PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 1: KEY CONCEPTS IN CHEMISTRY (PACK 2)

SCORE	PERCENTAGE
/155	%

STEMUP

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Q1.

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.

Q2.

Most candidates knew how to carry out this calculation, although a few did struggle with its execution. Most obtained the first mark for the formula mass of $POCl_3$, although one candidate just added together the relative atomic masses not taking into account the number of Cl atoms. For some reason a couple of candidates erroneously worked out the percentage of phosphorus and so missed the second mark. The main reason for candidates not getting the second mark was for using an incorrect number of chlorine atoms when working the percentage.

Q3. No Examiner's Report available for this question

Q4.

In general, candidates performed well in this question with the majority being able to score the full 4 marks available for calculating the relative atomic mass of lithium in the sample. Some candidates did not, however, show this understanding of how to use the data given with different methods of divisions and subtractions seen, resulting in an incorrect answer. They could still, however, access mark point 4 for their answer given to 2 decimal places.

Lithium has two naturally occurring isotopes, lithium-6 and lithium-7.

A sample of lithium contains
7.59% of lithium-6
92.41% of lithium-7.

Calculate the relative atomic mass of lithium in this sample.

Give your answer to two decimal places.
You must show your working.

(4)

$$\frac{(7.59 \times 6) + (92.41 \times 7)}{100}$$

$$= 6.9241$$

relative atomic mass of lithium = 6.9241

Results Plus: Examiner Comments

In some cases, candidates lost a mark as they did not give their answer to 2 decimal places.

$$\frac{\text{7.59 (\% x RFM) + (\% x RFM)}}{\text{No. Moles.}}$$

$$\frac{(7.59 \times 6) + (92.41 \times 7)}{100}$$

$$\frac{45.54 + 64687}{100} = 6.924$$

relative atomic mass of lithium = 6.92

Results Plus: Examiner Comments

A well laid out answer with the correct answer to 2 decimal places on the answer line to gain full marks.

Q5.

This question was well answered with a large proportion of candidates scoring the full three marks available. Of those that did lose marks it was often because they had made an error during the multiplication step, in some cases candidates tried to combine steps two and three and then confused themselves and repeated the division again.

Q6.

For the first part of the question, part (i), was well answered with the majority scoring the 2 marks available.

Candidates clearly understood how to use the relative atomic masses of calcium, carbon and oxygen to correctly deduce the relative formula mass of $CaCO_3$ to be 100.

A common error which often led to 1 mark only, often arose when failing to multiply the relative atomic mass of oxygen by three, namely arriving at a value of 68.

The second part of the question, part (ii), was very poorly answered with a significant majority of responses not scoring either of the 2 marks available.

Very few candidates clearly understood how to calculate the atom economy.

A common answer was 56, which generally did not score since no working was provided. The most commonly seen incorrect answer was 100 – indicating that a surprising number of candidates seemed to think both products were useful and so had an atom economy of 100%. With the relative formula mass of calcium carbonate being 100 (as calculated in part (i)), the need to both divide by 100 and then multiply by 100 in the same calculation may be a factor that proved most challenging to candidates.

(i) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

40 + 12 + (16 x 3)

40 + 12 + 48 = 100

relative formula mass = 100

(ii) Calculate the atom economy for the formation of calcium oxide in this reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

You must show your working.
(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

100 + 100 -> 40 + 16 + 12 + 32

100 -> 100

atom economy = 100 %

Results Plus: Examiner Comments

This response scored 2 marks for part (i).

The relative formula mass for calcium carbonate has been correctly calculated by adding together the relative atomic mass values for all the atoms in its formula.

The response for part (ii) was not credit worthy.

The candidate has not calculated the atom economy but has simply added together all the relative atomic masses for the atoms in the two products in the equation given in the question.

(i) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

relative formula mass = 100

(ii) Calculate the atom economy for the formation of calcium oxide in this reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

You must show your working.
(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

$\frac{CaO}{CaCO_3} \times 100 \quad \frac{56}{100} \times 100 =$

atom economy = 56 %

Results Plus: Examiner Comments

This response scored both marks for both parts (i) and (ii).

Although, no working has been shown in part (i), it is the correct value and is credited with the 2 marks.

With part (ii) the correct calculation for the atom economy has been shown, namely (56/100) x 100 =56.

Note that had 56 alone been given, i.e. without working, this would have not been credit worthy.

Results Plus: Examiner Tip

It is sensible with all calculations to show all working. Often where there has been a simple arithmetical error in a candidate's method, examiners are able to award marks in a calculation by error carried forward.

Q7.

In part (i), candidates, in the vast majority of cases, understood how to use the relative atomic masses of calcium, carbon and oxygen to correctly deduce the relative formula mass of $CaCO_3$ to be 100, although arithmetical errors sometimes cost candidates the second mark, or failing to multiply the Ar of oxygen by 3.

In part (ii), however strange it might have seemed dividing by 100 and multiplying by 100 in the same calculation, few candidates were fazed by this and many gave the correct answer. It was noted that most correctly followed instruction that they must show working. A surprising number seemed to think both products were useful and so had an atom economy of 100%.

(i) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

$12 + 40 + (16 \times 3) = 100$

relative formula mass = 100

(ii) Calculate the atom economy for the formation of calcium oxide in this reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

You must show your working.
(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

Mr desired $40 + 16$

Mr all $(40+16) + (12 + (16 \times 2))$

$\frac{56}{100} = 0.56 \times 100 = 56$

atom economy = 56 %

Results Plus: Examiner Comments

This is an example of a clearly set out correct answer.

Q8.

Few candidates appreciated that in one formula unit of $C_{12}H_{22}O_{11}$ there was 45 atoms. Missing this out in the calculation led to calculating the number of $C_{12}H_{22}O_{11}$ molecules and a mark of 1. Unfortunately, there were several candidates who did not know where to start on this calculation.

Q9.

(i)

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

The majority of candidates clearly subtracted the numbers of carbon atoms and hydrogen atoms in butene from those in decane, to arrive at the correct answers, 6 and 14 respectively.

(ii)

This question was very poorly answered on the whole, with only a fifth of responses scoring the 1 mark available.

The majority of responses were often left blank.

It is evident that extremely few candidates understood how the law of conservation of mass applies to a chemical reaction.

Q10.

This question was very poorly answered on the whole, with only a fifth of responses scoring typically 2 out of the 3 marks available.

Many responses scored 2 marks only, for 0.75, since many failed to convert dm^3 into cm^3 – many simply not recognising that there are 1000 cm^3 in 1 dm^3.

Many responses were left blank or in many cases candidates failed to score since they simply combined all sorts of number combinations, e.g. multiplying the numbers given in the question, namely 9.0 x 12.0 (= 108) was a very commonly seen response.

The concentration of a calcium chloride solution is 12 g dm^{-3}.

Calculate the volume of this solution, in cm^3, that contains 9.0 g of calcium chloride.

You must show your working.

(3)

12 x 1000 = 12000 cm^3

volume = mass / concentration 9 / 12000 = 0.0007

= 0.00075 cm^3

volume of solution = 0.00075 cm^3

Results Plus: Examiner Comments

This response was awarded 2 marks.

The correct formula for calculating the volume has been given. In the first stage, the concentration has been incorrectly multiplied by 1000 (rather than divided by 1000). However, by error carried forward, the mass has been divided by this concentration and evaluated.

12000 / 9 = 1333

volume of solution = 1333 cm^3

Results Plus: Examiner Comments

This response was awarded 1 mark.

The fraction is incorrectly inverted. However, the mark was given for the 'conversion' of the units, i.e. effectively multiplying the (incorrect) fraction by 1000.

Q11.

The majority of candidates were able to score 1 mark for being able to calculate the total mass of the mixture after the two solutions were mixed together. Where candidates lost marks, it was because they multiplied or subtracted the two numbers rather than adding them.

Calculate the total mass of the mixture after the precipitate has formed when these two solutions are mixed together.

(1)

$10.32 \times 5.12 = 52.8384$

52.8 g

Results Plus: Examiner Comments

In some cases candidates lost marks as they multiplied rather than divided the two numbers given.

Calculate the total mass of the mixture after the precipitate has formed when these two solutions are mixed together.

(1)

$$\begin{array}{r} 10.32 \\ +\ 5.12 \\ \hline 15.44 \end{array}$$

15.44 g

Results Plus: Examiner Comments

The correct answer that scored the mark.

Q12.

Generally very well answered with most candidates able to score all 3 marks available.

This was a well-performed calculation. It would seem that many candidates are well-drilled in evaluating an empirical formula, with working clearly set out in most of the responses seen.

Common errors, omissions, misconceptions:

There were still a significant number of candidates who obtained the 2:1 ratio and then were unable to write an empirical formula, restricting the score to 2 marks. There were the usual (typically seen in previous examination series) errors of getting the initial fractions upside down and using 32 for the mass of oxygen rather than 16. However, many candidates carried on correctly and earned marks from the allowance of an error carried forward. Some candidates used S as the symbol for sodium when writing the empirical formula.

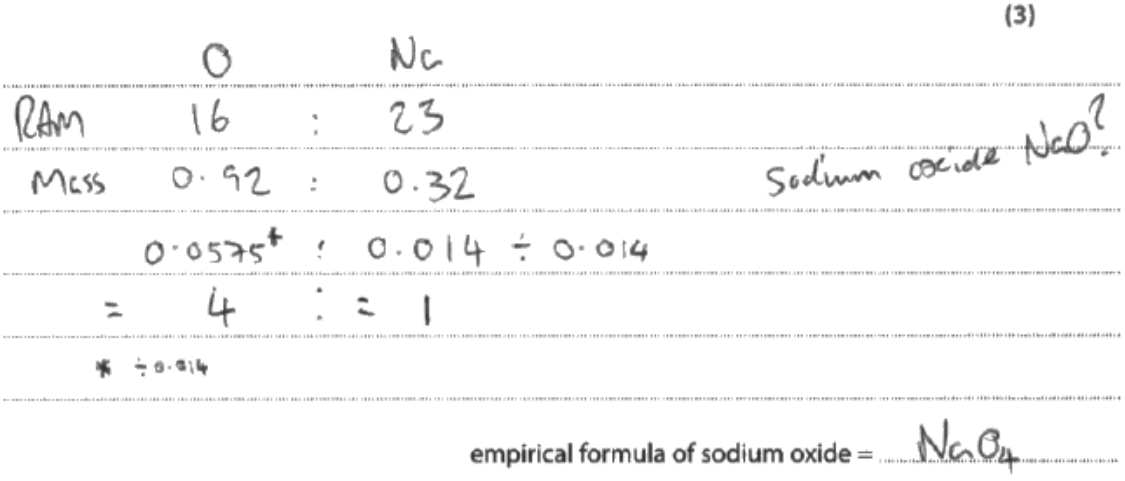
Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

Sodium metal tarnishes in air to form a layer of sodium oxide on its surface.
0.92 g of sodium combined with 0.32 g of oxygen in this oxide.

Calculate the empirical formula of this sodium oxide.
(relative atomic masses: O = 16, Na = 23)

You must show your working.

(3)



Results Plus: Examiner Comments

This response scored 2 of the 3 marks available.

There is only one error in this calculation, namely the masses of Na and O have been transposed. The error can be carried forward which allows 2 marks to be awarded.

Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

Sodium metal tarnishes in air to form a layer of sodium oxide on its surface.
0.92 g of sodium combined with 0.32 g of oxygen in this oxide.

Calculate the empirical formula of this sodium oxide.
(relative atomic masses: O = 16, Na = 23)

You must show your working.

(3)

Sodium — Oxygen

0.92 g — 0.32 g

$0.92/23 = 0.04$ — $0.32/16 = 0.02$

$\frac{0.04}{0.02} = 2$ — $\frac{0.02}{0.02} = 1$

$= Na_2$ — O

empirical formula of sodium oxide = Na_2O

Results Plus: Examiner Comments

A typically fully correct response which scored 3 marks.

All key steps in the working have been shown.

Q13.

Some candidates produced exemplary answers, often using a table which clearly showed their working and helped them to organise their work correctly. However, in general the response was not encouraging.

Some candidates managed get the correct ratio but did not then covert this ratio to the formula to gain the last mark.

In some cases, candidates inverted the fraction and so lost the first mark. In these cases, the next two marks could be awarded for an error carried forward and scored for the correct ratio from the incorrect fraction and the correct formula from this ratio. This highlights the importance of showing working. Those candidates that just stated NaO_2 scored zero marks, those that showed their working and came to an answer of NaO_2 could score 2 marks.

Some candidates had clearly not attempted empirical formula calculations before and simply multiplied all the numbers together and produced a numerical answer.

Lithium, sodium and potassium are reactive metals in group 1 of the periodic table.

Sodium metal tarnishes in air to form a layer of sodium oxide on its surface.
0.92 g of sodium combined with 0.32 g of oxygen in this oxide.

Calculate the empirical formula of this sodium oxide.
(relative atomic masses: O = 16, Na = 23)

You must show your working.

(3)

Sodium — Oxygen

Atomic mass = 23 — 16

$\frac{0.92}{23} = 0.04$ — $\frac{0.32}{16} = 0.02$

$\frac{0.04}{0.02} = 2$ — $\frac{0.02}{0.02} = 1$

Na_2O

empirical formula of sodium oxide = Na_2O

Results Plus: Examiner Comments

A very clearly worked out response.

Q14. No Examiner's Report available for this question

Q15. No Examiner's Report available for this question

Q16.

Surprisingly, fewer than half the candidates could calculate correctly the relative formula mass of water. Common errors seen here were answers 1+16 = 17 and 1 + 2×16 = 33. There were many who did not appear to know what to do with this question.

Q17.

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Q18. No Examiner's Report available for this question

Q19.

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.

Q20.

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.

Q21.

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

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

(3)

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

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

(3)

$1 \times 2 = 2$

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

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

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

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

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

Q22.

Stronger candidates answered this reacting mass calculation very well. Less confident

candidates mixed up the numbers in the calculation e.g. (100x40)/106, but others did not seem to know how to approach it and performed random calculations with the numbers given. Others simply did not attempt it.

Q23.

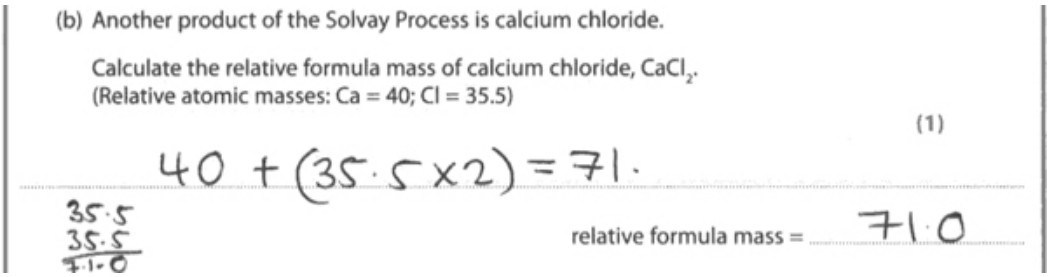
Stronger candidates answered this reacting mass calculation very well. Less confident candidates mixed up the numbers in the calculation e.g. (100x40)/106, but others did not seem to know how to approach it and performed random calculations with the numbers given. Others simply did not attempt it.

Q24. No Examiner's Report available for this question

Q25. No Examiner's Report available for this question

Q26.

The majority of candidates got this correct although there were the occasional addition errors, and a few candidates forgot to multiply 35.5 by 2. Some were awarded the mark (which was for the working) for doing the correct calculation but giving the answer as 110. Some weaker candidates gained no marks for incorrect calculations or did not attempt the question.


(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

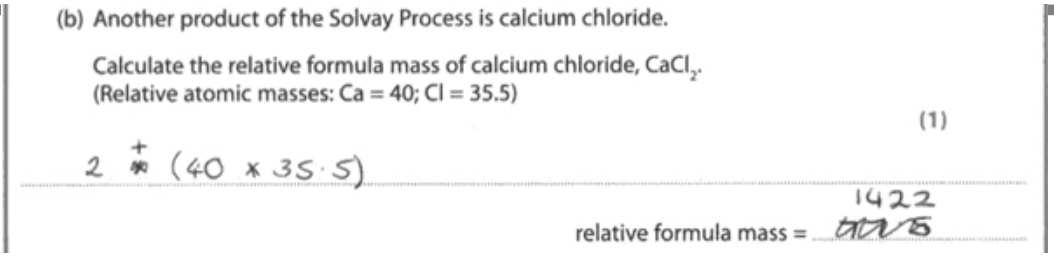
40 + (35.5 x 2) = 71.

35.5
35.5
71.0

relative formula mass = 71.0

Results Plus: Examiner Comments

This gained the mark as it was given for showing the correct working despite the careless error in evaluating the answer.


(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

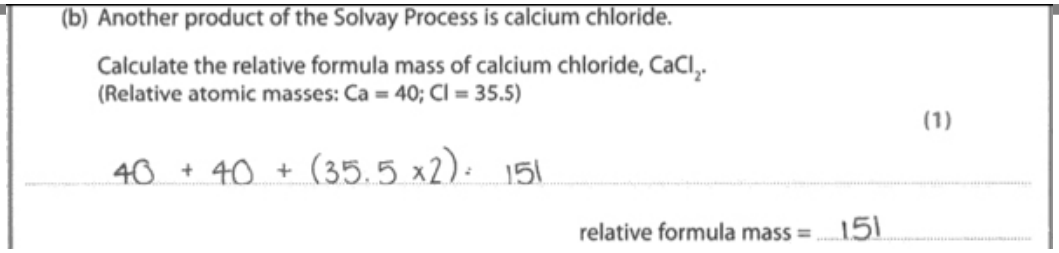
(1)

2 + (40 x 35.5)

relative formula mass = 1422

Results Plus: Examiner Comments

It was surprising what some candidates did with the relative atomic masses.



(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

40 + 40 + (35.5 x2) = 151

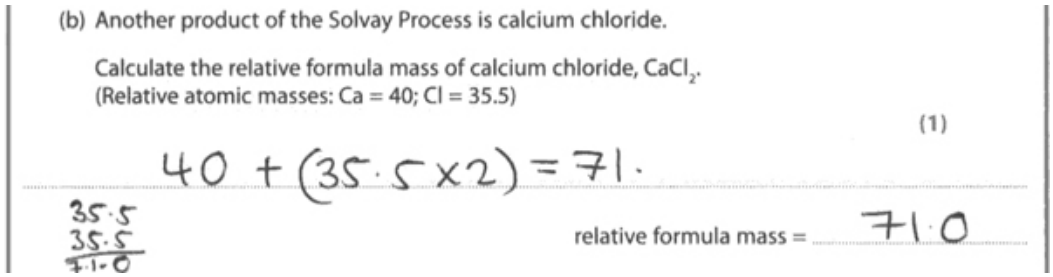
relative formula mass = 151

Results Plus: Examiner Comments

Some multiplied the Ar of calcium by two as well.

Q27.

The majority of candidates got this correct although there were the occasional addition errors, and a few candidates forgot to multiply 35.5 by 2. Some were awarded the mark (which was for the working) for doing the correct calculation but giving the answer as 110. Some weaker candidates gained no marks for incorrect calculations or did not attempt the question.



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(1)

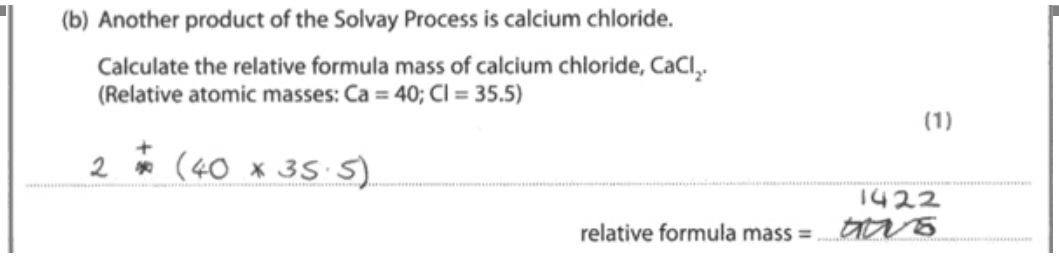
40 + (35.5 x2) = 71.

35.5
35.5
71.0

relative formula mass = 71.0

Results Plus: Examiner Comments

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(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

2 + (40 x 35.5)

1422

relative formula mass =

Results Plus: Examiner Comments

It was surprising what some candidates did with the relative atomic masses.

(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

40 + 40 + (35.5 x2) = 151

relative formula mass = 151

Results Plus: Examiner Comments

Some multiplied the Ar of calcium by two as well.

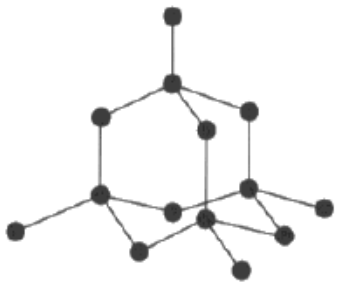
Q28. No Examiner's Report available for this question

Q29.

Candidates often gained one mark for referring to diamond having a giant structure or having strong bonds. Many then just went on to state that a high temperature was needed to melt it without recognising that a lot of energy is needed to break the bonds. Some answered this question by writing about intermolecular forces/bonding or even hydrogen bonding, both of which negated other previously given correct answers. Other candidates discussed uses of diamond and so did not answer the question.

Elements

6 (a) The arrangement of carbon atoms in diamond is shown.



diamond

Explain why diamond has a very high melting point.

(2)

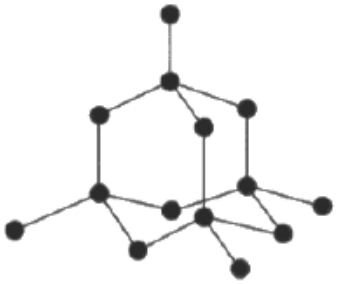
because it has strong covalent bonds

Results Plus: Examiner Comments

This proved to a very common way of scoring one mark.

Elements

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diamond

Explain why diamond has a very high melting point.

(2)

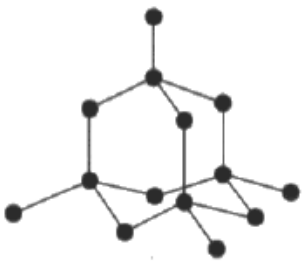
because the atoms are so strong and closely formed therefore it takes longer for it to heat up and melt.

Results Plus: Examiner Comments

Answers similar to this were very common. The candidate states the atoms are strong instead of the (covalent) bonds being strong. It "takes longer for it to heat up and melt" is not an acceptable alternative for a large amount of heat/energy (being needed to break the bonds).

Elements

6 (a) The arrangement of carbon atoms in diamond is shown.



diamond

Explain why diamond has a very high melting point.

(2)

because they have strong bonds that take ~~exte~~ a lot of energy to break.

Results Plus: Examiner Comments

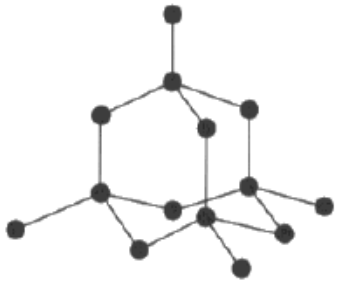
This was worth two marks.

Q30.

Candidates often gained one mark for referring to diamond having a giant structure or having strong bonds. Many then just went on to state that a high temperature was needed to melt it without recognising that a lot of energy is needed to break the bonds. Some answered this question by writing about intermolecular forces/bonding or even hydrogen bonding, both of which negated other previously given correct answers. Other candidates discussed uses of diamond and so did not answer the question.

Elements

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diamond

Explain why diamond has a very high melting point.

(2)

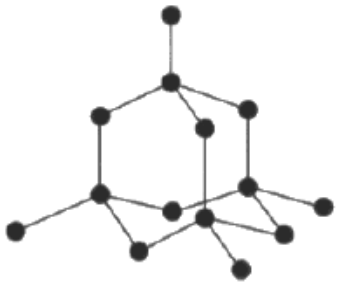
because it has strong covalent bonds

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diamond

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(2)

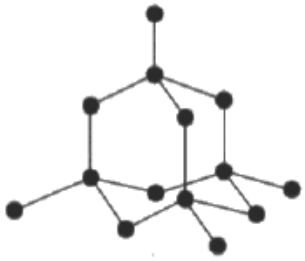
because the atoms are so strong and closely formed there fore it takes longer for it to heat up and melt.

Results Plus: Examiner Comments

Answers similar to this were very common. The candidate states the atoms are strong instead of the (covalent) bonds being strong. It "takes longer for it to heat up and melt" is not an acceptable alternative for a large amount of heat/energy (being needed to break the bonds).

Elements

6 (a) The arrangement of carbon atoms in diamond is shown.



diamond

Explain why diamond has a very high melting point.

(2)

Because they have strong bonds that take ~~one~~ a lot of energy to break.

Results Plus: Examiner Comments

This was worth two marks.

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Q31.

(a)(i)

The majority of candidates scored both marks. Those who gained only one mark had usually incorrectly calculated the number of neutrons for both isotopes.

5 (a) Chlorine has an atomic number of 17.
Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons	17	17
number of neutrons	18	19
number of electrons	17	17

Results Plus: Examiner Comments

One mark for correctly giving the numbers of protons and electrons but the neutrons were incorrect.

Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons	84	87
number of neutrons	86	83
number of electrons	17	17

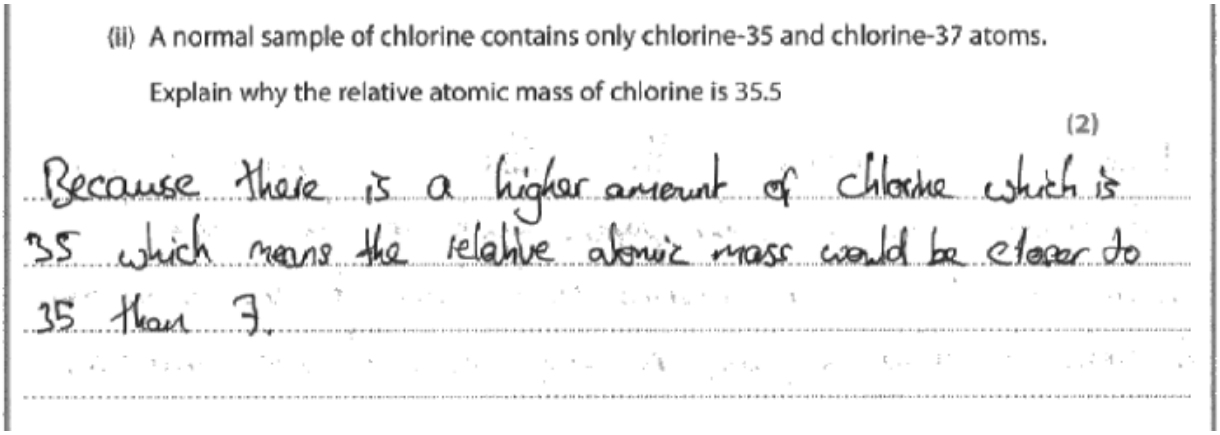
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One of the more unusual incorrect responses seen.

(a)(ii)

This proved to be a challenging question. Many scored one mark but only the strongest candidates scored both marks. The idea of RAM as an average mass was appreciated by many candidates, but there was a substantial minority who tried to explain the non-integer value with half a neutron. Many candidates made non-specific comments about abundances of isotopes but failed to say that Cl-35 was the most abundant. Others incorrectly stated that 35.5 was half way between 35 and 37 or that it should be 36, but 36 doesn't exist and so it's given as 35.5!

Some of the best candidates were able to use a calculation method to work out how to get 35.5 as the mean value.



(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

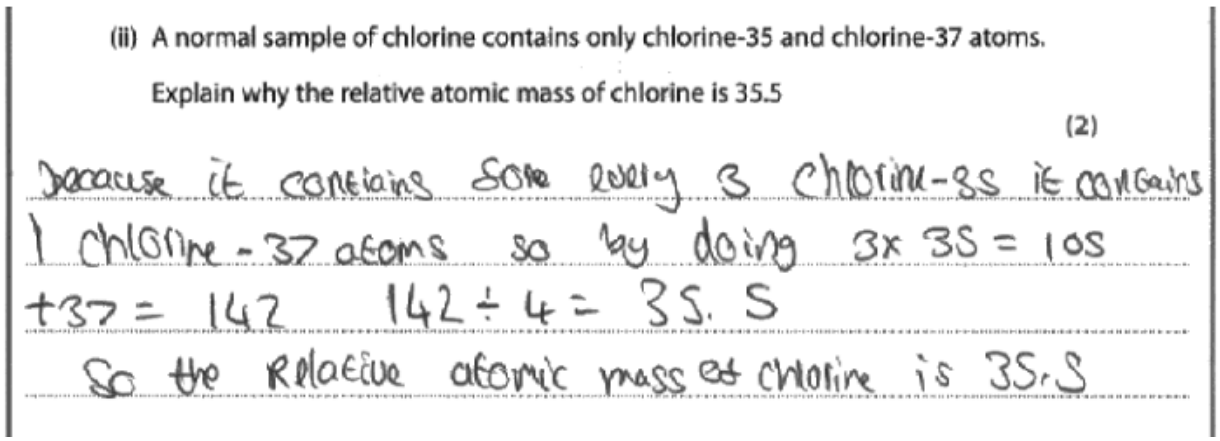
Explain why the relative atomic mass of chlorine is 35.5

(2)

Because there is a higher amount of chlorine which is 35 which means the relative atomic mass would be closer to 35 than 37.

Results Plus: Examiner Comments

This was worth one mark for indicating there is more Cl-35 but there is no mention of average.



(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

Because it contains some really 3 chlorine-35 it contains 1 chlorine-37 atoms so by doing 3x 35 = 105 +37 = 142 142 ÷ 4 = 35.5

So the Relative atomic mass of chlorine is 35.5

Results Plus: Examiner Comments

This answer is worth both marks by correctly using a calculation type approach.

(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

~~The~~ 75% of Chlorine atoms are -35 while only 25% are -37 so when you calculate the relative atomic mass by (35x75)+(37x25)=3,550 3550÷100=35.5 which is the relative atomic mass

Results Plus: Examiner Comments

Another calculation method worth both marks.

(b)

The majority of candidates gave fully correct electron structures. Those who did not often gave the incorrect number of atoms (despite having been given the chemical formula), had the atoms linked in a row, or drew ionic structures. A few candidates made careless errors such as missing out an electron in one of the shared pairs and subsequently forfeited both marks.

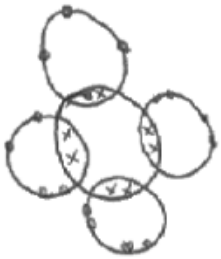
(b) Tetrachloromethane is a simple molecular, covalent compound.
The formula of its molecule is CCl_4.

There are four electrons in the outer shell of a carbon atom.
There are seven electrons in the outer shell of a chlorine atom.

Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4.

Show outer shell electrons only.

(2)

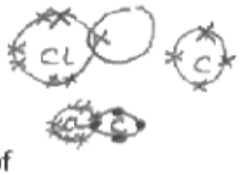


Results Plus: Examiner Comments

This answer was worth one mark for correctly showing four pairs of electrons being shared despite there being no symbols given.

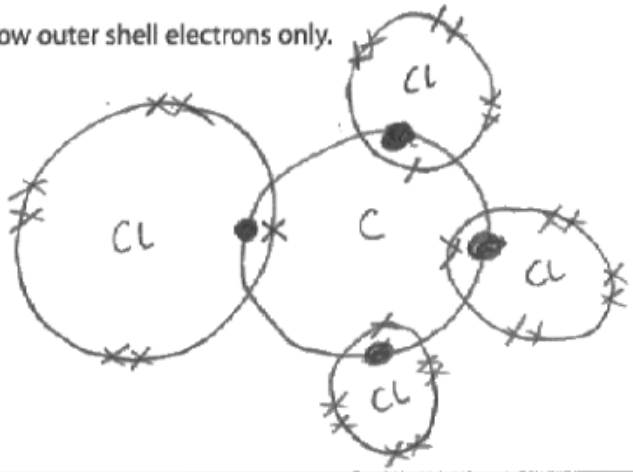
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Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4.

Show outer shell electrons only.



1 carbon
4 chlorines
= CCl_4

(2)

Results Plus: Examiner Comments

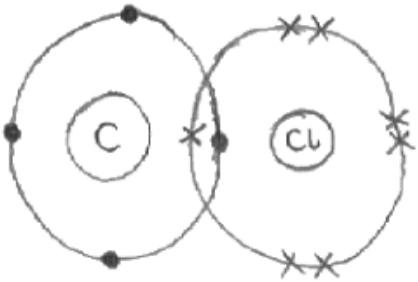
A fully correct answer worth both marks.

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Draw a dot and cross diagram to show the bonding in a molecule of tetrachloromethane, CCl_4.

Show outer shell electrons only.



(2)

Results Plus: Examiner Comments

Answers like this were quite common despite the correct formula having been given in the question. It obviously gained no marks.

(c)

It was very pleasing to see so many good answers to this question with about three quarters of candidates gaining a Level 2 or 3. However some had not read the question carefully which asked for a comparison of a use for diamond and a use for graphite with relevant explanations in terms of the bonding and structure, and so credit was only given for one use or property of each.

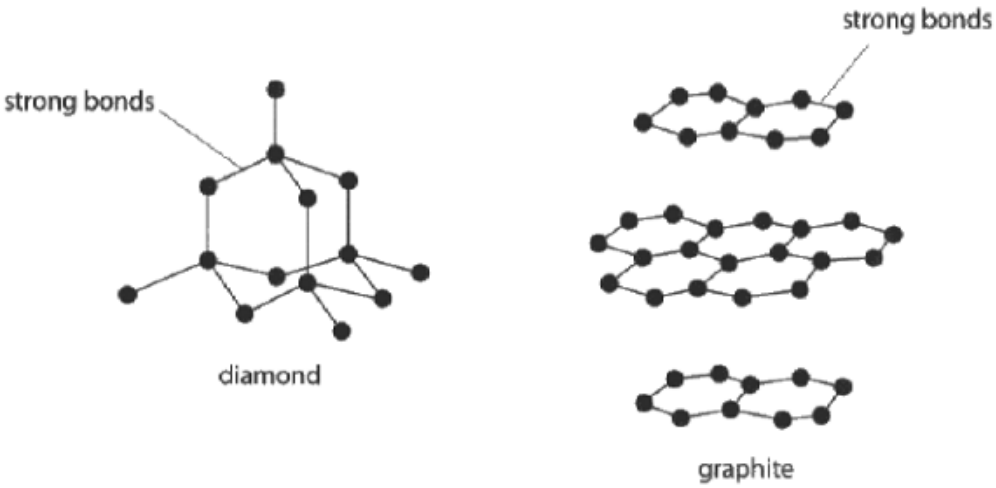
Candidates had a very good idea of the uses and properties of graphite and the linked explanations. They were less strong on those of diamond, with many just restating that diamond has strong bonds, which they had been told in the question and so did not attract credit. Others did not link their good explanations to a property or use, so limiting the mark they gained.

Some suggested a use of graphite as kitchen work surfaces or as a building material, suggesting they were thinking of granite.

Significant numbers incorrectly used the term intermolecular forces/bonds in their descriptions of diamond and graphite.

*(c) The diagrams show the arrangements of carbon atoms in diamond and in graphite.

● = carbon atom



Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding and structure. In your answer you should use information from the diagrams.

(6)

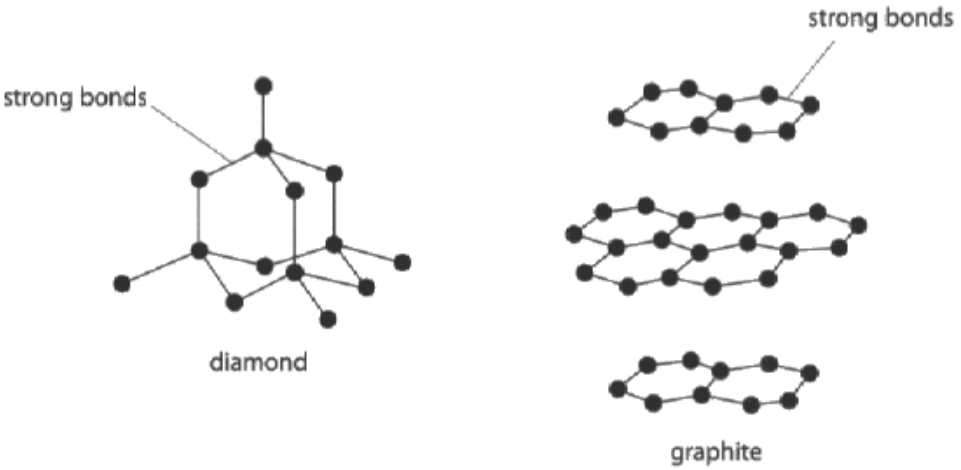
A use of graphite is pencils. As it has weak attractive forces the sheets slide over each other so graphite fragments rub off easily. Whereas a Diamond is used for cutting stones, metals and other gems. Diamond can do this as they have strong bonds making it dense.

Results Plus: Examiner Comments

The candidate has given a use of both graphite and diamond with some relevant explanation. However it is not worth Level 3 as there are not three relevant explanation points (no credit was given for the mention of strong bonds as this information was given in the question). Level 2 and 4 marks.

*(c) The diagrams show the arrangements of carbon atoms in diamond and in graphite.

● = carbon atom



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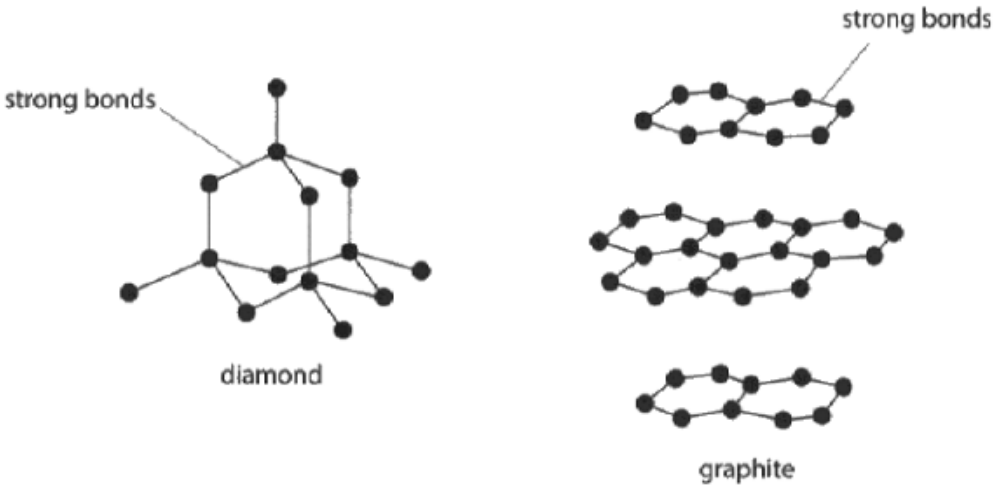
Both diamond and graphite are giant molecular covalent structures. Diamond is made of thousands of carbon atoms and has very strong covalent bonds between the atoms. It is very hard and does not conduct electricity. Diamond is therefore used for cutting tools as it does not break easily and it is therefore ideal for this purpose. Graphite is made of layers of carbon atoms also held together by covalent bonds. Graphite is softer than diamond and can conduct electricity as there is one delocalised electron from each carbon atom which is able to move between layers, and thus conduct electricity. Graphite is therefore used as a lubricant as the layers of carbon atoms can slide over each other easily, and it is also used to make electrodes as it can conduct electricity.

(Total for Question 5 = 12 marks)

Results Plus: Examiner Comments

This response was one of the many which were worthy of Level 3 and 6 marks.

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Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding and structure. In your answer you should use information from the diagrams.

(6)

Both graphite and diamond have strong bonds. Graphite can conduct electricity unlike diamond. But diamonds are examples of strong covalent substances. They ~~are~~ have strong bonds, insoluble, do not conduct electricity unlike graphite.

Results Plus: Examiner Comments

This response contains a correct property of graphite (and diamond) but there are no relevant explanation points so it was awarded Level 1 and 2 marks.

Q32.

(a)(i)

The majority of candidates scored both marks. Those who gained only one mark had usually

incorrectly calculated the number of neutrons for both isotopes.

5 (a) Chlorine has an atomic number of 17.
Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons	17	17
number of neutrons	18	19
number of electrons	17	17

Results Plus: Examiner Comments

One mark for correctly giving the numbers of protons and electrons but the neutrons were incorrect.

Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	chlorine-37
number of protons	8.84	8.87
number of neutrons	8.86	8.83
number of electrons	17	17

Results Plus: Examiner Comments

One of the more unusual incorrect responses seen.

(a)(ii)

This proved to be a challenging question. Many scored one mark but only the strongest candidates scored both marks. The idea of RAM as an average mass was appreciated by many candidates, but there was a substantial minority who tried to explain the non-integer value with half a neutron. Many candidates made non-specific comments about abundances of isotopes but failed to say that Cl-35 was the most abundant. Others incorrectly stated that 35.5 was half way between 35 and 37 or that it should be 36, but 36 doesn't exist and so it's given as 35.5!

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(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

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Because there is a higher amount of chlorine which is 35 which means the relative atomic mass would be closer to 35 than 37.

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because it contains some every 3 chlorine-35 it contains 1 chlorine-37 atoms so by doing 3x 35 = 105 +37 = 142 142 ÷ 4 = 35.5 So the Relative atomic mass of chlorine is 35.5

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This answer is worth both marks by correctly using a calculation type approach.

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~~The~~ 75% of Chlorine atoms are -35 while only 25% are -37 so when you calculate the relative atomic mass by (35x75)+(37x25)=3,550 3,550 ÷ 100 = 35.5 which is the relative atomic mass

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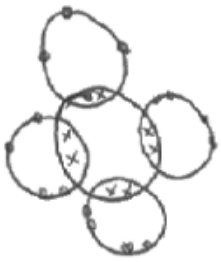
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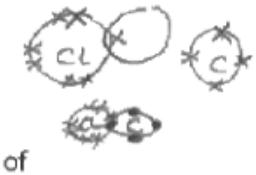


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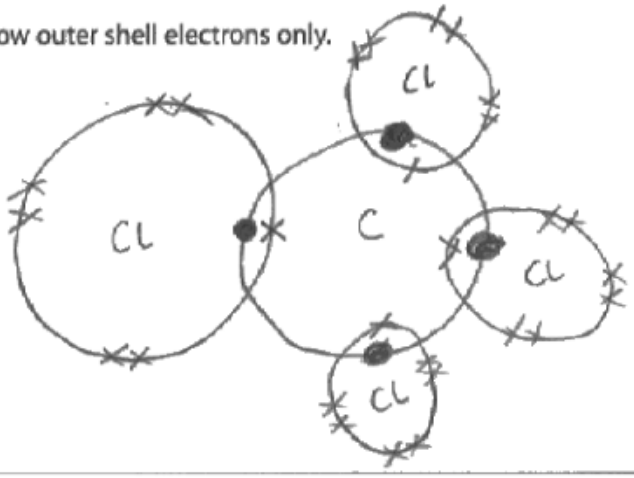
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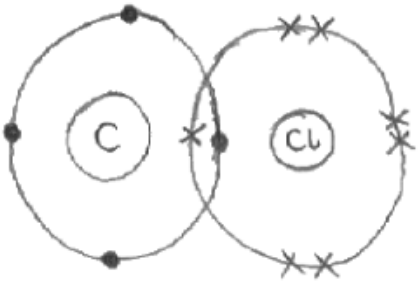
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It was very pleasing to see so many good answers to this question with about three quarters of candidates gaining a Level 2 or 3. However some had not read the question carefully which asked for a comparison of a use for diamond and a use for graphite with relevant explanations in terms of the bonding and structure, and so credit was only given for one use or property of each.

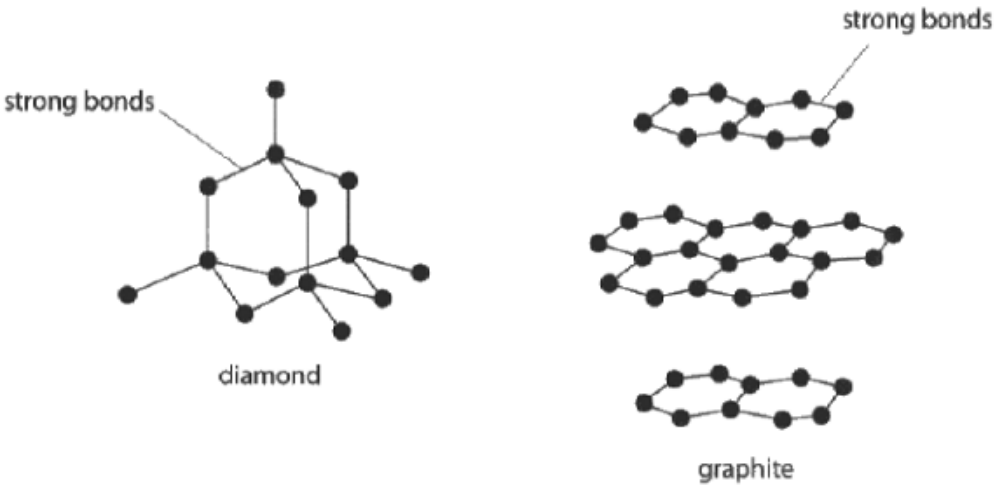
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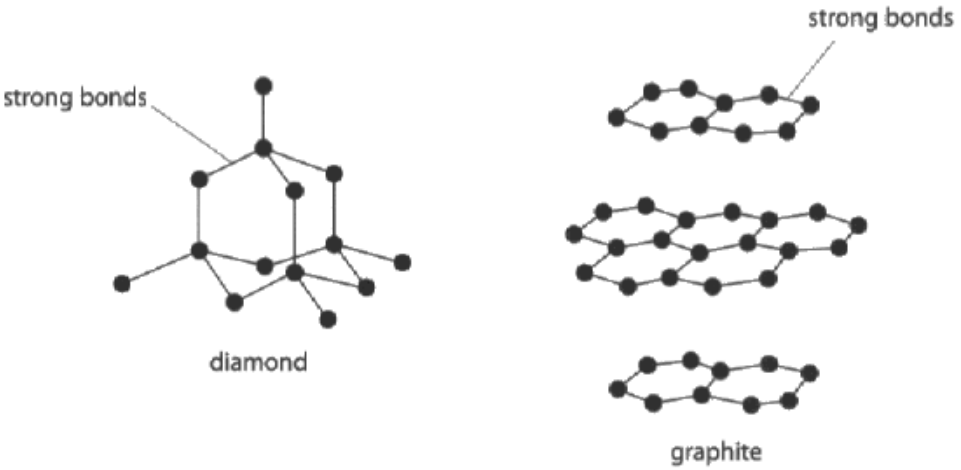
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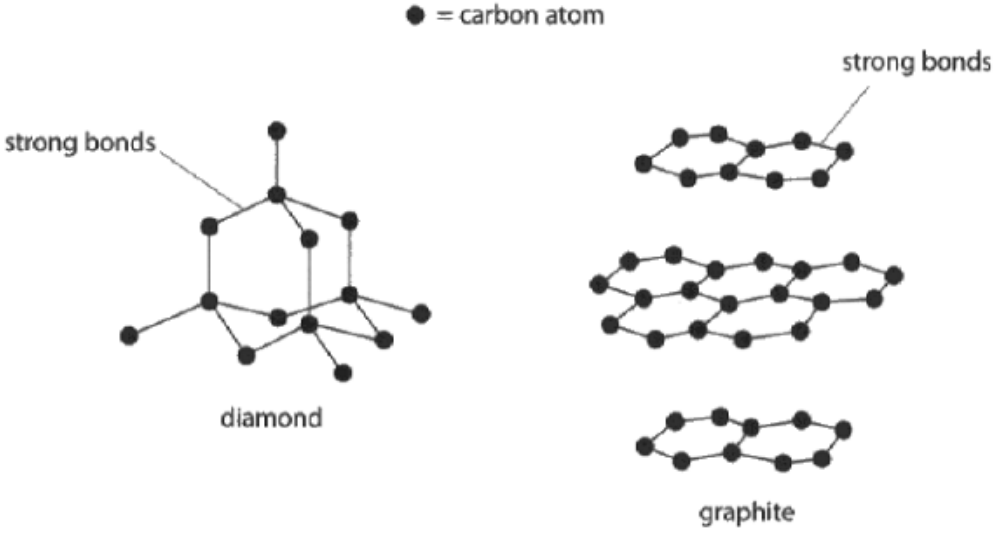
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This response was one of the many which were worthy of Level 3 and 6 marks.

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Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding and structure. In your answer you should use information from the diagrams.

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Both graphite and diamond have strong bonds. Graphite can conduct electricity unlike diamond. But diamonds are examples of strong covalent substances. They ~~are~~ have strong bonds, insoluble, do not conduct electricity unlike graphite.

Results Plus: Examiner Comments

This response contains a correct property of graphite (and diamond) but there are no relevant explanation points so it was awarded Level 1 and 2 marks.

Q33. No Examiner's Report available for this question

Q34. No Examiner's Report available for this question

Q35.

This question started, in question (i) with a balanced equation for candidates to complete. Many were able to score with a good proportion gaining both marks available, where candidates lost a mark, it was often as they could not recall the formula for sulfuric acid. In part (ii) the vast majority of candidates were able to calculate the relative formula mass of copper carbonate to score both marks available.

Q36.

(i)

This question was very poorly answered on the whole, with a significant majority of responses not scoring the 1 mark available.

Very few responses correctly drew in four electrons between the two carbon atoms in the diagram presented.

The majority of responses were often left blank. The vast majority of candidates drew a double bond as two lines and did not add in electrons. It would appear that candidates were unfamiliar with dot and cross diagrams where there were no rings shown to represent the electrons shells, as demonstrated by a number of responses where candidates added them in, often incorrectly.

The structure of a molecule of ethene is shown in Figure 8.

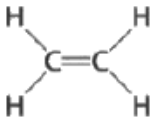


Figure 8

(i) Figure 9 shows the incomplete dot and cross diagram for a molecule of ethene.

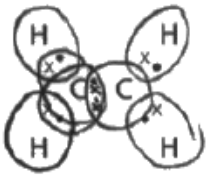


Figure 9

Complete Figure 9 to show the electrons of the C=C double bond.

Results Plus: Examiner Comments

An example of a fully correct response.

The candidate has correctly drawn in the four electrons representing the double bond between the carbon atoms. It is also worthwhile noting that shells have been added by the candidate to help clarify the bonding.

(i) Figure 9 shows the incomplete dot and cross diagram for a molecule of ethene.

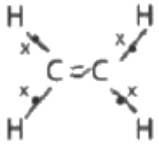


Figure 9

Complete Figure 9 to show the electrons of the C═C double bond.

(1)

Results Plus: Examiner Comments

A typical example of the many incorrect responses seen that did not score.

The candidate has simply drawn in a double bond between the carbon atoms and not followed the instructions in the question which is to show the electrons.

(ii)

This question was poorly answered on the whole, with only a fifth of responses scoring the 1 mark available.

Few candidates were able to recall the correct products, besides water, of the incomplete combustion of ethene.

The most commonly seen incorrect response was 'carbon dioxide'.

Q37.

This question was very well answered with over half of responses scoring both marks.

The majority of responses produced a correct dot and cross diagram, namely another shared pair of electrons between the oxygen and the hydrogen atoms and four non-bonding electrons in the shell for oxygen.

A further third of the candidates scored 1 mark only for a correct shared pair of electrons between oxygen and the other hydrogen atom, losing the second mark by having too many or too few electrons on the oxygen atom. Some candidates added extra electrons to both hydrogen atoms or added extra hydrogen atoms around the oxygen atom.

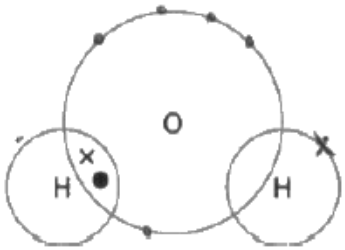
An oxygen atom has six electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of water, H_2O.

Show outer shell electrons only.

(2)



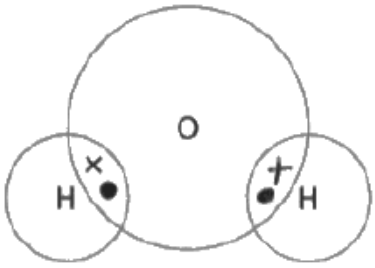
Results Plus: Examiner Comments

A typical example of a response that did not score.

A shared pair of electrons has not been drawn between the oxygen and the hydrogen atoms on the right hand side. Also, the outer shell of oxygen has too many electrons, five, drawn and a cross has been incorrectly drawn in shell for the hydrogen atom.

Results Plus: Examiner Tip

Practise drawing dot and cross diagrams, particularly for those molecules listed in the specification.



Results Plus: Examiner Comments

This response scored 1 mark only.

Only the shared pair of electrons has been shown between the hydrogen and oxygen atoms, with the four non-bonding electrons omitted from the outer shell of oxygen.

Q38. No Examiner's Report available for this question

Q39.

Although many good responses were seen, some candidates lost marks for not following the instructions about using dots and crosses. Others simply repeated the dot-and-cross diagrams for the atoms that had already been given. Those who drew correct diagrams usually also scored the mark for the charges, although some had the + and − signs on the wrong species.

The majority managed to transfer electrons from Ca to O, although not always in the right number. A minority transferred electrons the other way, sometimes in seemingly random numbers. Some candidates drew 2 electrons on the outer shell of the calcium ion with arrows to show where they moved to and thus lost the first mark. In addition, there were candidates who wrote '10' for the charge on the calcium ion and '6' for the charge on the oxide.

Candidates need reminding that electrons are negatively charged, so gaining them makes negative charged ions and losing electrons makes positive charged ions. The link between numbers of electrons lost or gained will help with correct charges in future.

Complete Figure 6 to show the electronic configurations and charges of the calcium ion and the oxide ion.

Use dots to show the electrons originally in the calcium atom and crosses to show the electrons originally in the oxygen atom.

(3)

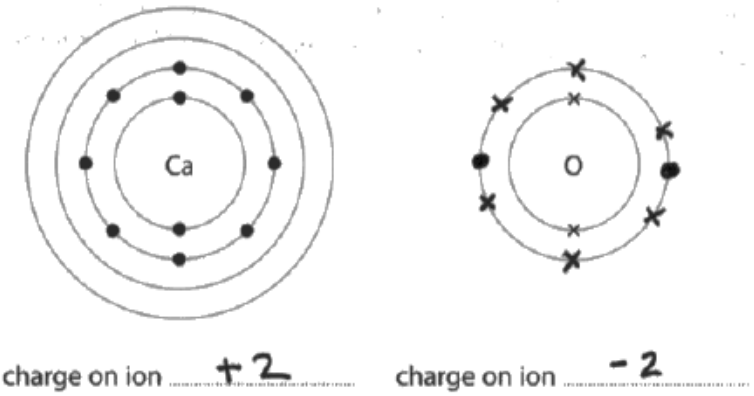


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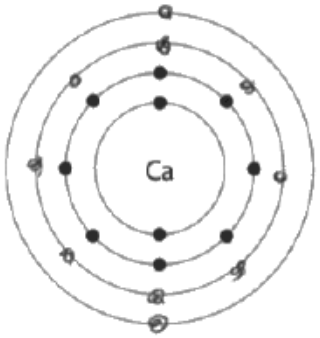
Results Plus: Examiner Comments

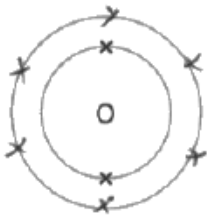
Marks were awarded for the correctly completed diagram of oxygen − the 6 crosses representing the electrons from the oxygen atom and two dots to show the electrons transferred from the calcium atom, and for the correct charges on the ions. However the diagram of calcium is incomplete – the third shell is missing.

Complete Figure 6 to show the electronic configurations and charges of the calcium ion and the oxide ion.

Use dots to show the electrons originally in the calcium atom and crosses to show the electrons originally in the oxygen atom.

(3)





charge on ion 2+ charge on ion 2-

Figure 6

Results Plus: Examiner Comments

Only the charges here were correct and so just achieved 1 mark. The diagrams drawn were for the original atoms and not the ions.

Results Plus: Examiner Tip

Take care to read the question carefully.

Q40.

The lines of best fit were mostly drawn. The most common error here was to try and make the line of best fit go through the origin or draw best fit lines that miss the points given. Examiners reported seeing a few freehand line drawings with a small number of candidates joining the points dot to dot probably as a result of not having a ruler. Several candidates were not sure how to deal with the anomalous point or best fit lines were drawn that missed the points given, with many drawing a line from the origin going through the point at 3 cm^3.

Many responses extended the line of best fit to 6 cm^3, gaining a mark – although a significant number did not do this and therefore lost both marks in part (ii).

Candidates were less successful at reading from their graph to obtain the correct answer and a significant number had clearly misinterpreted the scale and assumed that each small square was

0.2 mm rather than 0.4 mm. However, they were lucky in that this was within the margin of error in most cases and they got the mark anyway. At this point, several examiners reported seeing candidates attempting to carry out some form of calculation, but were not sure what they were trying to accomplish. Examiners had to check the graph and marked the estimated precipitate height based on the extrapolated line.

It was also common to see 'tram-lines' or sometimes very thick lines which could have been avoided with a sharper pencil.

Graph plotting is a mathematical skill that will be tested in future examinations.

$10\,cm^3$ samples of copper sulfate solution were placed in five test tubes.
Different volumes of sodium hydroxide solution were added to these test tubes.
The volumes of sodium hydroxide solution added were $1\,cm^3$, $2\,cm^3$, $3\,cm^3$, $4\,cm^3$ and $5\,cm^3$.

In each test tube a precipitate of copper hydroxide was formed.
The precipitate was allowed to settle and the height of the precipitate was measured with a ruler as shown in Figure 1.

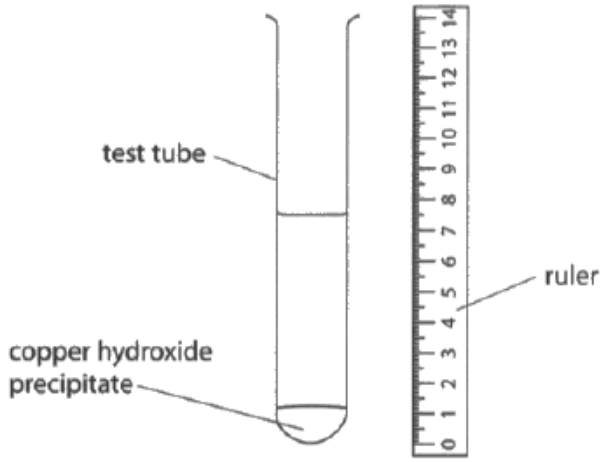


Figure 1

The results are shown in Figure 2.

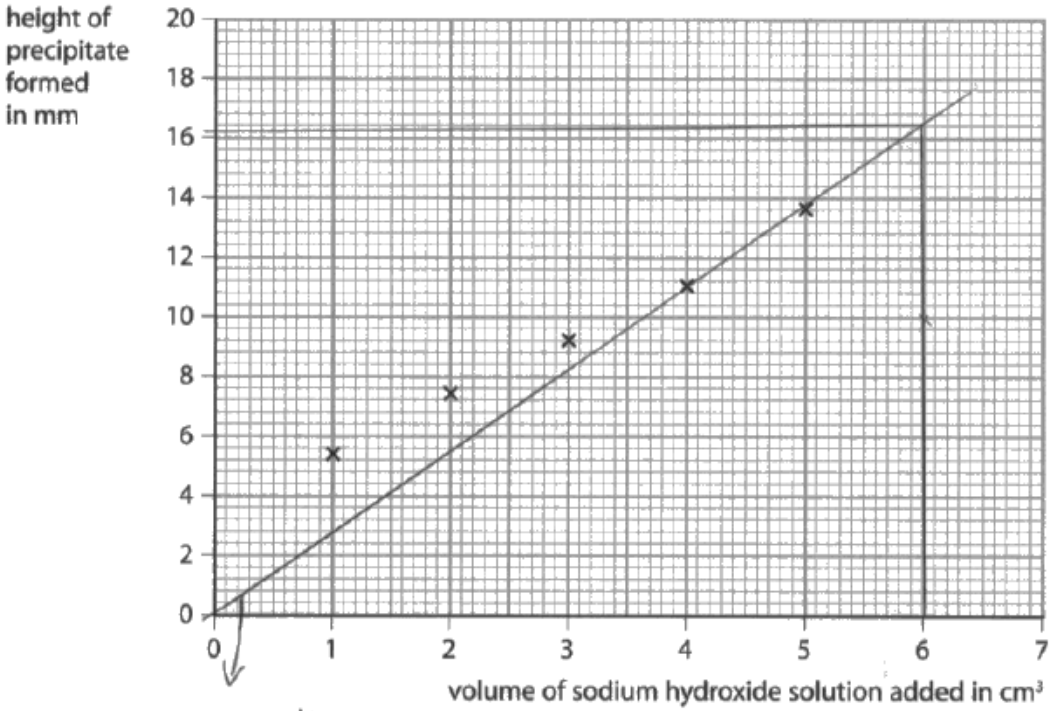


Figure 2

Line of best fit.

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

≈16.1 mm

Results Plus: Examiner Comments

The line of best fit is not as shown in this response. Lines of best fit do not have to go through the origin, but should take in as many of the points as possible.
The line was extrapolated to allow a reading at 6cm3 and so was credited for that. The scale of the vertical is 1 small square = 0.4 mm. The predicted height from the graph is 16.4 mm, but the answer was given within tolerance accepted and so was credited with the mark. Part (ii) was given 2 marks.

Results Plus: Examiner Tip

A line of best fit here would be a straight line through most of the first four points.
Understand what is meant by using a graph to make a prediction. Take care with scales on graphs.

The results are shown in Figure 2.

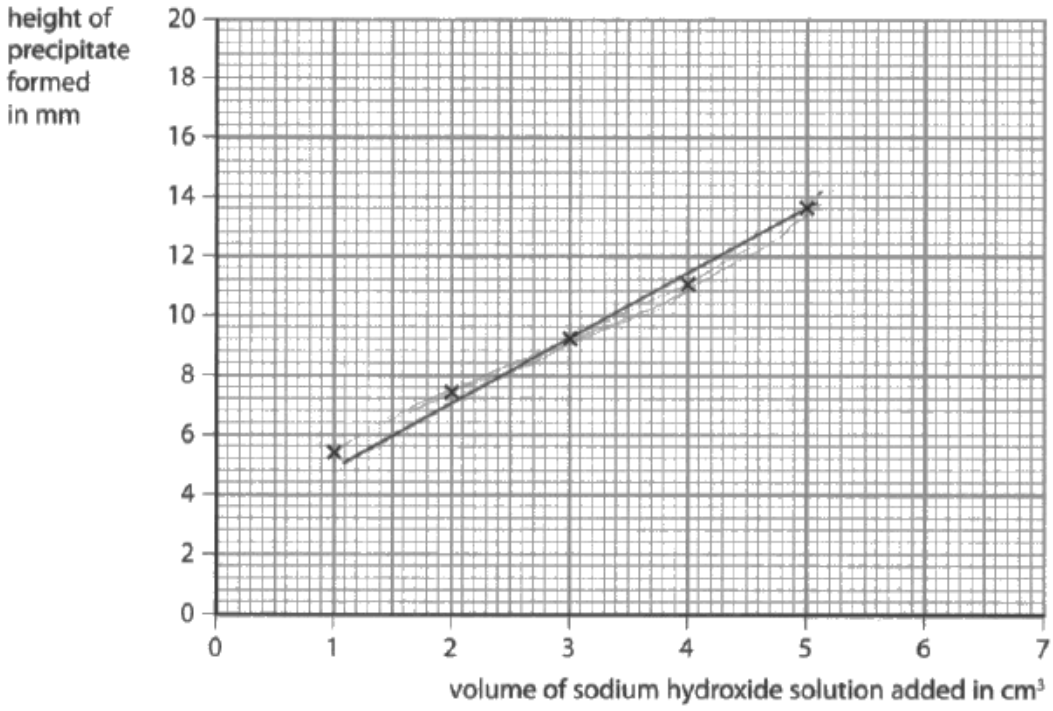


Figure 2

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

15 mm

Results Plus: Examiner Comments

The line shown on the graph was considered to be a line of best fit as all points were within close proximity of the straight line drawn. The faint sketched line was ignored. 1 mark was given for this part of the answer. The line was extended to beyond 6 cm^3, so the accuracy of the predicted precipitate could not be verified from the graph. The predicted height could only be credited if it was clear from the graph how the prediction was made. 0 marks were given to this part of the answer.

The results are shown in Figure 2.

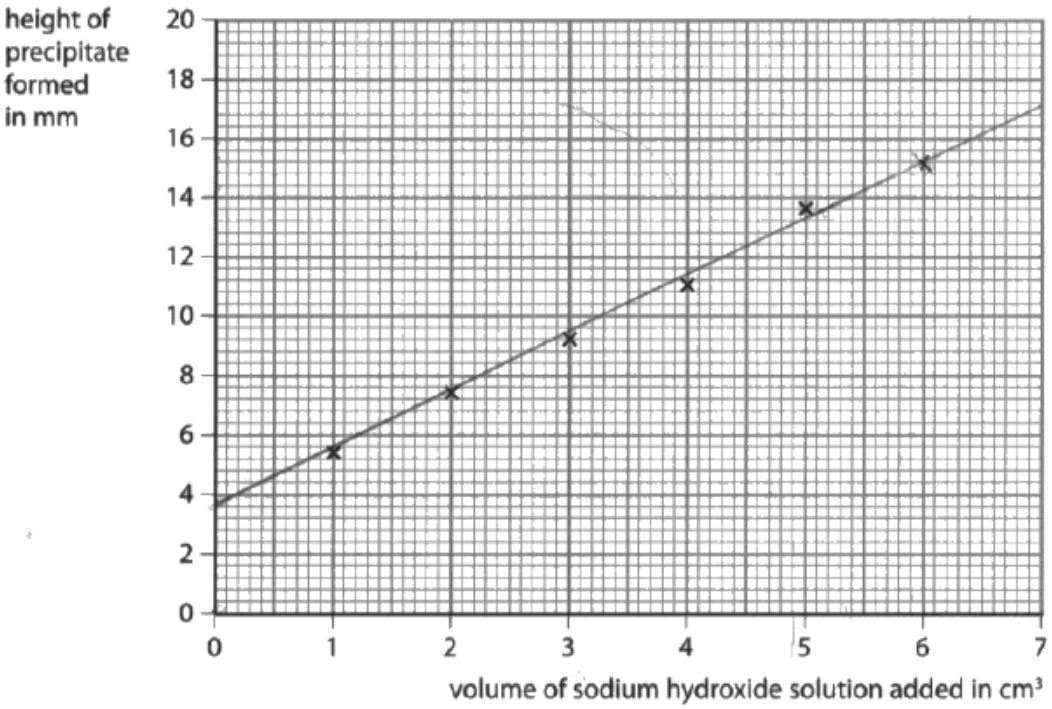


Figure 2

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

14.6 mm

Results Plus: Examiner Comments

This was a good line of best fit and scored the mark. The line was extended to allow a prediction at 6 cm^3, but the candidate made an error in reading the graph by not looking carefully enough at the scale on the vertical axis. Here the answer should have been 15.2 mm rather than 14.6 mm. This part of the question only received 1 mark.

Results Plus: Examiner Tip

Take care with graphs – the scale on the vertical axis of this graph was 1 small square = 0.4 mm, not 0.2 mm.

The results are shown in Figure 2.

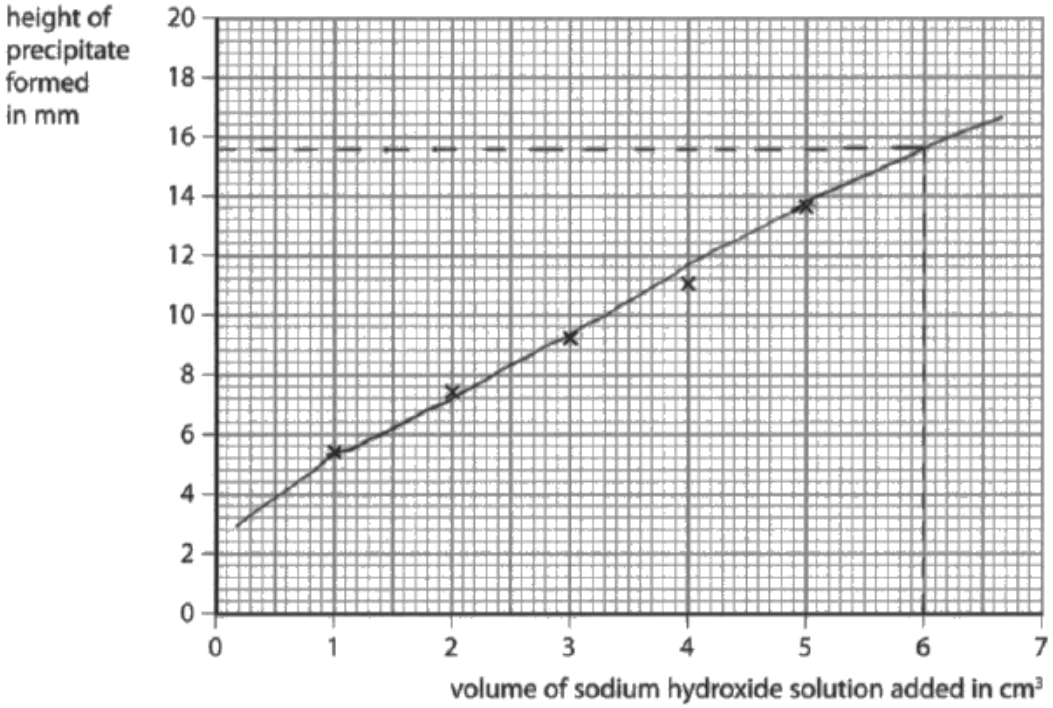


Figure 2

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

15.5 mm

Results Plus: Examiner Comments

The line drawn is not a best-fit line, so this did not score a mark, as it is not straight. However, the line was extended to be used to predict the precipitate height at 6 cm^3 and the value given was with the tolerance allowed. This part of the question received 2 marks.

Results Plus: Examiner Tip

Graph plotting is a skill that may be tested on future exams, so a ruler may be needed.

Q41.

In part (i) of this question, many candidates found it hard to draw a line of best fit to complete the graph. Many candidates felt that the line should go through the origin and therefore did not draw a best fit line though the points. In some cases, candidates drew dot to dot, curved or very untidy or double lines which were rejected.

In part (ii) it was found that many candidates did not know how to extrapolate the line of best fit and therefore did not gain marks in this section. Of those that were able to extrapolate the line, many could not then read from their line accurately.

10 cm^3 samples of copper sulfate solution were placed in five test tubes.
Different volumes of sodium hydroxide solution were added to these test tubes.
The volumes of sodium hydroxide solution added were 1 cm^3, 2 cm^3, 3 cm^3, 4 cm^3 and 5 cm^3.

In each test tube a precipitate of copper hydroxide was formed.
The precipitate was allowed to settle and the height of the precipitate was measured with a ruler as shown in Figure 7.

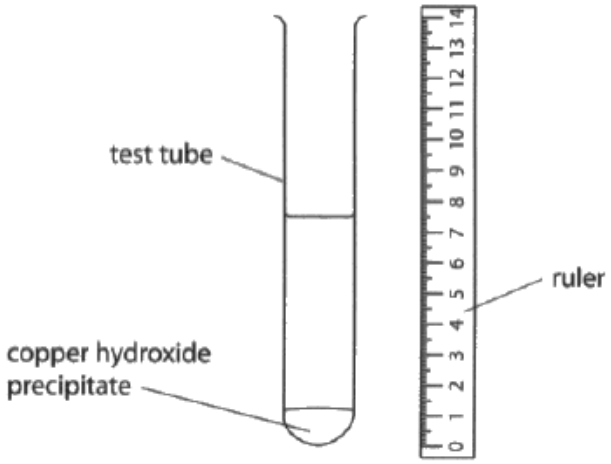


Figure 7

The results are shown in Figure 8.

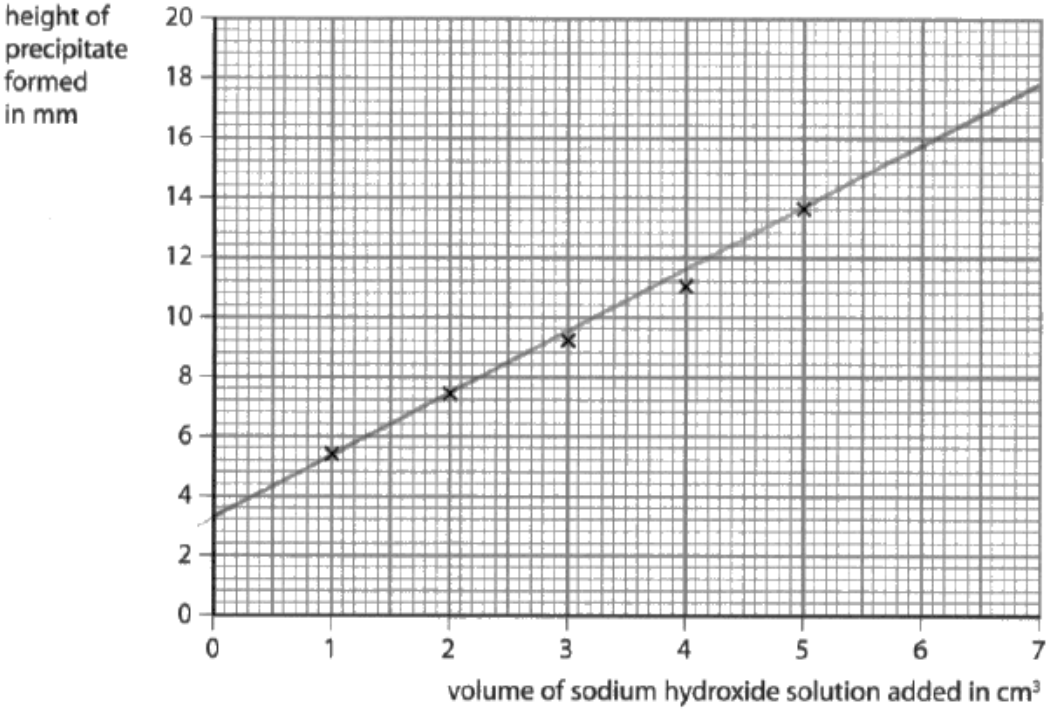


Figure 8

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

16 mm

Results Plus: Examiner Comments

In this example the candidate has drawn a good line of best fit through the points 1-5. The line has been extrapolated and the correct value read from the extrapolated line, therefore gaining 1 mark in part (i) and 2 marks in part (ii).

10 cm^3 samples of copper sulfate solution were placed in five test tubes. Different volumes of sodium hydroxide solution were added to these test tubes. The volumes of sodium hydroxide solution added were 1 cm^3, 2 cm^3, 3 cm^3, 4 cm^3 and 5 cm^3.

In each test tube a precipitate of copper hydroxide was formed. The precipitate was allowed to settle and the height of the precipitate was measured with a ruler as shown in Figure 7.

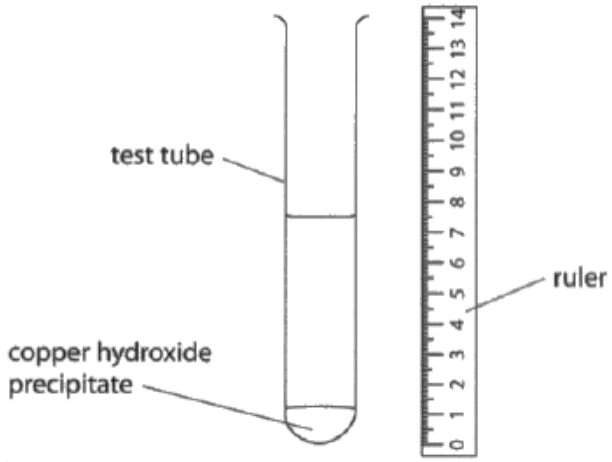


Figure 7

The results are shown in Figure 8.

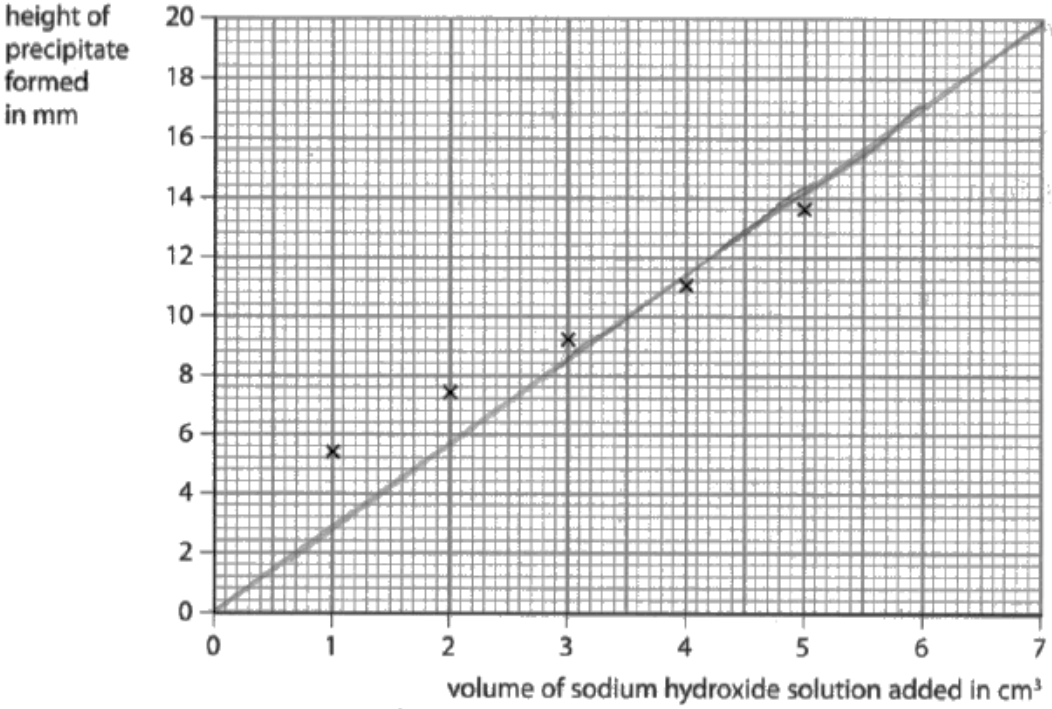


Figure 8

(i) Draw the line of best fit to complete the graph.

(1)

(ii) Predict the height of precipitate that would be formed if 6 cm^3 of sodium hydroxide solution was added to 10 cm^3 of copper sulfate solution. This mixture would contain excess copper sulfate solution.

(2)

18 mm

Results Plus: Examiner Comments

In this case, the candidate has tried to take the line of best fit through the origin and therefore not drawn a line of best fit through the data provided.

Results Plus: Examiner Tip

Remember that not all lines of best fit must go through the origin. When asked to draw lines of best fit, only include the data that has been provided.

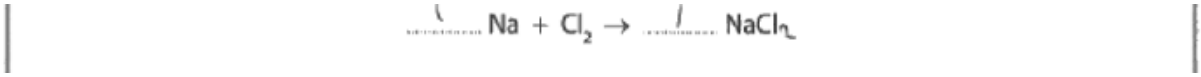
Q42.

Well answered overall with only a few blank responses. There were a few responses showing the formula of aluminium phosphate with the ion charges.

Q43.

(a)(i)

The majority of candidates were able to balance the equation. A common error was to put 2 in front of Na and 4 in front of NaCl. It was surprising to see some candidates using negative numbers in the equation. A few candidates put formulae or state symbols on the dotted lines instead of balancing numbers. Some candidates changed the formulae to balance the equation.

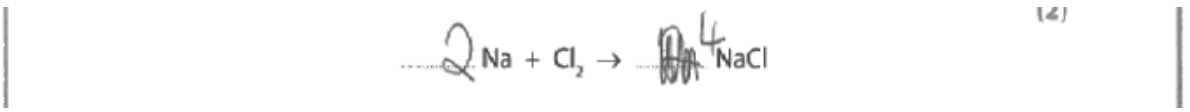


Results Plus: Examiner Comments

This candidate has changed the formula of sodium chloride to $NaCl_2$. If you are given an equation to balance, the formulae will always be correct and you need to balance the equation by putting numbers in front of the formulae in the spaces provided. This answer did not score any marks.

Results Plus: Examiner Tip

Do not change any formulae you are given in a question to balance an equation.



Results Plus: Examiner Comments

This candidate has the first balancing number correct, so scores 1 mark.

Results Plus: Examiner Tip

Count up the number of atoms on the left side of the equation first. There are 2 sodium atoms and 2 chlorine atoms. The number of atoms on the right of the equation must be the same as on the left. The equation is balanced by writing a 2 in front of NaCl.

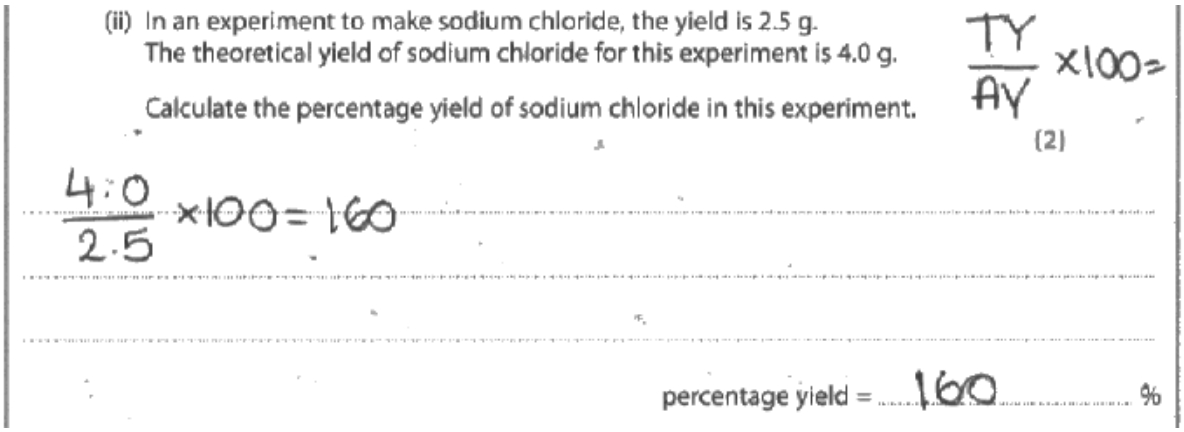
2 Na + Cl_2 → 2 NaCl

Results Plus: Examiner Comments

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

(a)(ii)

Many candidates were able to calculate the percentage yield. Some candidates divided 4.0 by 2.5 then multiplied by 100 to get a yield of 160%. They should realise that the yield cannot be higher than 100%. Candidates should show their working for calculations so that they have the opportunity to gain a consequential error mark if they have the final answer wrong.

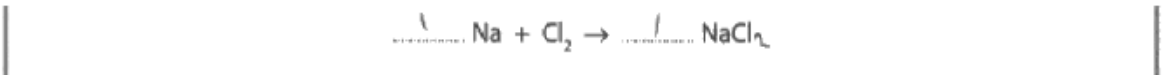


Results Plus: Examiner Comments

This answer is incorrect, but it scored 1 mark for some correct working. The first step is wrong as the candidate should have divided 2.5 by 4.0. The candidate has then shown their fraction multiplied by 100 to obtain the percentage and they score a consequential mark.

Results Plus: Examiner Tip

Always show your working for calculations.

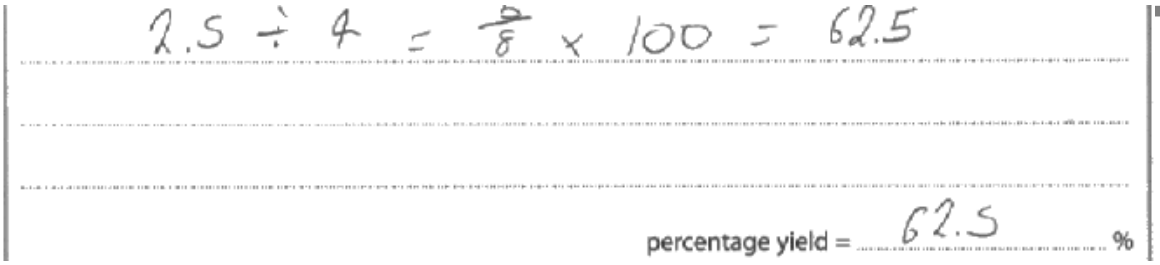


Results Plus: Examiner Comments

This is an incorrect answer and it scored no marks. If some working had been shown, it might have scored 1 mark for correct working, even if the final answer is wrong.

Results Plus: Examiner Tip

Show your working for all calculations.

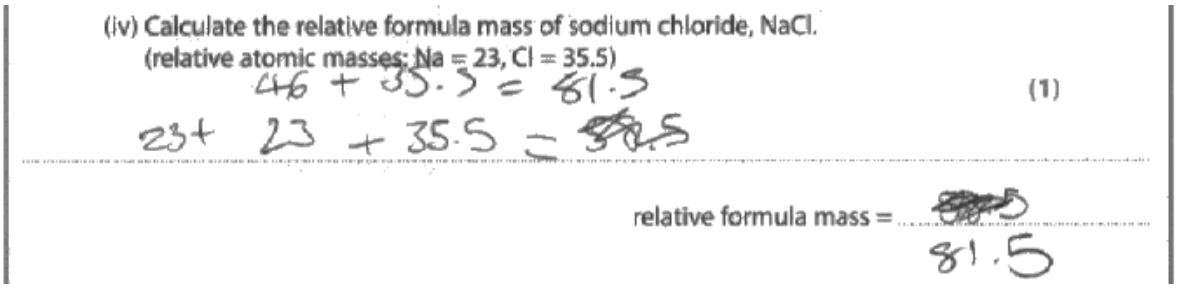


Results Plus: Examiner Comments

This is a very good answer, showing the correct working and answer. This scored 2 marks.

(a)(iv)

The majority of candidates could work out the relative formula mass for sodium chloride. Some candidates multiplied the relative atomic masses and a few subtracted or divided them.

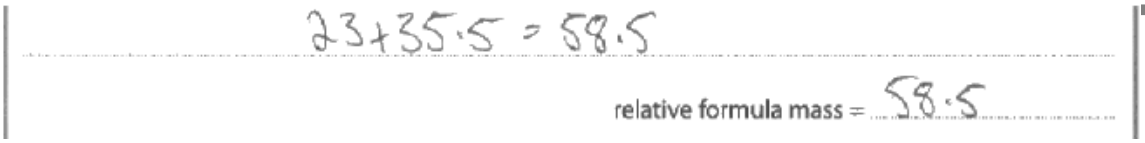


Results Plus: Examiner Comments

This candidate has assumed the formula for sodium chloride is Na_2Cl as they have added the relative atomic mass of two sodium atoms to one chlorine atom. This did not score the mark.

Results Plus: Examiner Tip

Use the formula given in the question. NaCl contains one sodium and one chlorine atom.



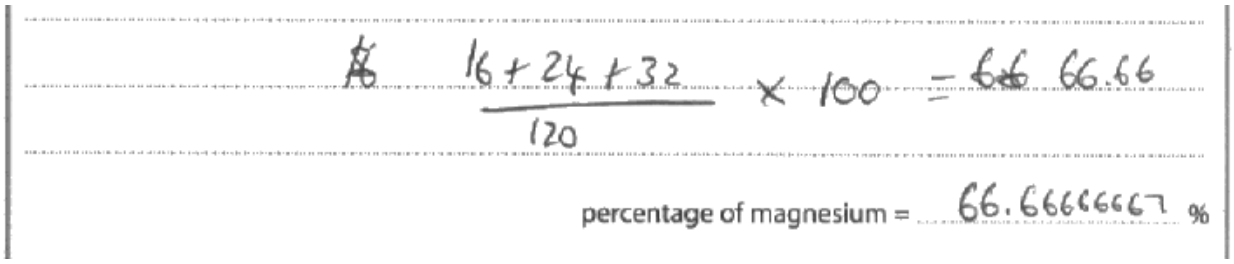
Results Plus: Examiner Comments

This is an example of a correct answer, with the working shown. This scores 1 mark.

(b)

Many candidates were able to calculate the percentage of magnesium in magnesium sulfate.

Some candidates tried to calculate the relative formula mass for magnesium sulfate and got a different answer to the value given in the question.

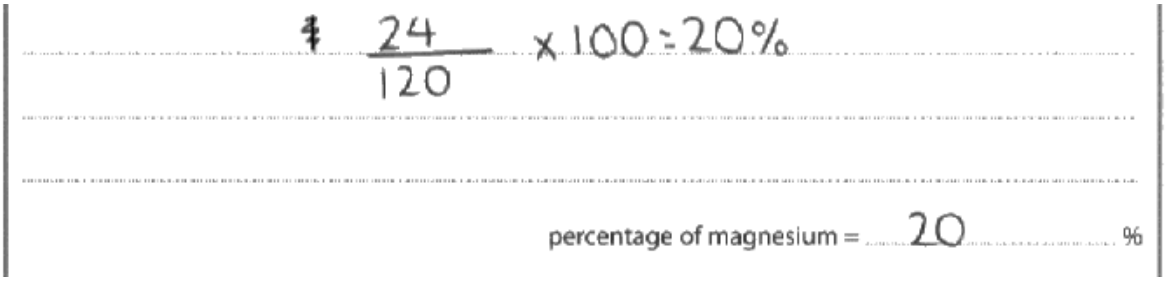


Results Plus: Examiner Comments

This candidate has got the first step of the calculation wrong as they should have just divided the mass of magnesium (24) by 120. However, they have then multiplied their fraction by 100, so they score 1 mark.

Results Plus: Examiner Tip

Show your working in calculations.



Results Plus: Examiner Comments

This candidate has given correct working and has the correct answer so was awarded 2 marks.

(c)(i)

Very few candidates understood the term 'empirical formula', so they were unable to score a mark for this question. A common incorrect answer was CH_8.



Results Plus: Examiner Comments

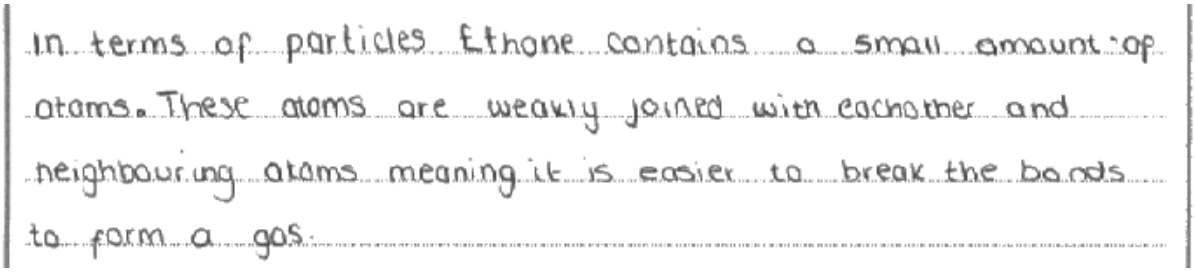
This candidate has correctly worked out that the simplest ratio of carbon to hydrogen is 1:3, but they did not score a mark as the question asked for the empirical formula.

The empirical formula shows the simplest whole number ratio of atoms in the formula. The correct empirical formula for ethane is CH_3.

(c)(ii)

This question was designed to be answered correctly by the candidates working at the top end of the grade range for this paper and it achieved that aim. The concept of weak intermolecular forces between molecules was only given by the more able candidates. Many candidates wrote about the weak bonds between the atoms but a large number did not refer to bonds at all and wrote about few particles that are far apart in a gas.

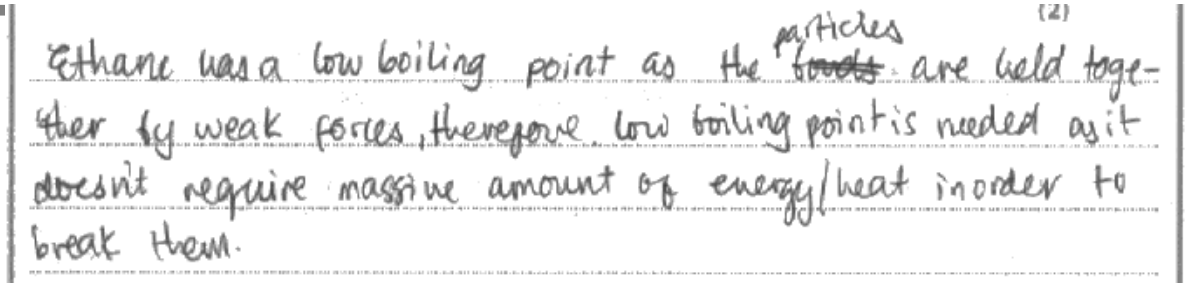
Examiners were surprised to see some candidates writing about hydrogen bonds. There are no hydrogen bonds between ethane molecules and we would not expect candidates to know about specific intermolecular forces at GCSE.


In terms of particles Ethane contains a small amount of atoms. These atoms are weakly joined with eachother and neighbouring atoms meaning it is easier to break the bonds to form a gas.

Results Plus: Examiner Comments

This answer did not score a mark as it referred to the bonds between atoms being weak.

The bonds between atoms are strong but the forces between molecules are weak.


Ethane has a low boiling point as the ~~bonds~~ particles are held together by weak forces, therefore low boiling point is needed as it doesn't require massive amount of energy/heat inorder to break them. (2)

Results Plus: Examiner Comments

This is an excellent answer that scored 2 marks.

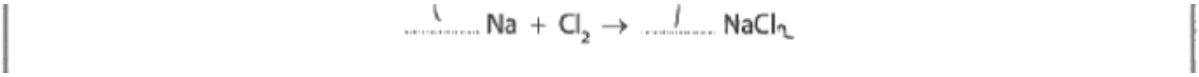
Results Plus: Examiner Tip

Try to remember that the covalent bonds that hold the atoms together in molecules are strong. There are just weak forces between the molecules.

Q44.

(a)(i)

The majority of candidates were able to balance the equation. A common error was to put 2 in front of Na and 4 in front of NaCl. It was surprising to see some candidates using negative numbers in the equation. A few candidates put formulae or state symbols on the dotted lines instead of balancing numbers. Some candidates changed the formulae to balance the equation.

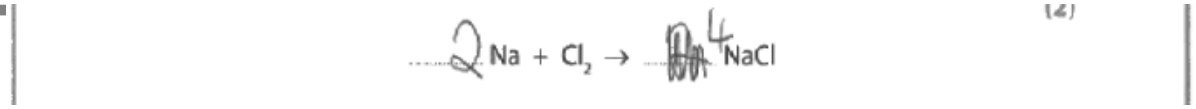


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Results Plus: Examiner Tip

Do not change any formulae you are given in a question to balance an equation.

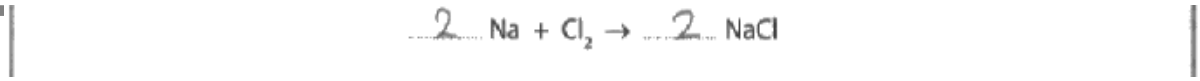


Results Plus: Examiner Comments

This candidate has the first balancing number correct, so scores 1 mark.

Results Plus: Examiner Tip

Count up the number of atoms on the left side of the equation first. There are 2 sodium atoms and 2 chlorine atoms. The number of atoms on the right of the equation must be the same as on the left. The equation is balanced by writing a 2 in front of NaCl.

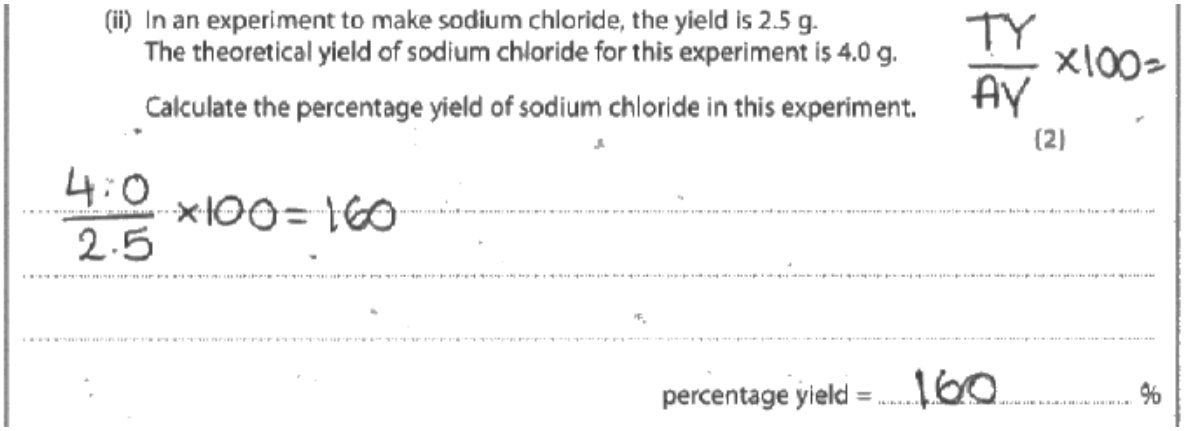


Results Plus: Examiner Comments

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

(a)(ii)

Many candidates were able to calculate the percentage yield. Some candidates divided 4.0 by 2.5 then multiplied by 100 to get a yield of 160%. They should realise that the yield cannot be higher than 100%. Candidates should show their working for calculations so that they have the opportunity to gain a consequential error mark if they have the final answer wrong.

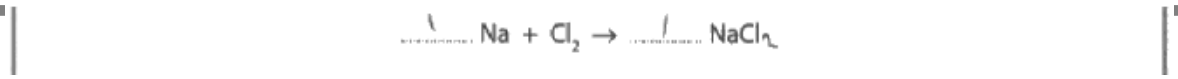


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Results Plus: Examiner Tip

Always show your working for calculations.

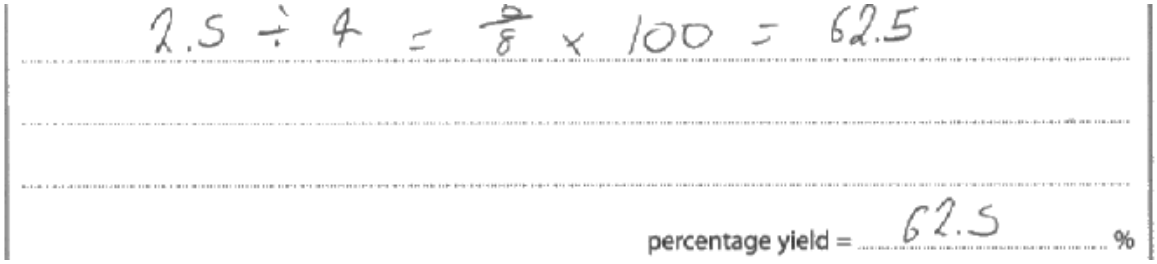


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Results Plus: Examiner Tip

Show your working for all calculations.

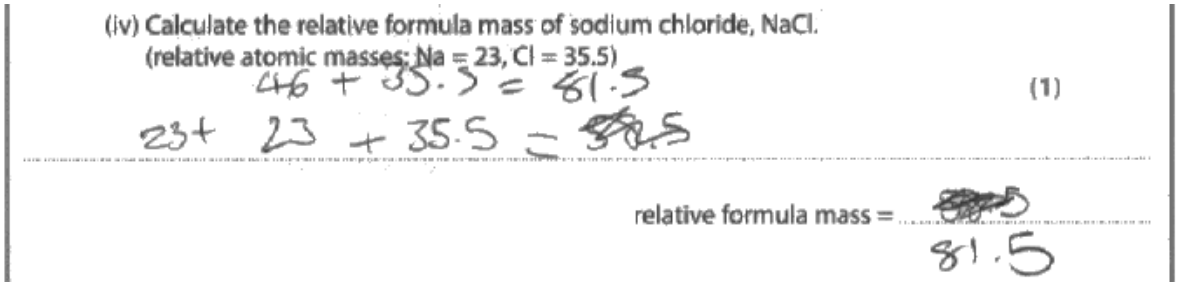


Results Plus: Examiner Comments

This is a very good answer, showing the correct working and answer. This scored 2 marks.

(a)(iv)

The majority of candidates could work out the relative formula mass for sodium chloride. Some candidates multiplied the relative atomic masses and a few subtracted or divided them.

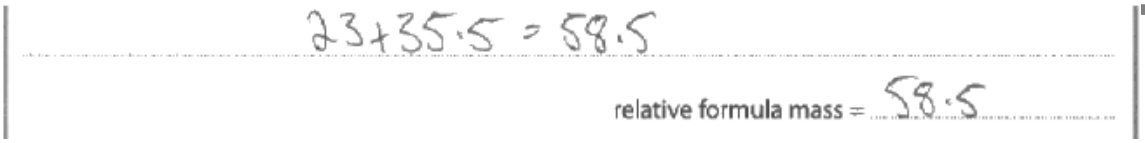


Results Plus: Examiner Comments

This candidate has assumed the formula for sodium chloride is Na_2Cl as they have added the relative atomic mass of two sodium atoms to one chlorine atom. This did not score the mark.

Results Plus: Examiner Tip

Use the formula given in the question. NaCl contains one sodium and one chlorine atom.



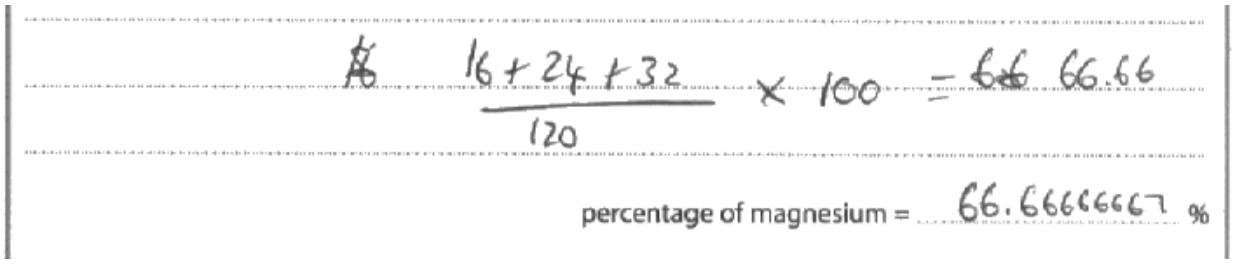
Results Plus: Examiner Comments

This is an example of a correct answer, with the working shown. This scores 1 mark.

(b)

Many candidates were able to calculate the percentage of magnesium in magnesium sulfate.

Some candidates tried to calculate the relative formula mass for magnesium sulfate and got a different answer to the value given in the question.

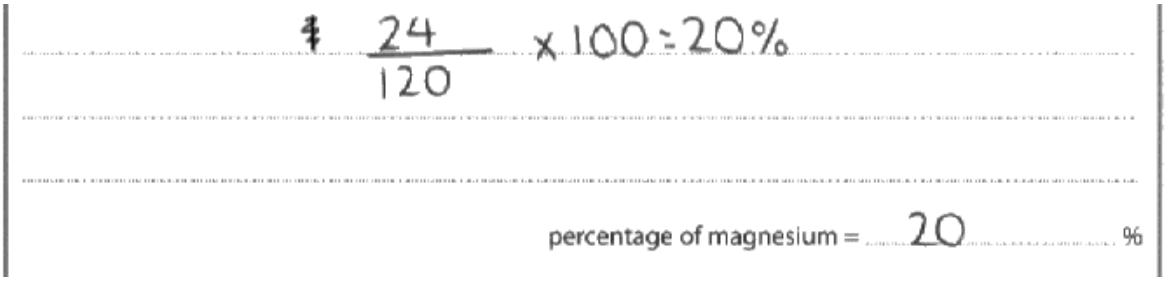


Results Plus: Examiner Comments

This candidate has got the first step of the calculation wrong as they should have just divided the mass of magnesium (24) by 120. However, they have then multiplied their fraction by 100, so they score 1 mark.

Results Plus: Examiner Tip

Show your working in calculations.



Results Plus: Examiner Comments

This candidate has given correct working and has the correct answer so was awarded 2 marks.

(c)(i)

Very few candidates understood the term 'empirical formula', so they were unable to score a

mark for this question. A common incorrect answer was CH_8.



Results Plus: Examiner Comments

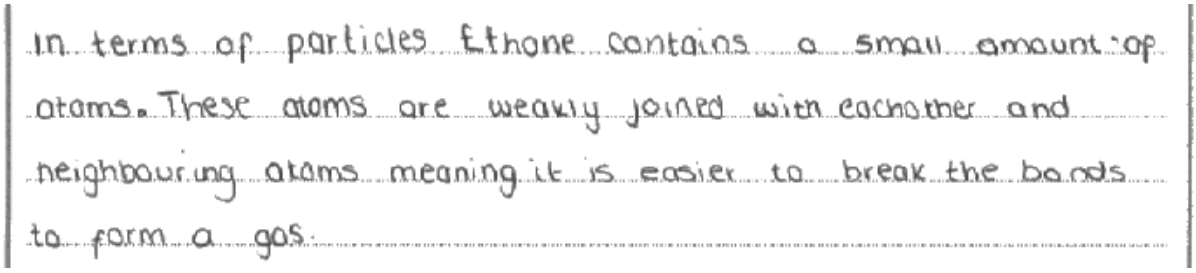
This candidate has correctly worked out that the simplest ratio of carbon to hydrogen is 1:3, but they did not score a mark as the question asked for the empirical formula.

The empirical formula shows the simplest whole number ratio of atoms in the formula. The correct empirical formula for ethane is CH_3.

(c)(ii)

This question was designed to be answered correctly by the candidates working at the top end of the grade range for this paper and it achieved that aim. The concept of weak intermolecular forces between molecules was only given by the more able candidates. Many candidates wrote about the weak bonds between the atoms but a large number did not refer to bonds at all and wrote about few particles that are far apart in a gas.

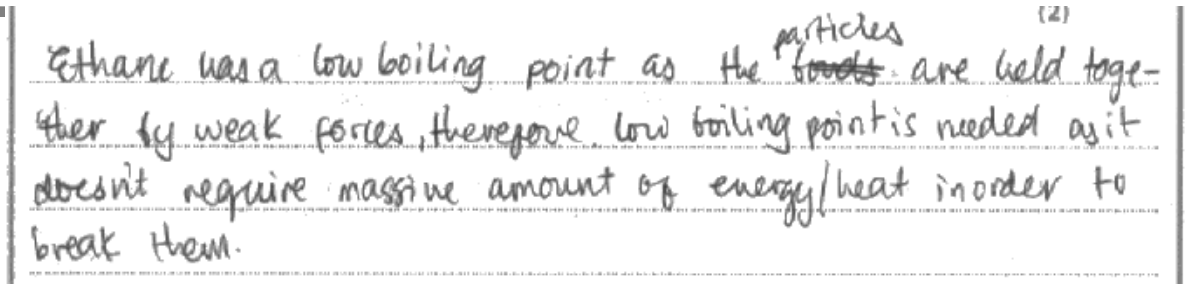
Examiners were surprised to see some candidates writing about hydrogen bonds. There are no hydrogen bonds between ethane molecules and we would not expect candidates to know about specific intermolecular forces at GCSE.


In terms of particles Ethane contains a small amount of atoms. These atoms are weakly joined with eachother and neighbouring atoms meaning it is easier to break the bonds to form a gas.

Results Plus: Examiner Comments

This answer did not score a mark as it referred to the bonds between atoms being weak.

The bonds between atoms are strong but the forces between molecules are weak.


Ethane has a low boiling point as the ~~bonds~~ particles are held together by weak forces, therefore low boiling point is needed as it doesn't require massive amount of energy/heat in order to break them. (2)

Results Plus: Examiner Comments

This is an excellent answer that scored 2 marks.

Results Plus: Examiner Tip

Try to remember that the covalent bonds that hold the atoms together in molecules are strong. There are just weak forces between the molecules.

Q45.

It was pleasing to see that a good proportion of candidates were able to calculate the concentration correctly to gain the two marks available.

A common error seen was where candidates did not convert the volume from cm^3, obtaining 0.094, in these cases 1 mark was awarded.

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

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

(2)

$250 \div 1000 = 0.25\ dm^3$

$\frac{23.5}{0.25\ dm^3} = 94\ g\ dm^{-3}$

concentration = 94 g dm^{-3}

Results Plus: Examiner Comments

The correct calculation that scored both marks.

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

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

(2)

23.5 ÷ 250 = 0.094

concentration = 0.094 g dm^{-3}

Results Plus: Examiner Comments

This candidate scores just 1 mark.

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

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

(2)

Concentration = 250 ÷ 23.5

= 10.64

Results Plus: Examiner Comments

Another common error was to invert the fraction, this scored no credit.

Q46.

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

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

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

(2)

concentration ($g dm^{-3}$) = mass (g) / volume (cm^3)

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

concentration = 0.094 g dm^{-3}

Results Plus: Examiner Comments

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

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

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

(2)

23.5 ÷ 250 = 0.094

0.094 × 240 = 22.56

concentration = 22.56 g dm^{-3}

Results Plus: Examiner Comments

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

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

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

(2)

$250\,cm \times 10^{-3} = 0.25\,dm^{-3}$ (0.25)

$23.5 \times 0.25 = 5.875$

$23.5 \div 0.25 = 94$

concentration = 94 g dm^{-3}

Results Plus: Examiner Comments

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

Results Plus: Examiner Tip

Practice calculations of this type.

Q47.

This question was well answered overall with many candidates achieving at least a level 2 response – either by explaining the properties ionic, covalent and metallic compounds without identifying the bonding as asked in the question, or by identifying metallic bonding and explaining the properties of metals. Some candidates did not correctly identify ionic and simple covalent compounds and had the properties of these mixed up. Some candidates that achieved a level 2 response did not achieve level 3 only because they did not identify the bonding in the different substances.

Q48.

This was a question on one of the Core Practicals for the specification, so it was surprising to see many candidates produce a poor answer or made no attempt to answer the question. Candidates are advised to read the question: a large proportion of candidates wasted time outlining the early setting up and weighings, when the question asked them to start from the point of having a weighed sample of magnesium in a crucible. Some even added extra detail to the start of the experiment and said the empty crucible should be heated strongly to remove water/oil residues, all this did not gain credit. Most went on to gain the mark for heating the crucible. The lifting of the lid was not always known; and candidates were slightly vague on the weighing that takes place at the end of the experiment, rather than clearly measuring the crucible, the lid and contents after cooling. Few candidates left the heated crucible to cool before reweighing. Key details were missing from their descriptions of weighing the product and how to find the mass of oxygen combined.

Errors reported by examiners included:

- how several candidates wrote about burning the magnesium ribbon instead of heating it in the crucible.
- that several candidates mentioned leaving a small gap when putting the lid on the crucible, but this would result in too much loss of magnesium oxide when formed. Some candidates had the crucible sealed with the magnesium and oxygen inside.
- that some candidates scored zero as they used magnesium oxide from the start instead of magnesium. Worryingly, there were candidates who that thought oxygen would be removed by heating as in thermal decomposition.
- how some students chose completely random methods − distillation, boiling, burning, crystallisation etc. This arose presumably because those candidates had yet to carry out that experiment for themselves.
- that some candidates described the calculation rather than the practical.

Describe an experiment to determine the mass of oxygen that combines with a known mass of magnesium, in a crucible and lid of known mass.

(3)

You would weigh the crucible ~~lid~~ and lid and then take that away from the known mass of magnesium and then heat up crucible with bunsen burner and then at the end weigh how much is in the crucible by weighing them together and taking away starting mass of crucible and lid, this should leave you with a mass and then that's the mass of oxygen combined.

Results Plus: Examiner Comments

This response scored two marks: for heating the crucible with the Bunsen burner and for finding the final mass of the crucible + contents. The mark for subtraction was not given as the original mass of magnesium did not seem to figure in that sum.

Results Plus: Examiner Tip

Candidates will be expected to know the details of how to carry out the core practicals.

Describe an experiment to determine the mass of oxygen that combines with a known mass of magnesium, in a crucible and lid of known mass.

(3)

~~Measure~~ weigh magnesium oxide then put it in a crucible and heat it up so the oxygen gets burnt away, bonds break. Then ~~measure~~ weigh the pure magnesium and ~~weight~~ subtract it's ~~weight~~ mass from the original mass of the magnesium oxide to find the mass of oxygen and find the ratio from the mass of the magnesium and oxygen

Results Plus: Examiner Comments

Several of these were seen where the candidate started with magnesium oxide and hoped to produce magnesium by the thermal decomposition of magnesium oxide. There was nothing in this answer that was creditworthy.

Describe an experiment to determine the mass of oxygen that combines with a known mass of magnesium, in a crucible and lid of known mass.

(3)

First, weigh the crucible and lid (Mass A)
Second, place the magnesium in the crucible and re-weigh (Mass B)
Third, Subtract Mass A from Mass B to find the mass of magnesium
Fourth, Heat the crucible over a bunsen burner carefully lifting the lid occasionally to allow oxygen in to react. Continue until only ash is left. Allow the crucible to cool and then re-weigh (Mass C) and subtract Mass B from Mass C to find the mass of oxygen that reacted.

Results Plus: Examiner Comments

This is an example of a response where the first three lines were superfluous as it did not follow from the question that was being asked. Many answers like this were seen, where valuable time was used up by the candidate. From line 4 onwards, the response was given a mark for heating the crucible (and contents), a mark for lifting the lid occasionally and a mark for reweighing at the end. 3 marks were awarded.

Results Plus: Examiner Tip

Candidates need to read the question carefully and know what is asked of them before they start writing.

Q49.

Other than some confusion between atomic mass and atomic number, and which version of the periodic table uses which, this question was fairly well answered. The most commonly scored mark was for the Mendeleev's periodic table to have gaps for elements that had not been discovered. Some top candidates used bullet points and balanced their answers from describing Mendeleev's periodic table and the modern periodic table. Candidates need reminding of the terms **atomic number** and **relative atomic mass** as these were frequently used incorrectly. Candidates need to realise that the subatomic particles were not known to Mendeleev as by then they had not yet been discovered and played no part in his ordering of the known elements at that time. Candidates using electrons to describe the order in the modern Periodic table were not always making the link between outer shells and group number.

There were very few zero-scoring answers, and with so many creditable responses possible, a good proportion of candidates obtained 3 marks.

Inevitably there were several misconceptions reported by examiners including 'Mendeleev left gaps missing', 'Mendeleev arranged the elements by atomic mass number' and 'the modern periodic table is arranged by metals and non-metals'.

In 1871, the Russian chemist Dmitri Mendeleev produced the first version of the periodic table.

Describe how Mendeleev arranged the elements in this first version of the periodic table and why the elements are arranged differently in the modern periodic table.

(3)

Mendaleev arranged the first periodic table based on reactivity and relative atomic mass. He also left gaps as he realised that not all elements had been found. The modern periodic table uses proton number to order it as it is more efficient

(Total for Question = 11 marks)

Results Plus: Examiner Comments

Three points were made extremely well and the response was given 3 marks.

Describe how Mendeleev arranged the elements in this first version of the periodic table and why the elements are arranged differently in the modern periodic table.

(3)

The periodic table was set up to include new elements which had'nt yet been discovered. He knew this because of how he set it out. He set it out so elements with similar properties would be next to each other.

Results Plus: Examiner Comments

Although nothing was mentioned about the modern periodic table, the answer contained the relevant points about the original periodic table.

Describe how Mendeleev arranged the elements in this first version of the periodic table and why the elements are arranged differently in the modern periodic table.

(3)

Mendeleev arranged the elements in order of ~~proton~~ mass number, but the modern periodic table they are arranged in order of proton number. This is because its more accurate as there are isotopes to most elements so but the ~~proton~~ proton number is always the same

Results Plus: Examiner Comments

The idea of 'mass number' did not exist at the time of Mendeleev – that only came once the sub-atomic particles were discovered. Arrangement by proton number was the only idea here that could be credited.

In 1871, the Russian chemist Dmitri Mendeleev produced the first version of the periodic table.

Describe how Mendeleev arranged the elements in this first version of the periodic table and why the elements are arranged differently in the modern periodic table.

(3)

Mendeleev measured and arranged the elements in relative atomic number from highest to lowest, but then realised that there was still elements missing, he left spaces for the missing elements. this idea was laughed at for years, but then changed to order of relative atomic mass.

Results Plus: Examiner Comments

The only point that was credited here was that Mendeleev left spaces for elements he predicted should exist.

Results Plus: Examiner Tip

The modern periodic table is ordered by atomic number and by electron arrangements of the atoms of those elements.

Q50. No Examiner's Report available for this question

Q51.

Many good answers were seen here, with candidates giving the numbers of neutrons in the three isotopes. Those who wrote down the numbers of protons and electrons in the three isotopes and then the number of neutrons invariably scored both marks for the question. Note that candidates who only compared two isotopes only scored one mark. Candidates should make sure that they use the data given in questions like this − although a simple statement about isotopes differing in neutron number still gained one mark. It was likely that many candidates did not read the question carefully enough as credit was only given for differences and not similarities.

A significant minority mixed up neutrons with protons or electrons, and some wrote vaguely of 'subatomic particles'.

Some candidates thought that the line in magnesium-24 meant that there were a negative number of particles.

Responses that referred to differences in electron and proton numbers were quite common.

The atomic number of magnesium is 12.
Magnesium exists as three isotopes: magnesium-24, magnesium-25 and magnesium-26.

Describe, by referring to the numbers of subatomic particles, the differences between one atom of each of these isotopes.

(2)

magnesium-25 contains an extra neutron than magnesium-24 whilst magnesium-26 contains 2 extra neutrons than magnesium-24.

Results Plus: Examiner Comments

The answer does focus on the differences between the 3 isotopes and this description was given 2 marks.

Describe, by referring to the numbers of subatomic particles, the differences between one atom of each of these isotopes.

(2)

All three isotopes will have the same number as protons and electrons (12). However the neutrons will change which effects its mass. For instance mg 24 has 12 neutrons, where as mg 25 has 13.

Results Plus: Examiner Comments

Although this answer says that the number of neutrons will be different for each of the isotopes, only the numbers for Mg-24 and Mg-25 have been given; the number for Mg-26 is missing, so this answer was only credited with 1 mark.

Describe, by referring to the numbers of subatomic particles, the differences between one atom of each of these isotopes.

(2)

All the magnesium will have a proton number and a electron number of 12 but they all have a different of nuebrons. Mg-26 will have 12 nuetrons, mg-25 will have 13 nuebrons and

Results Plus: Examiner Comments

The numbers of neutrons in each of the isotopes have been identified and so this answer was given 2 marks.

Results Plus: Examiner Tip

Take care to read the question. This question is about the differences and not about similarities.

Mark Scheme

Q1.

Question number	Answer	Mark
	number of protons = 52 (1) number of neutrons = 125 - number of protons (1) (= 73)	(2) AO2

Q2.

Question number	Answer	Additional guidance	Mark
	Formula mass $POCl_3$ = (31+16+3x35.5) (1) (= 153.5) % Cl = $\frac{3x35.5}{153.5}$ x 100 (1) (= 69.4%)	allow answers to 2 or more sig figs allow ecf on formula mass allow % Cl = $\frac{35.5}{82.5}$ x 100 = 43% (1)	(2) AO2

Q3.

Question number	Answer	Mark
	$\frac{63.5}{159.5}$ (= 0.39811912) (1) 0.398 x 100 (= 39.811912) (1) 40 (1)	(3) AO2

Q4.

Question number	Answer	Additional guidance	Mark
	6.92 with or without working scores 4 7.59 x 6 (1) (= 45.54) 92.41 x 7 (1) (= 646.87) (1) $\frac{45.54 + 646.87}{100}$ (1) (= 6.9241) 6.92 (1)	penalise early rounding once only $\frac{(7.59 \times 6) + (92.41 \times 7)}{100}$ (3) 6 x 0.0759 (1) (= 0.4554) 7 x 0.9241 (1) (= 6.4687) 0.4554 + 6.4687 (1) = 6.92 (1) allow 7.59% of 6 (1) (= 0.4554) 92.41% of 7 (1) (= 6.4687) 0.4554 + 6.4687 (1) = 6.92 (1) allow ecf allow MP4 for incorrect answer with working to 2 dp if using most of the data in question	**(4)**

Q5.

Question number	Answer	Additional guidance	Mark
	final answer of 47.91 / 47.9 with or without working (3) All percentages given as: Ti–46 = 8 Ti–47 = 7 Ti–48 = 75 Ti–49 = 6 Ti–50 = 4 (1) 46 x 8 = (368) 47 x 7 = (329) 48 x 75 = (3600) 49 x 6 = (294) 50 x 4 = (200) (= 4791) (1) $\frac{4791}{100}$ = 47.91 (1)	48 without working = 0 allow 7-7.5 for Ti-47 (7.5 gives 48.145) allow ECF for MP2 [Note: answer of 48 can score MP3 but must have correct working] Allow ECF but answer for MP3 must be between 46 and 50	**(3)**

Q6.

Question number	Answer	Additional guidance	Mark
(i)	100 with or without working scores 2 40 + 12 + 3 x 16 (1) =100 (1)	ignore any units ecf for MP2 if using 12,16 and 40, using addition and multiplication only	(2)
(ii)	**56% without working scores 0** $\frac{56}{100}$ (1) (x 100) = 56 (%) (1)	56/answer to 4(d)(i) (1) x 100 (1) MP2 only for correctly x 100 some figure derived from the data given 100% scores 0	(2)

Q7.

Question number	Answer	Additional guidance	Mark
(i)	100 with or without working scores 2 40 + 12 + 3 x 16 (1) =100 (1)	ignore any units ecf for MP2 if using 12, 16 and 40, using addition and multiplication only	(2)
(ii)	**56% without working scores 0** $\frac{56}{100}$ (1) (x 100) = 56 (%) (1)	56/answer to 4(d)(i) (1) x 100 (1) MP2 only for correctly x 100 some figure derived from the data given 100% scores 0	(2)

Q8.

Question number	Answer	Mark
	moles sucrose = $\frac{10.0}{342}$ (1) (=0.029) number of atoms = $\frac{10.0}{342}$ x 45 x 6.02 x 10^{23} (1) (= 7.92 x 10^{23})	**(2)** **AO2**

Q9.

Question number	Answer	Mark
(i)	x = 6 (1) y = 14 (1)	(2)
(ii)	25 (g)	(1)

Q10.

Question number	Answer	Additional guidance	Mark
	MP1 : using volume = $\frac{\text{mass}}{\text{concentration}}$ (1) MP2: volume = $\frac{9.0}{12}$ (dm^3) (1) (= 0.75 dm^3) MP3: converting volume to cm^3 = 0.75 x 1000 (1) (= 750 (cm^3))	without working 750 cm^3 (3) 0.75 (dm^3) (2) $\frac{12}{9}$ (0) x 1000 (1) = 1333 cm^3	(3)

Q11.

Question number	Answer	Mark
	10.32 + 5.12 (1)= (15.44) (g)	(1)

Q12.

Question Number	Answer	Additional guidance	Mark
	Na : O $\frac{0.92}{23}$: $\frac{0.32}{16}$ (1) 0.04 : 0.02 OR 2 : 1 (1) (empirical formula from ratio) Na_2O (1)	formula alone scores 0 2nd MP is either for working out correct number of moles OR for finding the correct ratio by dividing by the smaller number from an incorrect first step 3rd MP is for correctly converting a ratio to a formula with whole numbers only example $\frac{23}{0.92}$: $\frac{16}{0.32}$ 25 : 50 (0) 1 : 2 (1) NaO_2 (1)	**(3)** AO 2 1

Q13.

Question Number	Answer	Additional guidance	Mark
	Na : O $\frac{0.92}{23}$: $\frac{0.32}{16}$ (1) 0.04 : 0.02 OR 2 : 1 (1) (empirical formula from ratio) Na_2O (1)	formula alone scores 0 2nd MP is either for working out correct number of moles OR for finding the correct ratio by dividing by the smaller number from an incorrect first step 3rd MP is for correctly converting a ratio to a formula with whole numbers only example $\frac{23}{0.92}$: $\frac{16}{0.32}$ 25 : 50 (0) 1 : 2 (1) NaO_2 (1)	**(3)** AO 2 1

Q14.

Question number	Answer	Additional guidance	Mark
	25 cm^3 solution contains = 0.25 g ammonium chloride 1 cm^3 solution contains = $\frac{0.25}{25}$ g (1) 10 cm^3 solution contains = $\frac{0.25}{25}$ x 10 g (1) = 0.1 (g)	allow full marks for correct answer with no working	**(2)**

Q15.

Question Number	Answer	Mark
(i)	5 molecules of each have reacted/ 5:5 (1) 1: 1 (1)	**(2)**

Question Number	Answer	Mark
(ii)	**C** $H_2 + Cl_2 \rightarrow 2HCl$	**(1)**

Q16.

	Answer	Acceptable answers	Mark
	2x1 + 16 (=18)		**(1)**

Q17.

	Answer	Acceptable answers	Mark
	2x1 + 16 (=18)		**(1)**

Q18.

Question Number	Answer	Mark
	• 0.4 dm^3 (1) • 100/0.4 (1) • = 250 (g dm^{-3}) (1) OR • 400 cm^3 contain 100 g • 1 cm^3 contains $\frac{100}{400}$ g (1) • 1 dm^3 contains $\frac{100 \times 1000}{400}$ g (1) • = 250 (g dm^{-3}) (1)	**(3)**

Q19.

	Answer	**Acceptable answers**	**Mark**
	A calculation involving mass of solid = 258.515 – 258.450 (1) (= 0.065 g) concentration = 0.065 × $^{1000}/_{500}$ (1) (= 0.130 (g dm^{-3}))	 allow TE from mass of solid for second mark	**(2)**

Q20.

	Answer	**Acceptable answers**	**Mark**
	A calculation involving mass of solid = 258.515 – 258.450 (1) (= 0.065 g) concentration = 0.065 × $^{1000}/_{500}$ (1) (= 0.130 (g dm^{-3}))	 allow TE from mass of solid for second mark	**(2)**

Q21.

Question Number	Answer	Additional guidance	Mark
	1 mol of hydrogen atoms = a mass of 1.00 g = 6.02×10^{23} atoms 6.02×10^{23} H atoms has mass = 1.00 g (1) mass of 1 H atom = $\frac{1.00}{6.02 \times 10^{23}}$ (1) $= 1.66 \times 10^{-24}$ (g) (1)	correct answer alone (3) if $1 \times 6.02 \times 10^{23}$ is followed by atoms or particles, then award 1st marking point on answer line 3.32×10^{-24} (g) (2) ignore sig figs except for one	**(3)** AO 2 1

Q22.

	Answer	Acceptable answers	Mark
	• 100 (kg) (calcium carbonate) → 106 (kg) (sodium carbonate) (1) $\frac{106 \times 40}{100}$ (1) (=42.4)	OR alternative 106÷100 40000÷100 /40÷100 (moles approach) Only 42.4 with no working worth 2 marks 42400**g** worth 2 marks	**(2)**

Q23.

	Answer	Acceptable answers	Mark
	• 100 (kg) (calcium carbonate) → 106 (kg) (sodium carbonate) (1) $\frac{106 \times 40}{100}$ (1) (=42.4)	OR alternative 106÷100 40000÷100 /40÷100 (moles approach) Only 42.4 with no working worth 2 marks 42400**g** worth 2 marks	**(2)**

Q24.

Question number	Answer	Additional guidance	Mark
	relative formula mass SO_2 $=32.0 + (2x16.0)$ $= 64.0$ (1) amount of SO_2 $= \frac{48.0}{64.0}$ (1) number of molecules $= \frac{48.0}{64.0} \times 6.02 \times 10^{23}$ $= 4.52 \times 10^{23}$ (1)	4.52×10^{23} without working - 3 marks	(3)

Q25.

Question Number	Answer	Mark
(i)	<table><tr><th>isotope</th><th>mass number</th><th>number of protons</th><th>number of neutrons</th></tr><tr><td>magnesium-24</td><td>24</td><td>12</td><td>12</td></tr><tr><td>magnesium-25</td><td>25</td><td>**12**</td><td>**13**</td></tr><tr><td>magnesium-26</td><td>26</td><td>**12**</td><td>**14**</td></tr></table> all four numbers correct (2) any two numbers correct (1)	(2)

Question Number	Answer	Mark
(ii)	total mass of Mg-24 atoms = 78.60 x 24 = 1886.4 total mass of Mg-25 atoms = 10.11 x 25 = 252.75 total mass of Mg-26 atoms = 11.29 x 26 = 293.54 mass of 100 atoms $= (78.60 \times 24) + (10.11 \times 25) + (11.29 \times 26)$ (1) relative atomic mass $= \frac{(78.60 \times 24) + (10.11 \times 25) + (11.29 \times 26)}{100}$ (1) $= 24.3$ (2) allow (1) only for any other number of significant figures	(4)

Q26.

	Answer	Acceptable answers	Mark
	40 +[2 × 35.5] (=111)	111 alone	**(1)**

Q27.

	Answer	Acceptable answers	Mark
	40 +[2 × 35.5] (=111)	111 alone	**(1)**

Q28.

Question Number	Answer	Mark
	• 88 + (14 + 16x3) x 2 (1) • = 212 (1)	**(2)**

Q29.

Question Number	Answer	Acceptable answers	Mark
	An explanation linking any two of • giant (covalent structure)/ giant molecule /macromolecule /large number of bonds (1) • strong (covalent) bonds (1) • large amount of heat /energy (needed to break bonds) (1)	Any reference to ionic bonding or intermolecular forces scores 0/2 lattice lots of/many bonds hard to break ignore hard to melt/high temperature needed	**(2)**

Q30.

Question Number	Answer	Acceptable answers	Mark
	An explanation linking any two of • giant (covalent structure)/ giant molecule /macromolecule /large number of bonds (1) • strong (covalent) bonds (1) • large amount of heat /energy (needed to break bonds) (1)	Any reference to ionic bonding or intermolecular forces scores 0/2 lattice lots of/many bonds hard to break ignore hard to melt/high temperature needed	**(2)**

Q31.

Question Number	Answers	Acceptable Answers	Mark
(a)(i)	<table><tr><td></td><td>chlorine-35</td><td>chlorine-37</td></tr><tr><td>number of protons</td><td>**17**</td><td>**17**</td></tr><tr><td>number of neutrons</td><td>**18**</td><td>**20**</td></tr><tr><td>number of electrons</td><td>**17**</td><td>**17**</td></tr></table> the four 17s (1) the 18 and 20 (1)		**(2)**

Question Number	Answers	Acceptable Answers	Mark
(a)(ii)	An explanation linking M1 average (mass of atoms/isotopes present) (1) M2 more chlorine-35 than chlorine-37 / higher {percentage / abundance} of Cl-35 / lower {percentage / abundance} of Cl-37 / (1)	 mean ignore weight 75% chlorine-35 / 25% chlorine-37/ chlorine-35 and chlorine-37 in ratio 3:1 / correct calculation to obtain 35.5 (2) eg[(75x35) + (25x37)]/100	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(b)	Diagram showing one carbon and four chlorines four pairs of electrons shared between the carbon and chlorine atoms (1) fully correct (1)	use of dots or crosses or mixture of both ignore inner shells even if incorrect ignore symbols	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (c)**	A response including some of the following points Note: (carbon to carbon) strong bonds is given in question Diamond: Uses and Properties • in cutting tools/engraving • drill bit • jewellery • diamond very hard/strong • attractive/lustrous • high melting point Explanations • giant molecular/covalent • each carbon atom bonded to four other carbon atoms • three dimensional structure • to break it lots of bonds would need to be broken • would need lot of energy/force Graphite: Uses and Properties • to make electrodes • a lubricant • sporting equipment • in pencils/drawing • graphite conducts electricity • soft Explanations • giant molecular/covalent • each carbon atom bonded to three other carbon atoms • each carbon atom has a free electron • delocalised electrons • (delocalised) electrons move to carry current • layers of carbon atoms • weak forces/bonds between layers/sheets • so layers/sheets can slide/rub off or over each other	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description eg for either diamond ***or*** graphite states a correct Use ***or*** Property • 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/explanation eg for ***both*** diamond ***and*** graphite states a correct Use ***or*** Property linked with at least **one relevant** explanation point **OR** for ***either*** diamond ***or*** graphite States a correct Use or Property linked to at least **two relevant** explanation points • 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 explanation eg for ***both*** diamond ***and*** graphite States a correct Use or Property linked to at least **three relevant** explanation points (in total) **OR** for ***either*** diamond ***or*** graphite States a correct Use or Property linked to at least **four relevant** explanation points (in total) • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q32.

Question Number	Answers	Acceptable Answers	Mark
(a)(i)	<table><tr><td></td><td>chlorine-35</td><td>chlorine-37</td></tr><tr><td>number of protons</td><td>**17**</td><td>**17**</td></tr><tr><td>number of neutrons</td><td>**18**</td><td>**20**</td></tr><tr><td>number of electrons</td><td>**17**</td><td>**17**</td></tr></table> the four 17s (1) the 18 and 20 (1)		**(2)**

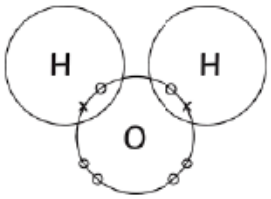
Question Number	Answers	Acceptable Answers	Mark
(a)(ii)	An explanation linking M1 average (mass of atoms/isotopes present) (1) M2 more chlorine-35 than chlorine-37 / higher {percentage / abundance} of Cl-35 / lower {percentage / abundance} of Cl-37 / (1)	 mean ignore weight 75% chlorine-35 / 25% chlorine-37/ chlorine-35 and chlorine-37 in ratio 3:1 / correct calculation to obtain 35.5 (2) eg[(75x35) + (25x37)]/100	**(2)**

Question Number	Answers	Acceptable Answers	Mark
(b)	Diagram showing one carbon and four chlorines four pairs of electrons shared between the carbon and chlorine atoms (1) fully correct (1)	use of dots or crosses or mixture of both ignore inner shells even if incorrect ignore symbols	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (c)**	A response including some of the following points Note: (carbon to carbon) strong bonds is given in question Diamond: Uses and Properties • in cutting tools/engraving • drill bit • jewellery • diamond very hard/strong • attractive/lustrous • high melting point Explanations • giant molecular/covalent • each carbon atom bonded to four other carbon atoms • three dimensional structure • to break it lots of bonds would need to be broken • would need lot of energy/force Graphite: Uses and Properties • to make electrodes • a lubricant • sporting equipment • in pencils/drawing • graphite conducts electricity • soft Explanations • giant molecular/covalent • each carbon atom bonded to three other carbon atoms • each carbon atom has a free electron • delocalised electrons • (delocalised) electrons move to carry current • layers of carbon atoms • weak forces/bonds between layers/sheets • so layers/sheets can slide/rub off or over each other	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description eg for either diamond ***or*** graphite states a correct Use ***or*** Property • 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/explanation eg for ***both*** diamond ***and*** graphite states a correct Use ***or*** Property linked with at least **one relevant** explanation point **OR** for ***either*** diamond ***or*** graphite States a correct Use or Property linked to at least **two relevant** explanation points • 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 explanation eg for ***both*** diamond ***and*** graphite States a correct Use or Property linked to at least **three relevant** explanation points (in total) **OR** for ***either*** diamond ***or*** graphite States a correct Use or Property linked to at least **four relevant** explanation points (in total) • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q33.

Question number	Answer	Additional guidance	Mark
	 (2) OR shared pair of electrons between the oxygen and a hydrogen (1) rest of molecule correct (1)	allow dots or crosses or a mixture of both	**(2)** **AO1**

Q34.

Question number	Answer	Additional guidance	Mark
(i)	Left : H_2SO_4 (1) Right : $CuSO_4$ (1)	reject superscript numbers reject superscript numbers incorrect balancing max 1	(2)

Question number	Answer	Mark
(ii)	63.5 + 12 + 3x16 (1) = 123.5 (1)	(2)

Question number	Answer	Mark
(iii)	**A** bubble the gas through limewater, limewater turns cloudy **The only correct answer is A** **B** is not correct because test shows only an acidic gas **C** is not correct because test shows only that the gas does not support combustion **D** is not correct because test shows only an acidic gas	(1)

Q35.

Question number	Answer	Additional guidance	Mark
(i)	Left : H_2SO_4 (1) Right : $CuSO_4$ (1)	reject superscript numbers reject superscript numbers incorrect balancing max 1	(2)

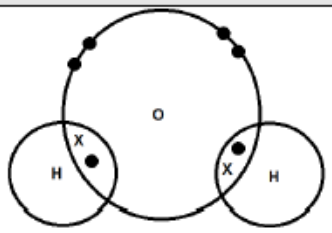
Question number	Answer	Mark
(ii)	63.5 + 12 + 3x16 (1) = 123.5 (1)	(2)

Question number	Answer	Mark
(iii)	**A** bubble the gas through limewater, limewater turns cloudy **The only correct answer is A** **B** is not correct because test shows only an acidic gas **C** is not correct because test shows only that the gas does not support combustion **D** is not correct because test shows only an acidic gas	**(1)**

Q36.

Question number	Answer	Additional guidance	Mark
(i)	4 electrons shown between the 2 carbon atoms	electrons may be shown as dots, crosses or as a mixture	**(1)**
(ii)	carbon monoxide / carbon / soot	allow CO / C ignore carbon dioxide	**(1)**

Q37.

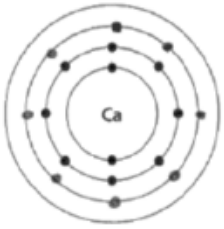
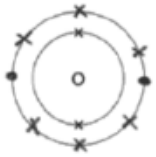
Question number	Answer	Additional guidance	Mark
	 (2)	shared pair of electrons in right hand overlap(1) rest of molecule with 4 electrons drawn in outer shell of O only (1) MP2 dependent on MP1 allow x or • or combinations thereof for any electrons ignore inner shells of electrons even if incorrect	EXP (2)

Q38.

Question number	Answer	Additional guidance	Mark
(i)	$C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$ (2) left hand side (1) right hand side (1)	correct formulae with incorrect balancing (1)	(2)

Question number	Answer	Mark
(ii)	**C** 4/60 x 100 **C** is the only correct answer. **A** is incorrect because there are four atoms of hydrogen in ethanoic acid **B** is incorrect because there are four atoms of hydrogen in ethanoic acid **D** is incorrect because the fraction is inverted and there are four atoms of hydrogen in ethanoic acid	(1)

Q39.

Question number	Answer	Additional guidance	Mark
	  charge on ion +2 charge on ion -2 (3) • correct dots for calcium ion (1) • correct 2 dots and 6 crosses for the oxide ion (1) • correct charges 2+/+2 and 2-/-2 (1)	ignore arrows showing movement of electrons	(3) **EXP**

Q40.

Question number	Indicative content	Additional guidance	Mark
(i)	straight line of best fit (1 cm^3 to 5 cm^3)	ignore line between 0 and 1 and after 5 must be a single ruled line	(1)

Question number	Indicative content	Additional guidance	Mark
(ii)	• any line extrapolated to $6cm^3$ (1) • value read from their extrapolated line +/- 1 small square (1)	2^{nd} mark dependent on 1^{st} no line = 0	(2)

Q41.

Question number	Answer	Additional guidance	Mark
(i)	straight line of best fit (1 cm^3 to 5 cm^3)	ignore line between 0 and 1 and after 5 must be a single ruled line	(1)

Question number	Answer	Additional guidance	Mark
(ii)	• any line extrapolated to $6cm^3$ (1) • value read from their extrapolated line +/- 1 small square (1)	2^{nd} mark dependent on 1^{st} no line = 0	(2)

Q42.

Question number	Answer	Additional guidance	Mark
	$Al^{3+} + PO_4^{3-} \rightarrow AlPO_4$ (2) Al^{3+} (1) $AlPO_4$ (1)	allow any neutral aluminium phosphate formula based on their aluminium ion. allow $Al^{3+}PO_4^{3-}$	(2) AO2

Q43.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**2** Na **(1)** + Cl_2 → **2** NaCl (1) Ignore + in front of the 2s	maximum 1 mark if any balancing number is added in front of Cl_2 or if any of the formulae are changed eg $4Na + 2Cl_2 \rightarrow 4NaCl$ or $Na + 1/2\ Cl_2 \rightarrow NaCl$ score (1) do not allow negative signs in front of balancing numbers	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	2.5 / 4.0 (1) their fraction x 100 (1) (=62.5)	0.625 or 5/8 62.5/63 with {no/incorrect} working correct working with {no/wrong}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	A ionic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	23 + 35.5 (=58.5) Ignore g	58.5 with {no/incorrect} working 23 + 35.5 with {no/wrong} answer do not allow 58/59 without working	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	$\frac{24}{120}$ (1) their fraction x 100 (1) (=20%)	1/5 or 0.2 20 with {no/incorrect} working correct working with {no/wrong} answer	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	CH_3	2 CH_3 / C_1H_3 / H_3C do not allow just 1:3	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking any **two** from weak {forces/attractions} (1) between {molecules/particles/them}/ intermolecular (1) little {heat/energy} needed {to separate the molecules/overcome force(s) between molecules} (1)	maximum **1** mark if breaking bonds between atoms/breaking down {molecules/ particles}/breaking covalent bonds specific weak forces eg Van der Waals/London weak bonds do not allow covalent bonds are weak /weak bonds between atoms ignore weak hydrogen bonds weak bonds between {molecules / particles} do not allow intramolecular 'little energy is needed to break the bonds' only if it is clear that {covalent/single} bonds are not being broken	**(2)**

(Total for Question = 11 marks)

Q44.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**2** Na **(1)** + Cl_2 → **2** NaCl (1) Ignore + in front of the 2s	maximum 1 mark if any balancing number is added in front of Cl_2 or if any of the formulae are changed eg 4Na + $2Cl_2$ → 4NaCl or Na + 1/2 Cl_2 → NaCl score (1) do not allow negative signs in front of balancing numbers	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	2.5 / 4.0 (1) their fraction x 100 (1) (=62.5)	0.625 or 5/8 62.5/63 with {no/incorrect} working correct working with {no/wrong}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	A ionic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	23 + 35.5 (=58.5) Ignore g	58.5 with {no/incorrect} working 23 + 35.5 with {no/wrong} answer do not allow 58/59 without working	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	$\frac{24}{120}$ (1) their fraction x 100 (1) (=20%)	1/5 or 0.2 20 with {no/incorrect} working correct working with {no/wrong} answer	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	CH_3	2 CH_3 / C_1H_3 / H_3C do not allow just 1:3	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking any **two** from weak {forces/attractions} (1) between {molecules/particles/them}/ intermolecular (1) little {heat/energy} needed {to separate the molecules/overcome force(s) between molecules} (1)	maximum **1** mark if breaking bonds between atoms/breaking down {molecules/ particles}/breaking covalent bonds specific weak forces eg Van der Waals/London weak bonds do not allow covalent bonds are weak /weak bonds between atoms ignore weak hydrogen bonds weak bonds between {molecules / particles} do not allow intramolecular 'little energy is needed to break the bonds' only if it is clear that {covalent/single} bonds are not being broken	**(2)**

(Total for Question = 11 marks)

Q45.

Question Number	Answer	Additional guidance	Mark
	final answer of 94 (g dm^{-3}) with or without working (2) OR $\frac{23.5}{250}$ (1) (= 0.094) 0.094 x 1000 (1) OR $\frac{250}{1000}$ (dm^3) (1) (= 0.25 (dm^3)) $\frac{23.5}{0.25}$ (1) OR $\frac{1000}{250}$ (1) = 4 4 x 23.5 (1)	allow ECF (error carried forward) throughout other final answers: 0.094 / 9.4 (1) 0.000094 or 9.4 x 10^{-5} (1) 0.25 (dm^3) (1) allow $\frac{250}{23.5}$ x 1000 or 10638(.3) (1)	**(2)** AO 2 1

Q46.

Question Number	Answer	Additional guidance	Mark
	final answer of 94 (g dm^{-3}) with or without working (2) OR $\frac{23.5}{250}$ (1) (= 0.094) 0.094 x 1000 (1) OR $\frac{250}{1000}$ (dm^3) (1) (= 0.25 (dm^3)) $\frac{23.5}{0.25}$ (1) OR $\frac{1000}{250}$ (1) = 4 4 x 23.5 (1)	allow ECF (error carried forward) throughout other final answers: 0.094 / 9.4 (1) 0.000094 or 9.4 x 10^{-5} (1) 0.25 (dm^3) (1) allow $\frac{250}{23.5}$ x 1000 or 10638(.3) (1)	**(2)** AO 2 1

Q47.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. Substance A • giant ionic structure • (high melting point) strong electrostatic attractions between ions • due to a lot of energy required to overcome strong forces • (electrical conductivity) in solid ions strongly attracted in lattice ions cannot move, so poor conductor when solid • when molten ions free to move, so good conductor when molten Substance B • metallic structure • (high melting point) strong attraction between metal ions and delocalised electrons • due to a lot of energy required to overcome strong forces between particles in solid • (electrical conductivity) in solid delocalised electrons • free to move throughout metallic lattice, so good conductor when solid • delocalised electrons and ions free to move when molten, so good conductor when molten Substance C • covalent simple molecular • (low melting point) weak intermolecular forces/ attractions between molecules • little energy needed to separate molecules, so low melting point • (electrical conductivity) in solid and when molten no delocalised electrons or ions to carry charge, so poor conductor	(6) AO1 / AO3

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Identifies correct structure types OR explains a property of one substance	Possible candidate responses • A – giant ionic, B – metallic, C – simple molecular • High mp (for A or B) due to strong bonds (between atoms / ions) • Low mp for C due to weak intermolecular forces • A conducts when molten – ions can move • B conducts when solid / molten – electrons can move • C does not conduct – no free ions or electrons can't move
Level 2	3–4	Additional guidance Identifies correct structure type for one substance AND explains at least one property of that substance OR explains at least two properties	Possible candidate responses • A – giant ionic AND high mp due to strong bonds between ions AND poor conductor when solid – ions not free to move; good conductor when molten – ions free to move • B – metallic AND high mp due to strong bonds between {atoms / metal ions and delocalised electrons} AND good conductor when solid and molten – electrons free to move • C – simple molecular AND low mp due to weak intermolecular forces AND poor conductor when solid and molten – no ions and electrons not free to move
Level 3	5–6	Additional guidance Identifies correct structure types and explains properties for least two substances	Possible candidate responses • A – giant ionic AND high mp due to strong bonds between ions AND poor conductor when solid – ions not free to move; good conductor when molten – ions free to move AND / OR • B – metallic AND high mp due to strong bonds between {atoms / metal ions and delocalised electrons} AND good conductor when solid and molten – electrons free to move AND / OR • C – simple molecular AND low mp due to weak intermolecular forces AND poor conductor when solid and molten – no ions and electrons not free to move

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. (AO3)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently (AO3)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. (AO3)

Q48.

Question number	Answer	Additional guidance	Mark
	A description that combines three of the following points to provide a method: • heat the magnesium (in crucible) (1) and any two from • lift lid from time to time/allow to cool (1) • determine mass of crucible, lid and product (1) • subtract to find mass of oxygen combined (1)	 allow heat crucible (containing magnesium) allow use of weigh in place of determine mass ignore 'measure' alone allow heat to constant mass allow weigh at end /OWTTE	**(3)** **EXP**

Q49.

Question number	Answer	Mark
	An answer that provides a description by making reference to three of the following points: • using the properties of the known elements and their compounds at the time (1) • leaving gaps for elements / predicting existence and properties of elements yet to be discovered / newly discovered elements have been added (1) • in order of (increasing) (relative) atomic mass (1) • in modern periodic table elements arranged in order of increasing {atomic number / no of protons} (1) • Mendeleev thought that he had arranged the elements in the order of increasing relative atomic mass, but this was not always true due to the relative abundance of some of the pairs of isotopes (1) Note: do not allow 'mass number ' in MP 3.	**(3)** **EXP**

Q50.

Question number	Answer	Additional guidance	Mark
	A description including • conductivity increases **and** then decreases (1) **AND** any one *quantitative description* from • conductivity increases (from 0) to 150 (g dm^{-3}) (1) • conductivity reaches maximum at 150 (g dm^{-3}) (1) • conductivity then decreases from 150 (to 500) (g dm^{-3}) (1)	allow positive correlation for increases and negative correlation for decreases	**(2)**

Q51.

Question number	Answer	Additional guidance	Mark
	^{24}Mg, ^{25}Mg and ^{26}Mg have 12, 13 and 14 neutrons respectively / ^{25}Mg, ^{26}Mg have 1 and 2 more neutrons than ^{24}Mg respectively (2)	allow {each isotope has / they have} a different number of neutrons (in nucleus) / different numbers in two of the isotopes (1) ignore any similarities	**(2)** **EXP**