbols ignore incorrect attempts at balanced equation ignore mixtures of words and formulae	**(2)**
(b)(i)	C orange-red		**(1)**
(b)(ii)	A description including two points from CLEAN • clean (flame test) wire with (hydrochloric) acid (1) SAMPLE • put (wire) into solid (1) TEST • hold (wire) in (Bunsen) flame (1)	• moisten splint • put splint into solid • hold splint in (Bunsen) flame ignore : hold <u>over</u> flame use of tongs / spatula etc for equipment, max 1	**(2)**
(c)(i)	40/44 (1) (= 0.909) (any fraction) x 100 (1) (= 90.9 / 90.91 / 91(%))	correct answer (2) Ignore 90(%)	**(2)**
(c)(ii)	reaction is incomplete / not hot enough / not heated for long enough / use of impure calcium carbonate	ignore {gas escaping / not all collected / incorrect measurement}	**(1)**
(d)	D have high melting points		**(1)**

Q35.

Question number	Answer	Additional guidance	Mark
(i)	12 + (16 x 2) (1) = 44 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	320 tonnes iron oxide → 224 tonnes iron (1) 640 tonnes iron oxide → $\frac{224 \times 640}{320}$ (tonnes) iron (1) = 448 (tonnes) (1) OR 160 tonnes iron oxide → 112 tonnes iron (1) 640 tonnes iron oxide → $\frac{112 \times 640}{160}$ (tonnes) iron (1) = 448 (tonnes) (1) OR 160 tonnes iron oxide → 112 tonnes iron (1) 4 x 160 → 4 x 112 (1) = 448 (tonnes) (1)	award full marks for correct numerical answer without working. allow 2 marks for 224 as a final answer with or without working. allow $\frac{640}{160}$ (1) (= 4) 4 x 112 = (1) = 448 (tonnes) (1) if no other marks scored allow 1 mark for 320 and 224 or 160 and 112 seen	(3)

Q36.

Question number	Answer	Additional guidance	Mark
	final answer of 114 (g dm^{-3}) with or without working (3) OR $\frac{28.4}{250}$ (1) (= 0.1136) 0.1136 x 1000 (1) (= 113.6) = 114 (g dm^{-3}) (1)	allow ECF throughout $\frac{250}{1000}$ (dm^3) (1) (= 0.250 (dm^3)) $\frac{28.4}{0.250}$ (1) (= 113.6) OR $\frac{1000}{250}$ (1) = 4 4 x 28.4 (1) (= 113.6) Must have 3sf for MP3 0.114 scores 2 Lose MP1 if rounded incorrectly e.g, to 0.11 or 0.113 but mark on	(3)

Q37.

Question number	Answer	Additional guidance	Mark
	46.25 / 46 with or without working scores 2 marks $\frac{200}{1000}$ (1)= 0.200 (dm^3) $\frac{9.25}{0.200}$ (1) = 46.25 / 46 OR $\frac{9.25}{200}$ = (0.04625) (1) 0.04625 x 1000 = 46.25 (1)	answer to 2 or more sig fig	(2) AO2

Q38.

Question number	Answer	Additional guidance	Mark
	final answer of 114 (g dm^{-3}) with or without working (3) OR $\frac{28.4}{250}$ (1) (= 0.1136) 0.1136 x 1000 (1) (= 113.6) = 114 (g dm^{-3}) (1)	allow ECF throughout $\frac{250}{1000}$ (dm^3) (1) (= 0.250 (dm^3)) $\frac{28.4}{0.250}$ (1) (= 113.6) OR $\frac{1000}{250}$ (1) = 4 4 x 28.4 (1) (= 113.6) Must have 3sf for MP3 0.114 scores 2 Lose MP1 if rounded incorrectly e.g, to 0.11 or 0.113 but mark on	**(3)**

Q39.

Question number	Answer	Additional guidance	Mark
	250 cm^3 contains 6.36 g (1 cm^3 solution contains) $\frac{6.36}{250}$ (g) (1) (=0.02544) (1000 cm^3 solution contains) $\frac{6.36 \times 1000}{250}$ (g) (1) concentration = 25.44 (g dm^{-3}) = 25.4 (g dm^{-3}) (1) OR volume of solution = 250/1000 (1) (=0.250) (mass) concentration = $\frac{\text{mass (in g)}}{\text{volume (in } dm^3\text{)}}$ = $\frac{6.36 \times 1000}{250}$ g (1) concentration = 25.44 (g dm^{-3}) = 25.4 (g dm^{-3}) (1)	0.02544 25.44 with or without working (2) 25.4 with or without working (3) (answer to 3 sig fig) other allows: 2.544 1 mark 2.54 2 marks 0.0254 2 marks 2.544 x 10^{-5} 1 mark 2.54 x 10^{-5} 2 marks with working: 39.31 0 marks 39.3 1 mark (answer to 3 sig fig)	**(3)** **EXP**

Q40.

Question number	Answer	Additional guidance	Mark
	114.78 - 111.23 (1) = 3.55 50 cm^3 solution contain = 3.55g sodium sulfate(1) 1000 cm^3 solution contains = $\frac{3.55 \times 1000}{50}$ g (1) concentration = 71 g dm^{-3} (1)	allow full marks for correct answer with no working	**(4)**

Q41.

Question number	Answer	Additional guidance	Mark
	$\frac{1.19}{119}$ and $\frac{1.42}{35.5}$ (1) 0.01 : 0.04 (1) $SnCl_4$. (1)	allow ECF	**(3)** **AO2**

Q42.

Question number	Answer	Additional guidance	Mark
	Al : Cl 0.270/27 : 1.065/35.5 (1) 0.01 : 0.03 (1) OR 1 : 3 empirical formula $AlCl_3$ (1)	allow ECF Al : 0.270/27 = 0.01 (1) Cl : 1.065/35.5 = 0.03 (1) 27/0.27 : 35.5/1.065 100 : 33.3 (1) OR 3 : 1 Al_3Cl (1) formula alone with no working scores no marks.	**(3)** **EXP**

Q43.

Question number	Answer	Additional guidance	Mark
	MP1 for dividing by atomic mass A : G $\frac{3.5}{7}$: $\frac{4.0}{16}$ (1) **MP2 for deriving ratio <u>from MP1</u>** 0.5 : 0.25 OR 2 : 1 (1) **MP3 for ratio in MP2 to formula** empirical formula A_2G (1)	A_2G with no relevant working (1) ONLY AG_2 (0) For MP2: If they go on to calculate a different ratio in addition to 0.5:0.25 or 2:1 do not award MP2 ecf on step 1: if inverted, $\frac{7}{3.5}$: $\frac{16}{4.0}$ (0) = 2 : 4 or 1 : 2 (1) AG_2 (1) allow 1 in empirical formula allow Li for A and O for G do not penalise incorrect case in formula	**(3)**

Q44.

Question number	Answer	Additional guidance	Mark
	Ti $\frac{12}{48}$ = 0.25 and O $\frac{8.0}{16}$ = 0.5 (1) simplest ratio 1:2 (1) empirical formula TiO_2 (1)	working must be shown to gain full marks allow TE Ti $\frac{48}{12}$ = 4 and O $\frac{16}{8.0}$ = 2 (0) simplest ratio 2:1 (1) empirical formula Ti_2O (1) allow (1) for formula with numbers obtained from 1st step with no simplest ratio	**(3)**

Q45.

Question number	Answer	Additional guidance	Mark
	MP1 for dividing by atomic mass **A : G** 3.5 : 4.0 (1) 7 16 **MP2 for deriving ratio from MP1** 0.5 : 0.25 OR 2 : 1 (1) **MP3 for ratio in MP2 to formula** empirical formula **A_2G** (1)	A_2G with no relevant working (1) ONLY AG_2 (0) For MP2: If they go on to calculate a different ratio in addition to 0.5:0.25 or 2:1 do not award MP2 ecf on step 1: If inverted, 7 : 16 (0) 3.5 4.0 = 2 : 4 or 1 : 2 (1) AG_2 (1) allow 1 in empirical formula allow Li for A and O for G do not penalise incorrect case in formula	**(3)**

Q46.

Question number	Answer	Additional guidance	Mark
	M_r H_2O = 18.0 (1) then moles of H_2O = 4.5 / 18.0 (= 0.25) (1) moles $CuSO_4.5H_2O$ = 1/5 x 0.25 (= 0.05)(1) mass $CuSO_4.5H_2O$ = 0.05 x 249.5 (= 12.475 g) (1) OR 5 H_2O : 1 $CuSO_4.5H_2O$ (1) 5 x 18 : 249.5 (1) mass $CuSO_4.5H_2O$ = 249.5 / 90 x 4.5 (= 12.475 g) (1)	12.475 / 12.48 (g) with or without working scores 4 Allow TE throughout Answer must be to 2 or more sig figs	**(4)** **AO2**

Q47.

Question number	Answer	Additional guidance	Mark
	2.25/ 2.3 with or without working scores 3 MgO = 24 + 16 = 40 (1) **THEN** 1 g Mg forms $\frac{40}{24}$ (1) = 1.67 (g) MgO 1.35 g Mg forms $\frac{40 \times 1.35}{24}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{24}$ (1) = 0.05625 MgO 0.05625 x 40 (1) = 2.25 (g)	allow ecf for incorrect formula mass allow 48 g Mg forms 80 g MgO (1) (could be under the equation) **THEN** 1 g Mg forms $\frac{80}{48}$ (1) = 1.67 g MgO 1.35 g Mg forms $\frac{80 \times 1.35}{48}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{48}$ (1) = 0.028125 MgO 0.028125 x 80 (1) = 2.25 (g) Note 40 x 1.35 = 54 (2) or 80 x 1.35 = 108 (2)	**(3)**

Q48.

Question number	Answer	Additional guidance	Mark
	114.78 - 111.23 (1) = 3.55 50 cm^3 solution contain = 3.55g sodium sulfate(1) 1000 cm^3 solution contains = $\frac{3.55 \times 1000\ g}{50}$ (1) concentration = 71 g dm^{-3} (1)	allow full marks for correct answer with no working	**(4)**

Q49.

Question number	Answer	Additional guidance	Mark
	2.25/ 2.3 with or without working scores 3 MgO = 24 + 16 = 40 (1) **THEN** 1 g Mg forms $\frac{40}{24}$ (1) = 1.67 (g) MgO 1.35 g Mg forms $\frac{40 \times 1.35}{24}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{24}$ (1) = 0.05625 MgO 0.05625 x 40 (1) = 2.25 (g)	allow ecf for incorrect formula mass allow 48 g Mg forms 80 g MgO (1) (could be under the equation) **THEN** 1 g Mg forms $\frac{80}{48}$ (1) = 1.67 g MgO 1.35 g Mg forms $\frac{80 \times 1.35}{48}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{48}$ (1) = 0.028125 MgO 0.028125 x 80 (1) = 2.25 (g) Note 40 x 1.35 = 54 (2) or 80 x 1.35 = 108 (2)	**(3)**

Q50.

Question number	Answer	Additional guidance	Mark
	• calculates relative molecular mass of C_4H_9OH (1) • calculates mass of C_4H_9OH produced (1) • final answer = 1.9 (kg) (1)	Example of calculation Relative molecular mass of C_4H_9OH = (4 × 12) + (9 × 1) + 16 + 1 = 74 Mass of C_4H_9OH produced = (74 ÷ 56) × 1.4 Accept 1.85 (kg) Award full marks for use of moles/correct numerical answer without working	**(3)**

Q51.

Question number	Answer	Additional guidance	Mark
	• Calculates relative molecular mass of C_4H_9OH (1) • Calculates mass of C_4H_9OH produced (1) • Final answer = 1.9 (kg) (1)	Example of calculation: relative molecular mass of C_4H_9OH = (4 × 12) + (9 × 1) + 16 + 1 = 74 mass of C_4H_9OH produced = (74 ÷ 56) × 1.4 Accept 1.85 (kg) Award full marks for use of moles/correct numerical answer without working.	**(3)**

Q52.

Question number	Answer	Additional guidance	Mark
	66 (g) as final answer with or without working scores 3 • mol carbohydrate = 135/180 = 0.75 mol **(1)** • mol of carbon dioxide = 0.75 x 2 = 1.5 mol **(1)** • mass = 1.5 x 44 = 66(g) **(1)** **OR** • 180g carbohydrate → 2 x 44g (=88g) carbon dioxide **(1)** • 135g carbohydrate → 135/180 x 2 x 44g carbon dioxide **(1)** • = 66(g) **(1)**	33 scores 2.	**(3)**

Q53.

Question number	Answer	Mark
	moles of sucrose = $\frac{\text{moles of ethanol}}{4}$ (1) (= $\frac{26.9}{4 \times 46}$ = 0.146) mass of sucrose = $\frac{\text{moles of ethanol}}{4}$ x 342 (1) (= $\frac{26.9 \times 342}{4 \times 46}$ = 49.999 g) allow 50 g for 2 marks	**(2)** **AO2**

Q54.

Question number	Answer	Additional guidance	Mark
	2.8g with or without working scores 2 0.043 x 65 (1) (=2.795) = 2.8 g (1)	 allow 1 mark for a different calculation using 65 and 0.043, correctly evaluated, with working, rounded to 1 decimal place	(2)

Q55.

Question number	Answer	Additional guidance	Mark
(i)	M_r $TiCl_4$ = 48.0 + (4 x 35.5) (1) (= 190) moles of $TiCl_4$ = 45 000/190 = 236.8 (1)	ecf allow two or more sig figs	(2) AO2

Question number	Answer	Additional guidance	Mark
(ii)	(minimum) moles of Mg needed = 236.8 x 2 = 473.6 (1) 500 moles of Mg added > minimum 473.6 moles required	allow ecf from (i) for moles of $TiCl_4$	(1) AO2

Q56.

Question number	Answer	Additional guidance	Mark
	1.8... x 10^{24} with or without working scores 2 • 3 x 6.02 x 10^{23} (1) • = 1.8 x 10^{24} (1)	 allow 18 x 10^{23} , 1.81 x 10^{24} , 1.806 x 10^{24} or any other form of correct answer to 2-4 sig figs allow 2 x 6.02 x 10^{23} = 1.2 x 10^{24} (1)	(2)

Q57.

Question number	Answer	Additional guidance	Mark
	final answer of $1.2(04) \times 10^{22}$ with or without working (2) OR $\frac{3.94}{197} = 0.02$ (1) $0.02 \times 6.02 \times 10^{23} = 1.2(04) \times 10^{22}$ (1)	allow ECF allow $0.12(04) \times 10^{23}$	**(2)**

Q58.

Question number	Answer	Additional guidance	Mark
	1.5×10^{21} with or without working scores 3 $\frac{0.11}{44}$ (1) (= 0.0025) $0.0025 \times 6.02 \times 10^{23}$ (1) $= 1.5 \times 10^{21}$ (1) **OR** 44g contains 6.02×10^{23} molecules (1) 0.11g contains $\frac{0.11}{44} \times 6.02 \times 10^{23}$ molecules (1) ($=1.505 \times 10^{21}$) $= 1.5 \times 10^{21}$ (1)	allow 15×10^{20} allow ecf in MP2 and MP3 if using 0.11 and/or 44 **and** Avogadro constant	**(3)**

Q59.

Question number	Answer	Additional guidance	Mark
(i)	relative formula mass = 192 + 12 + 28 +16 (1) = 248 number of moles = 0.50/248 or 0.002 or 2.0×10^{-3} or 2.02×10^{-3} (1)	award full marks for correct numerical answer without working. allow 1 mark max for ecf using incorrectly calculated value for relative formula mass allow any number of sig figs	(2) EXP

Question number	Answer	Additional guidance	Mark
(ii)	number of molecules = $2 \times 6.02 \times 10^{23}$ (1) = $1.2(04) \times 10^{24}$	allow $12(.04) \times 10^{23}$ without working	(1) GRAD

Q60.

Question number	Answer	Additional guidance	Mark
	$0.005/ 5 \times 10^{-3}$ mol with or without working scores 3 Mr = 63.5 + 32 + 4 x 16 (1) (=159.5) AND EITHER mass of copper sulfate = 50/1000 x 15.95 (1) (= 0.7975 g) moles = 0.7975/159.5 (1) (= 0.005 mol) OR conc = 15.95/159.5 (1) (=0.1 $moldm^{-3}$) moles = 50/1000 x 0.1 = (0.005 mol)	2 marks for (MUST show working): 5 0.1 ecf in all stages	(3)

Q61.

Question number	Answer	Mark
	number of protons = 52 (1) number of neutrons = 125 - number of protons (1) (= 73)	(2) AO2