PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

# CHEMISTRY



## MARK SCHEME

### TOPIC 1: KEY CONCEPTS IN CHEMISTRY (PACK 6)

| SCORE | PERCENTAGE |
| --- | --- |
| /69 | % |

STEMUP

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Q3. No Examiner's Report available for this question

Q4.

(i)

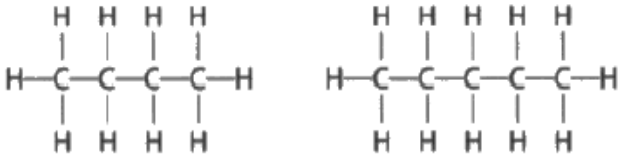
This question was poorly answered with only a third of responses scoring, generally just 1 mark of the 2 marks available.

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

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

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

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



butane pentane

**Figure 14**

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

**(2)**

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

**Results Plus: Examiner Comments**

This response scored 1 mark only.

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

(ii)

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

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

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

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

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

You must show your working.

**(3)**

$4 \times 12 = 48.$

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

mass of carbon = 83 g

**Results Plus: Examiner Comments**

This response scored 2 marks.

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

(iii)

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

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

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

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

Write the word equation for this reaction.

**(2)**

Butane + air → Carbon dioxide + water

**Results Plus: Examiner Comments**

This response scored 1 mark only.

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

**Results Plus: Examiner Tip**

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




**Results Plus: Examiner Comments**

This response was awarded 1 mark.

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

**Results Plus: Examiner Tip**

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

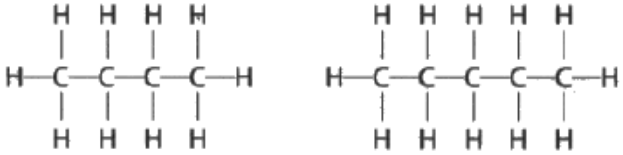
Q5.

(i)

Many candidates could score at least 1 mark on this question on homologous series for recognising that butane and pentane are in the alkane homologous series and then stated this or the general formula for an alkane to gain the second mark point. Fewer, however, could explain

why they are neighbouring members to gain the second mark. Some candidates lost marks as they were not careful with their use of terms and used the term same chemical or same molecular formula rather than same general formula and so therefore did not gain the mark.

Figure 2 shows the formulae of a molecule of butane and of a molecule of pentane.
Butane and pentane are neighbouring members of the same homologous series.



butane pentane

**Figure 2**

5 12

$C_nH_{2n+2}$ ×

4 10

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

**(2)**

they have similar chemical properties and have the same general formula eg $C_nH_{2n+2}$. They are both hydrocarbons and they increase by $CH_2$

**Results Plus: Examiner Comments**

A good answer that gained both marks.

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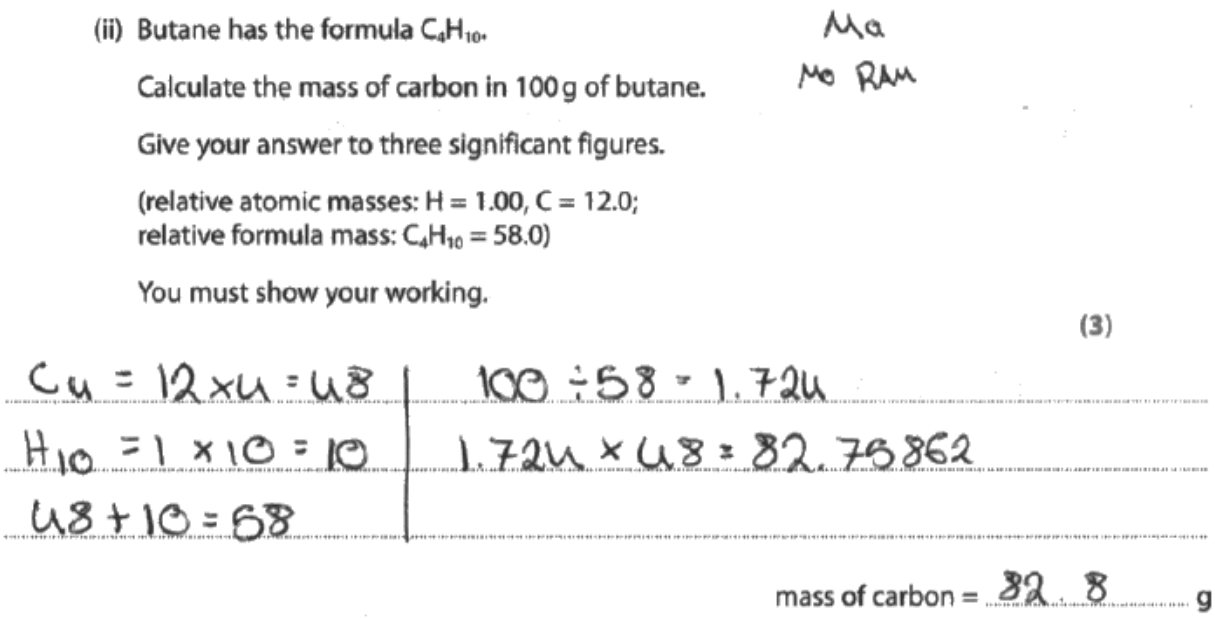
Butane has 4 carbons. Pentane has 5 carbons. Therefore they are neighbouring members. They are both alkanes and therefore both are part of the alkane homologous series

**Results Plus: Examiner Comments**

In some cases, candidates just re-stated the number of carbons in each of the molecules, rather than describing the difference. This was not deemed sufficient to gain the first marking point. A mark was still awarded for the fact that they are both alkanes.

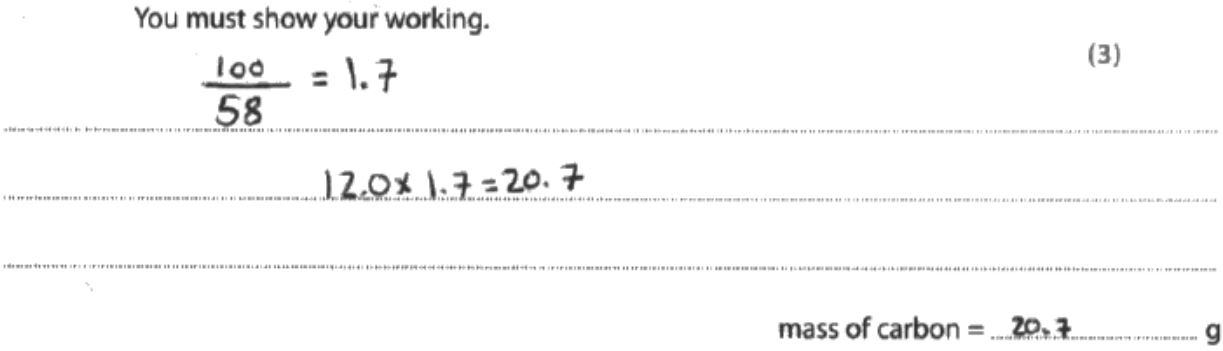
(ii)

Calculation of the mass of carbon contained in 100g of butane was generally well answered by candidates with many gaining the full 3 marks available. Where candidates lost marks, it was often as did not read the question carefully and did not give their answer to 3 significant figures.




**Results Plus: Examiner Comments**

The correct answer given to 3 significant figures gained 3 marks.




**Results Plus: Examiner Comments**

Another reason that candidates did not score full credit was where candidates had multiplied by 12 rather than 48. Where these answers were written correctly to 3 significant figures, these candidates were still able to score 2 of the 3 marks

**Results Plus: Examiner Tip**

It is important that you show your working on calculations so you can still obtain credit for method marks in the working.

Q6.

The majority of candidates scored at least one mark on this calculation. Many made an error with converting the units from $cm^3$ to $dm^3$, or missed that conversion out. Also there were a couple of instances where an interim answer was rounded to 1 sig fig. This should be discouraged and rounding should only take place for the final answer either to the same degree of accuracy as given for other values in the question or rounded to the number of specified sig figs or decimal places required.

Q7.

Most candidates did realise that the fractional atomic mass was due to the presence of different isotopes, and so reached level 1 at least. Many reached level 2, either by noting the effect of the Mg-25 and Mg-26 isotopes in raising the $A_r$ above 24, or by giving a fully correct calculation based on the percentages of isotopes in the sample.

A pleasing number of candidates attempted the calculation as part of their answer, and these attempts were mostly successful. To gain full marks, there did need to be some accompanying comment explaining the reasoning behind the calculation. Those who didn't attempt a calculation could still score marks − although simply repeating the data about isotopic composition did not obtain credit.

Note that there is no longer a requirement in these extended open response questions for QWC (Quality of Written Communication), but candidates are reminded to set out their answer logically.

Most candidates were not able to then make the connection between relative atomic mass being closer to Mg-24 than the others or did not describe fully the average value of the relative atomic mass, and many just repeated the data given in the question rather than using it. Several candidates erroneously assumed that the relative atomic mass = number of atoms in samples, i.e. 79% had 24 atoms. Some tried to justify numerically the added 0.3 to the RAM e.g. 'other samples had 1% difference'. Few thought that the hyphen in the stem of the question was a negative sign of Ar. Among the weakest candidates 'We use 24 because it's easier to do calculations' was a common explanation or there was no attempt at the question.

* A sample of magnesium contains

79% of magnesium-24 atoms
10% of magnesium-25 atoms
11% of magnesium-26 atoms.

In most calculations the relative atomic mass of magnesium used is 24.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

(6)

In this sample the relative atomic mass of magnesium is 24.3 because there are three different isotopes of it. Most of the magnesium in the sample is magnesium-24 (79%) meaning that the relative atomic mass is going to be just over 24 nearer to 24 than 25 or 26. Because there are two more isotopes, the mass cannot be 24 and has to be above 24. This is why the mass of it is 24.3. If there was only 11% of magnesium-26 and 79% of magnesium-26 then the relative atomic mass would be just under 26.

**Results Plus: Examiner Comments**

This was a level 2 answer where the candidate gave a qualitative explanation of why the relative atomic mass was 24.3. It included how all three isotopes influenced the value of the relative atomic mass. This was given 4 marks.

**Results Plus: Examiner Tip**

The Quality of Written Communication is no longer assessed. To distinguish between the marks within a level, a 'strong' level 2 answer would be given 4 marks, while a 'weak' level 2 answer would be given 3 marks.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

(6)

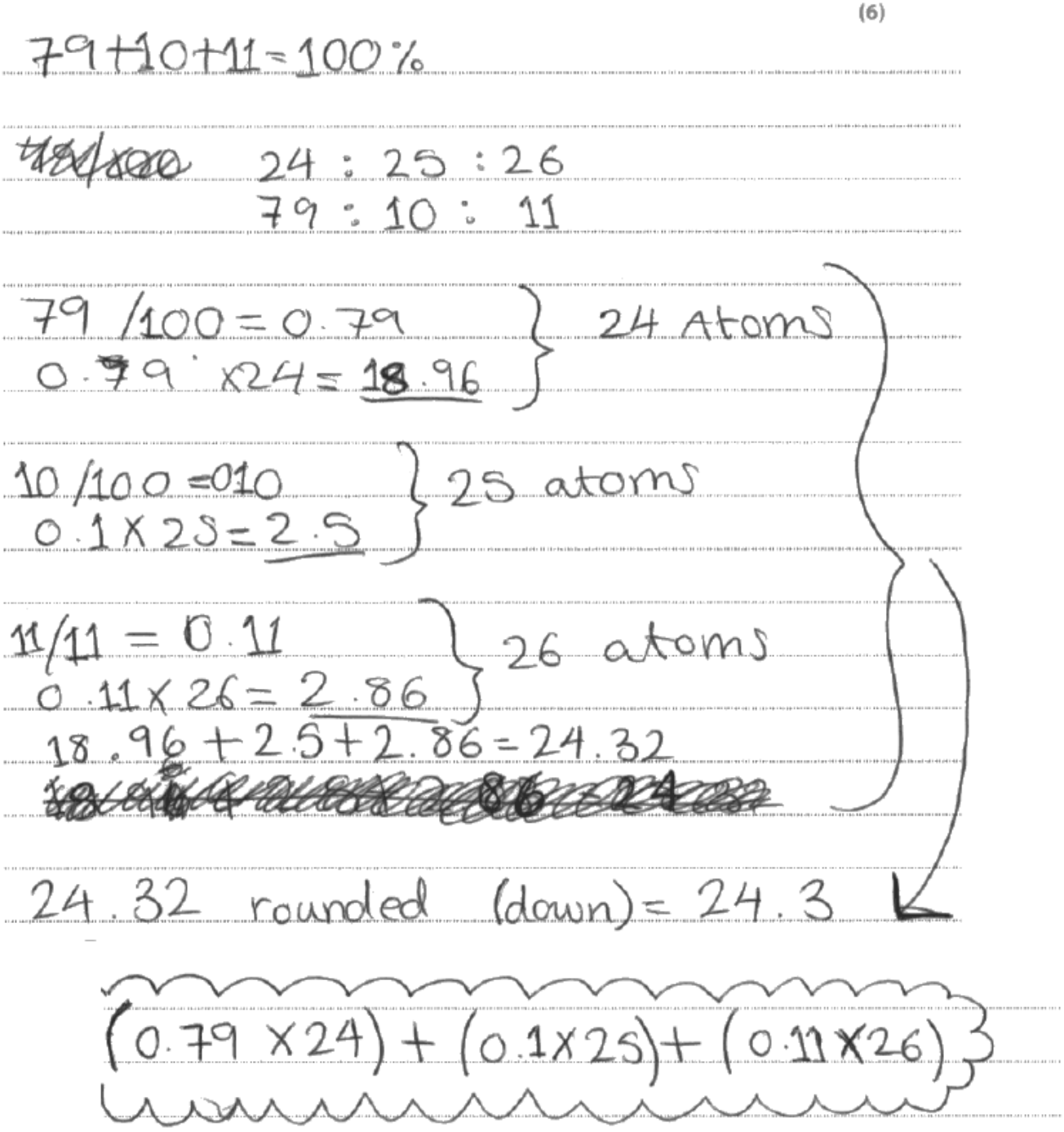
The original Magnesium atom has 2 different subatomic atoms that are added to it. So instead of making one 2 different Magnesium atoms standalone atoms. They Combined them once the original Magnesium atom and made 3 different categories. The main category that takes up 79% of magnesium, the 25 subatom that takes up 10% and then the 26 subatom that takes up 11% of Magnesium. Since these subatoms were not a large ~~big~~ enough percent and not strong enough, they combined it with the main magnesium atom to make all of them stronger and support on each other with combined atoms. Therefore because it has 2 different atoms inside it, it's classed as 2 + 3

**Results Plus: Examiner Comments**

There is nothing of substance within this answer that could be credited for this question. This scored 0 marks.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

(6)




**Results Plus: Examiner Comments**

This answer was all about carrying out a calculation of the relative atomic mass of magnesium using the information about the abundance of the 3 isotopes. Just this calculation alone was given level 2, 4 marks.

**Results Plus: Examiner Tip**

Calculations can also appear as part of an answer to an extended open response question.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

**(6)**

The ~~exact~~ relative atomic mass is usually 24 due to it being the average. To work ~~out~~ ~~what~~ it ~~you~~ out, you have to do the percent (eg 79%) & times by the relative atomic mass (eg 24) then divide by 100. The answer will give you 18.96. You then do the rest, (eg (10×25) ÷ 100 = 2.5 + (11×26) ÷ 100 = 2.86) and add it all together – 18.96 + 2.5 + 2.86 = 24.3

**Results Plus: Examiner Comments**

Although the first sentence is not quite correct, the candidate then went on to describe the calculation leading to the relative atomic mass. It is clear that the calculation was carried out as seen from the figures given and this answer was given level 2, 4 marks.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

**(6)**

Because the magnesium is made up of 3 isotopes of magnesium the and 2 have a relative atomic mass above 24 the relative atomic mass is above 24, so an average is made of the three. 24 + 25 + 26 = 75. Magnesium-24 = 79% so 75 × 0.79 = 59.25 ÷ 3 = 19.75.
Boron-25 = 10% so 75 × 0.10 = ~~11~~ 7.5 ÷ 3 = 2.5.
Boron-26 = 11% so 75 × 0.11 = 8.25 ÷ 3 = 2.75
19.75 + 2.5 + 2.75 = 24.3

**Results Plus: Examiner Comments**

This was an unusual response. The candidate had tried to perform a suitable calculation, but it was incorrect. For this type of answer, level 1, 2 marks was given.

Use this information to explain why, in this sample, magnesium has a relative atomic mass of 24.3.

(6)

Magnesium has a relative atomic mass of 24.3 because there is a higher percentage of magnesium 24 atoms that exist. The relative atomic mass is calculated not by just using the isotopes involved but also includes the percentage isotopes that exist. The reason why it is not just 24 is that 10% are 25 magnesium and 26 is 11% magnesium. This would bring up the total relative atomic mass because they are a higher number in the average and still account for some of the magnesium ions. Furthermore magnesium can exist in these states and on the whole is not only one state.

You can work out the relative atomic mass by

$\frac{24}{100} \times 79 = 18.96$

$\frac{25}{100} \times 10 = 2.5$

$\frac{26}{100} \times 11 = 2.86$

$18.96 + 2.5 + 2.86 =$

24.32

which would be rounded to

24.3

Collecting all ~~atoms~~ atoms

**Results Plus: Examiner Comments**

Overall, this was a very good answer and was seen quite often. The candidate here had carried out a correct calculation of the relative atomic mass and made a relevant comment about the justification of the calculation. This was a level 3 answer and given 6 marks.

Q8. No Examiner's Report available for this question

Q9.

***a***

The descriptions produced by candidates when answering this question were quite varied. A few were straightforward to mark, but the majority needed unpicking in order to award marks.

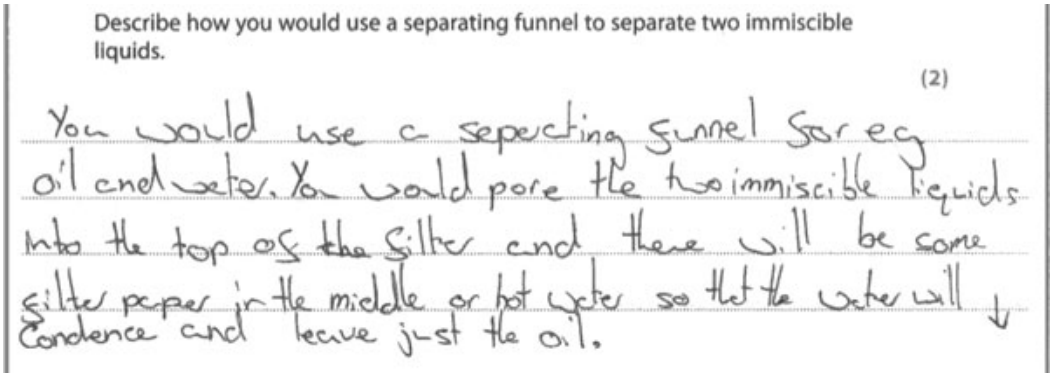
A significant number had no idea and many confused this type of separation with filtration. Although less than half of the candidates scored two marks, they were obtained largely by either allowing the layers to separate and operating the tap, or operating the tap and running out one layer.

Inversion of densities of oil and water was common and was ignored in this question, since no information about the densities of oil and water was provided.

This question attracted many misconceptions. Several candidates made reference to putting the oil and water into the separating funnel SEPARATELY (and then mixing and allowing to separate). Some described the lower layer being removed with the other liquid being left in the top half of the separating funnel (as if it had not moved). There were numerous, varied and inaccurate descriptions of the tap and its operation.

As mentioned, a significant number confused this separation with filtration. Some candidates wrote about using filter paper to allow water through but not oil (presumably being trapped by the filter paper). Some described the holes at the bottom could allow water to pass through but not oil as its molecules were too big.

Overall, almost two thirds of the candidates scored at least one mark on this question.



Describe how you would use a separating funnel to separate two immiscible liquids.

(2)

You would use a sepecting funnel for eg oil and water. You would pore the two immiscible liquids into the top of the filter and there will be some filter paper in the middle or hot water so that the water will ↓ condence and leave just the oil.

**Results Plus: Examiner Comments**

This answer was typical of those where confusion with the use of filter funnels occurred. Unfortunately there was nothing to credit here.

Describe how you would use a separating funnel to separate two immiscible liquids.

(2)

You would allow one of the immisicible liquids to pour out of the funnel ~~exactly~~ by releasing the screw until you get to the second liquid and screw back in so one liquid is out and the other is still in the funnel.

**Results Plus: Examiner Comments**

This was an answer that needed a little unpicking to find where credit could be awarded. For 'releasing the screw' we assumed that the candidate was referring to the tap and reading the whole answer showed that the candidate understood the use of the tap funnel. This answer was awarded two marks.

Describe how you would use a separating funnel to separate two immiscible liquids.

(2)

You would put one liquid in, then place another one on top. Once opened this would release one of the liquids, to separate it from the other.

**Results Plus: Examiner Comments**

This type of answer was seen quite often where the candidate had not fully understood the question. This answer had set up the two layers rather than the mixture separating out and it was not clear what was meant by 'Once opened', so this answer was given 0 marks.

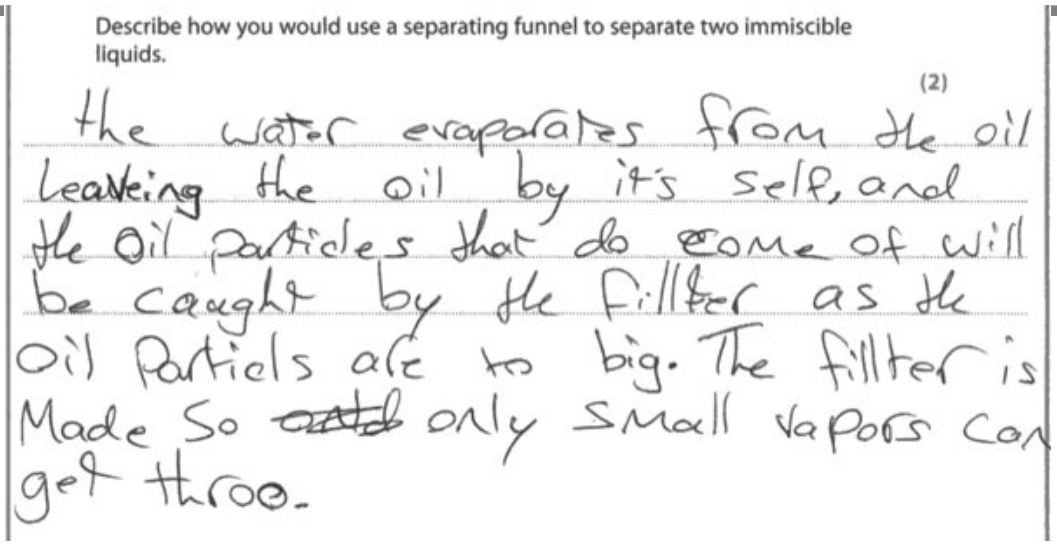
Describe how you would use a separating funnel to separate two immiscible liquids.

(2)

Because water floats on water, the oil will sit on top of the water. You would open the funnel and wait till the water is completly out of the funnel and you would be left with the oil.

**Results Plus: Examiner Comments**

This was a good answer where the candidate had indicated the formation of the two layers and the separation to give the two liquids.



Describe how you would use a separating funnel to separate two immiscible liquids.

(2)

the water evaporates from the oil leaving the oil by it's self, and the oil particles that do come of will be caught by the fillter as the oil Particls are to big. The fillter is Made So ~~oil~~ only small vapors can get throo.

**Results Plus: Examiner Comments**

This was another variation of a misconception often seen. It is clear that the candidate does not understand the workings of a separating funnel. This answer could not be given any credit.

**Results Plus: Examiner Tip**

Make sure the separation methods in the specification have been understood.

***(b)***

Two marks were scored by just over a third of the candidates: but chromatography, it seems, is not well-understood by a significant number. Descriptions of the interpretation varied widely and often showed little perception of what the dots actually represented. Many responses stated that the brown food colouring was made from two colours, so gaining one mark but didn't specify the actual colours.

Some responses stated there was more than one colour present which did not attract a mark, having made no reference to any specific colours. Some responses had brown as a component e.g. green, red and brown colouring present or brown colour in the brown colouring or two shades of brown.

A small number of candidates were a little side-tracked and started writing about solvents and solvent fronts, strength of colours and solubility of colours without following through on their argument.

Use the results of the chromatography experiment to describe the colours present in the brown food colouring.

(2)

In brown food colouring it is obvious that their is more than one colour as is shown in the chromatography experiment

**Results Plus: Examiner Comments**

Had this candidate given the actual number of colours or identified the colours, then marks could have been given. Stating '... more than one colour ...' without clarification attracted no marks.

Use the results of the chromatography experiment to describe the colours present in the brown food colouring.

(2)

The results shaw that the brown food colouring contain 2 colours. One is brown and the other maybe, yellow.

**Results Plus: Examiner Comments**

Although having correctly stated that two colours were present, this candidate gave the wrong colours, so no marks could be given.

***(c)***

The answers given to this question were quite varied. The more successful candidates started their answer by stating what would happen to the light bulb when each solution was tested and then went on to explain the observations. The examiners reported seeing very answers of this type. Quite a few candidates stated what happened to the light bulb in each case, but did not go on to account for the observations. A similar number gave the explanation correctly that the sodium chloride solution does conduct and the sucrose solution does not conduct but did not include how they knew this (i.e. whether the light bulb was glowing or not).

Common misconceptions included that the sucrose solution conducted, the correct observation about the bulb with the explanation that sodium chloride was covalent and the sucrose was ionic as well as the bulb not lighting because the sodium chloride was ionic. A significant number talked of delocalised electrons here when trying to explain conductivity; very few mentioned the presence of mobile ions. Some responses didn't refer to the specific solutions and gave a generic answer e.g. if it conducts the bulb will light, if it doesn't conduct it won't. Occasionally examiners saw answers of the type 'the sodium chloride lit the bulb brighter than sucrose' - a comparison of brightness so both were conducting. Some cited sodium chloride conducting electricity as it has a metal in it.

Explain what happens when each solution is tested in the circuit shown.

(3)

The sodium chloride will be found to not conduct electricity, This is due to it being an ionic compound. The sucrose will be found to conduct electricity, this is because Covalent compounds conduct electricity when molten or dissolved.

**Results Plus: Examiner Comments**

This candidate had confused the properties of ionic compounds with those of covalent, molecular compounds. Nothing was given in terms of observations and so this answer was given 0 marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

~~when the mixture is~~ when the two solutions are mixed and poured into the beaker if ~~the~~ they conduct electricity the circuit will be complete and the bulb will light up. ~~this~~

**Results Plus: Examiner Comments**

The question had asked for what happened when each solution was tested; so mixing the solutions does not score. Although the answer indicates that the bulb lights, it is not clear which component would cause the bulb to light up. So this answer could not be awarded any marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

As sodium chloride is tested, the bulb would illuminate yet as sucrose is tested the bulb would not.

**Results Plus: Examiner Comments**

Here the candidate had just given the observation and had not given an explanation of what happened. Only one mark could be given here.

**Results Plus: Examiner Tip**

Learn the characteristic properties of ionic and molecular, covalent compounds.

***(d)***

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.

Q10.

***a***

The descriptions produced by candidates when answering this question were quite varied. A few were straightforward to mark, but the majority needed unpicking in order to award marks.

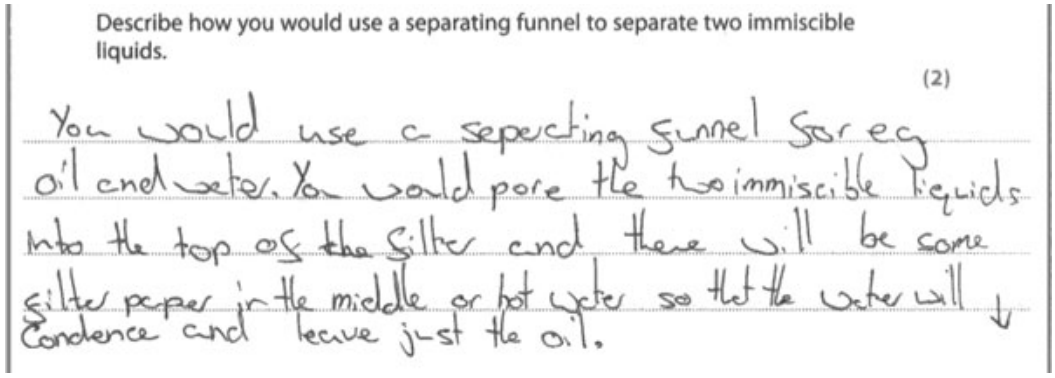
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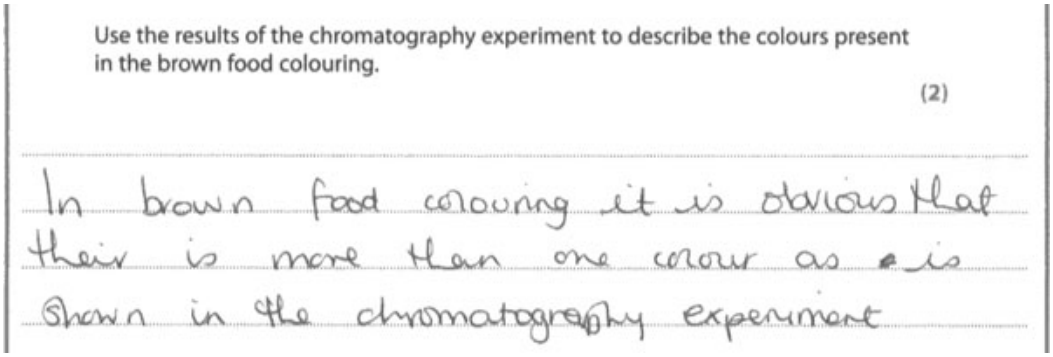
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A small number of candidates were a little side-tracked and started writing about solvents and solvent fronts, strength of colours and solubility of colours without following through on their argument.

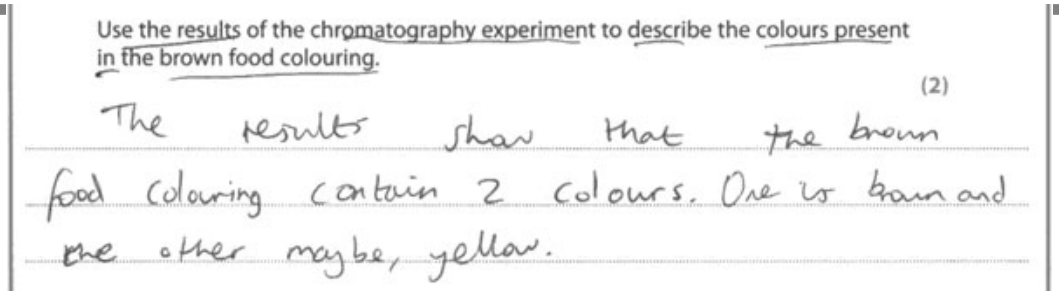

Use the results of the chromatography experiment to describe the colours present in the brown food colouring.

(2)

In brown food colouring it is obvious that their is more than one colour as is shown in the chromatography experiment

**Results Plus: Examiner Comments**

Had this candidate given the actual number of colours or identified the colours, then marks could have been given. Stating '... more than one colour ...' without clarification attracted no marks.


Use the results of the chromatography experiment to describe the colours present in the brown food colouring.

(2)

The results shaw that the brown food colouring contain 2 colours. One is brown and the other maybe, yellow.

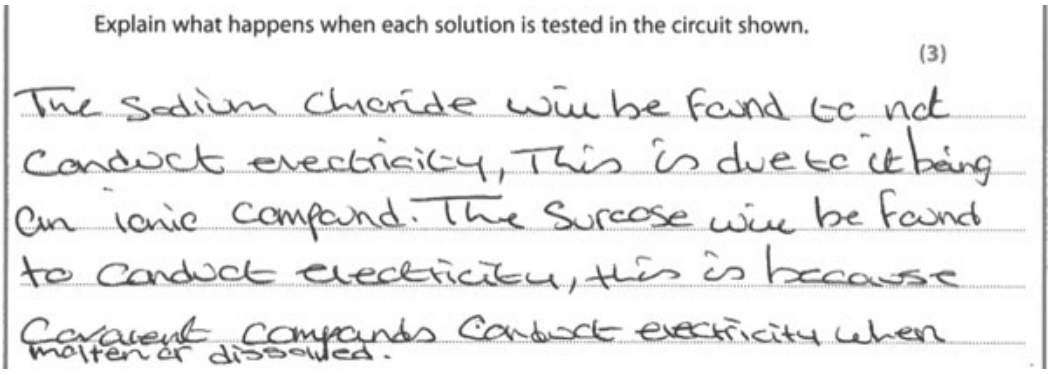
**Results Plus: Examiner Comments**

Although having correctly stated that two colours were present, this candidate gave the wrong colours, so no marks could be given.

***(c)***

The answers given to this question were quite varied. The more successful candidates started their answer by stating what would happen to the light bulb when each solution was tested and then went on to explain the observations. The examiners reported seeing very answers of this type. Quite a few candidates stated what happened to the light bulb in each case, but did not go on to account for the observations. A similar number gave the explanation correctly that the sodium chloride solution does conduct and the sucrose solution does not conduct but did not include how they knew this (i.e. whether the light bulb was glowing or not).

Common misconceptions included that the sucrose solution conducted, the correct observation about the bulb with the explanation that sodium chloride was covalent and the sucrose was ionic as well as the bulb not lighting because the sodium chloride was ionic. A significant number talked of delocalised electrons here when trying to explain conductivity; very few mentioned the presence of mobile ions. Some responses didn't refer to the specific solutions and gave a generic answer e.g. if it conducts the bulb will light, if it doesn't conduct it won't. Occasionally examiners saw answers of the type 'the sodium chloride lit the bulb brighter than sucrose' - a comparison of brightness so both were conducting. Some cited sodium chloride conducting electricity as it has a metal in it.

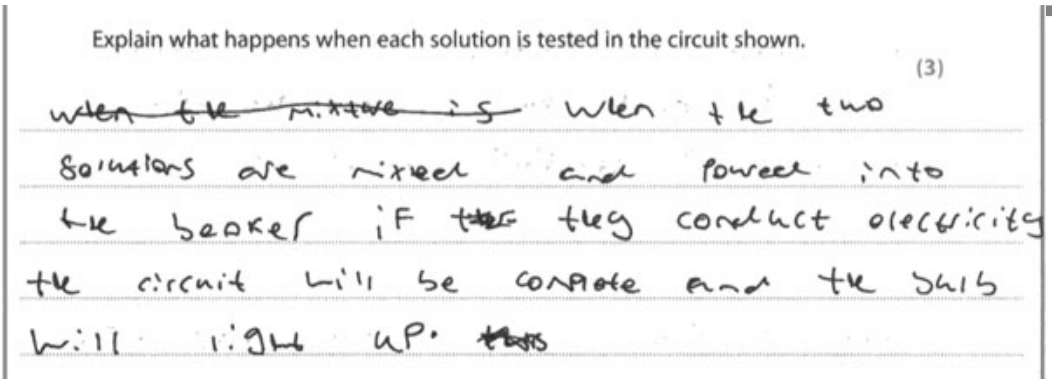

Explain what happens when each solution is tested in the circuit shown.

(3)

The sodium chloride will be found to not conduct electricity, This is due to it being an ionic compound. The Sucrose will be found to conduct electricity, this is because Covalent compounds Conduct electricity when molten or dissolved.

**Results Plus: Examiner Comments**

This candidate had confused the properties of ionic compounds with those of covalent, molecular compounds. Nothing was given in terms of observations and so this answer was given 0 marks.


Explain what happens when each solution is tested in the circuit shown.

(3)

~~when the mixture is~~ When the two solutions are mixed and poured into the beaker if they conduct electricity the circuit will be complete and the bulb will light up.

**Results Plus: Examiner Comments**

The question had asked for what happened when each solution was tested; so mixing the solutions does not score. Although the answer indicates that the bulb lights, it is not clear which component would cause the bulb to light up. So this answer could not be awarded any marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

As sodium chloride is tested, the bulb would illuminate yet as sucrose is tested the bulb would not.

**Results Plus: Examiner Comments**

Here the candidate had just given the observation and had not given an explanation of what happened. Only one mark could be given here.

**Results Plus: Examiner Tip**

Learn the characteristic properties of ionic and molecular, covalent compounds.

***(d)***

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.

Q11.

***(ii)***

Many candidates gave the expected answer of high melting point but others answered in terms of energy required to break bonds and many of these answers were correct. However some incorrectly made references to ionic or covalent or intermolecular bonds. A small minority of the candidates discussed a high boiling point while others effectively just repeated the question.

(ii) To join two pieces of metal by welding, they must be melted together.

State why a high temperature has to be used.

(1)

Because the strong bonds between the particles have to be broken first, and this can only be done at a high temperature as it provides enough energy to do so.

**Results Plus: Examiner Comments**

An acceptable way of answering the question worth the mark.

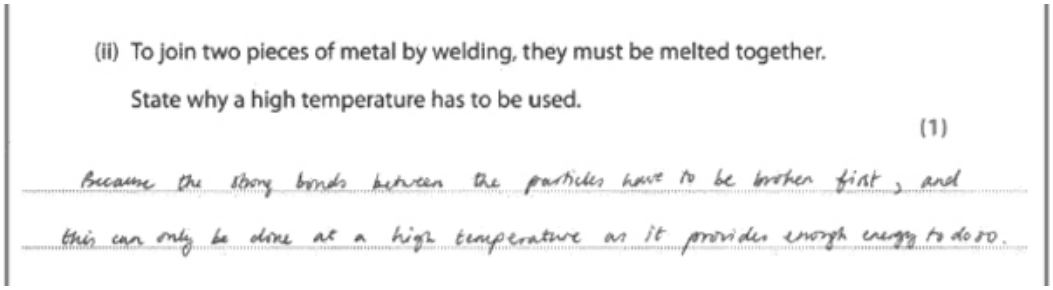
***(iii)***

Many candidates gained one mark by correctly stating that argon is inert or unreactive or a noble gas. Some candidates then went on to gain a second mark by explaining this idea using the idea of the full outer shell and some others explained that oxygen would react with the metal. However, a significant number of candidates did not gain a second mark as they answered in terms of argon not reacting with oxygen or not being flammable and a surprising number thought argon was a catalyst.

Q12.

***(ii)***

Many candidates gave the expected answer of high melting point but others answered in terms of energy required to break bonds and many of these answers were correct. However some incorrectly made references to ionic or covalent or intermolecular bonds. A small minority of the candidates discussed a high boiling point while others effectively just repeated the question.


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State why a high temperature has to be used.

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Because the strong bonds between the particles have to be broken first, and this can only be done at a high temperature as it provides enough energy to do so.

**Results Plus: Examiner Comments**

An acceptable way of answering the question worth the mark.

***(iii)***

Many candidates gained one mark by correctly stating that argon is inert or unreactive or a noble gas. Some candidates then went on to gain a second mark by explaining this idea using the idea of the full outer shell and some others explained that oxygen would react with the metal. However, a significant number of candidates did not gain a second mark as they answered in terms of argon not reacting with oxygen or not being flammable and a surprising number thought argon was a catalyst.

Q13. No Examiner's Report available for this question

Q14. No Examiner's Report available for this question

Q15. No Examiner's Report available for this question

Q16.

(i)

This was very poorly answered with exceptionally few candidates scoring the 1 mark available.

Candidates clearly struggled with this task requiring the writing the formula of a ionic compound, potassium sulfate, given the formulae of the constituent ions, $K^+$ and $SO_4^{2-}$ respectively.

The majority of incorrect responses simply stated, $KSO_4$, failing to understand the need for two potassium ions to balance the charge of the sulfate ion.

(ii)

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

The majority of candidates were able to calculate the mean value for the mass of potassium sulfate, namely 0.22g.

In the few cases where 1 mark only was scored, this was invariably for not correctly rounding the final answer to two decimal places or incorrectly rounding up, giving 5.23g.

(ii) Equal volumes of a solution of potassium carbonate were reacted separately with an excess of dilute sulfuric acid solution.
Pure dry samples of potassium sulfate were obtained from the resulting solutions.

The experiment was repeated three times using the same conditions.

The masses of potassium sulfate obtained were

experiment 1 = 5.22 g
experiment 2 = 5.24 g
experiment 3 = 5.21 g

Calculate the mean mass of potassium sulfate obtained, giving your answer to two decimal places.

(2)

5.22 + 5.24 + 5.21 ÷ 3 = 5.223 =
5.23

mean mass of potassium sulfate = 5.23 g

**Results Plus: Examiner Comments**

An example of a response scoring only 1 mark.

Although the calculation shown is correct, the final answer has been incorrectly rounded.

**Results Plus: Examiner Tip**

Rounding answers to a specified number of decimal places or significant figures is a required mathematical skill in the specification. Take care when the rounding of the final answer to calculation is a requirement for a particular question. This requirement will always be clearly stated in the question.

Q17.

This question proved quite difficult, the better answers clearly described the structure of the two atoms.Where candidates lost marks, it was often because they gave a generalized description of what an isotope was, rather than using the data given in the stem to calculate the number of subatomic particles.

Figure 4 shows the atomic number and mass number of two isotopes of argon.

| isotope | atomic number | mass number |
|---|---|---|
| argon-38 | 18 | 38 |
| argon-40 | 18 | 40 |

**Figure 4**

Describe the structure of an atom of argon-38 and of an atom of argon-40.

**(3)**

Argon - 38 has 18 protons, 18 electrons and 20 neutrons. where as argon - 40 has 18 protons, 18 electrons but this time has an additional two neutrons meaning it has 22 neutrons. So argon-40 has more neutrons than argon - 38

**Results Plus: Examiner Comments**

A correct answer that scored all three marks available.

Figure 4 shows the atomic number and mass number of two isotopes of argon.

| isotope | atomic number | mass number |
|---|---|---|
| argon-38 | 18 | 38 |
| argon-40 | 18 | 40 |

**Figure 4**

Describe the structure of an atom of argon-38 and of an atom of argon-40.

**(3)**

Argon$^{-38}$ has an electronic configuration of 2·8·8 and argon$^{-40}$ has an electronic configuration of 2·8·8 aswell. The mass number shows how many protons the atom has and in this case argon-40 has 2 more protons than argon-38.

**Results Plus: Examiner Comments**

Some candidates gave the electronic configuration of the atom rather than the number of electrons, this was accepted.

Q18.

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

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

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

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

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

(6)

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

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

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

**Results Plus: Examiner Comments**

There were some valid points but these were not really linked to make a coherent argument.

However, the answer linked diamond needing the most amount of energy to melt it and break those bonds with it containing 4 bonds per atom, so giving this some lines of reasoning. Also it noted that graphene conducts electricity without a real explanation. This was in between a 'good answer' (Level 3) and a weak answer (Level 1) with just enough to put this into Level 2, but as it was a weak Level 2, so given 3 marks.

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

**(6)**

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

Graphene has a simple covalent bond structure, graphene has a low Melting Point, Graphene it's not very strong, graphene it's able to conduct electricity

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

**Results Plus: Examiner Comments**

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

Q19. No Examiner's Report available for this question

Q20.

The responses to this question seemed to achieve either full marks or nothing in general. Candidates who understood what the question was asking explained very clearly about heating to a constant mass to ensure that the reaction was complete. Others suggested looking for things that they would not be able to see – for example, carbon dioxide being released or looking to see if all of the zinc carbonate had gone.

There was also some misunderstanding in the reading of the question for a number of candidates, in that they interpreted the term 'complete' to mean that the reaction had happened at all rather than that the reaction had finished.

Q21.

**(i)**

Candidates could recall the test for hydrogen more easily than the earlier test for carbon dioxide. However, some did still leave out the method of the test.

Candidates should be taught that in every test, two components are required: what you do and what you observe for a positive result. Some did not say that they splint had to be lit or that it was glowing and so gained no credit.

In some cases, candidates simply stated the 'squeaky pop test' this was not sufficient for marks and did not gain credit.

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

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

**(2)**

Squeaky pop with a lit splint.

**Results Plus: Examiner Comments**

A correct response which gained both marks.

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

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

**(2)**

When there is hyarogen, when let off in air there will be a loud squeaky pop due to it reacting with the elements in the air.

**Results Plus: Examiner Comments**

A fair few stated that a pop would spontaneously be heard, e.g. after taking the bung out the test tube.

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

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

**(2)**

place a metal & acid in a closed flask using a tube at the top to ~~,~~ hold produced hydrogen. Simmular to simple distilation

**Results Plus: Examiner Comments**

In some cases, candidates described how to produce the hydrogen, by reacting an acid and a metal, rather than stating the test for the hydrogen.

**(ii)**

Candidates found this part quite difficult with few scoring the full two marks available.

A common misconception seen was where candidates knew that two electrons were involved in the transfer but thought that the electrons were gained rather than lost. In these cases, one mark was awarded for showing an understanding that two electrons were involved.

In other cases, candidates knew that the ion has lost electrons but did not mention how many and so did not gain the second mark.

(ii) Nickel is a metal.

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

**(2)**

The nickel atom loses two electrons when it creates a nickel ion ~~or~~ therefore it becomes positive.

**Results Plus: Examiner Comments**

A good answer that scored 2 marks.

(ii) Nickel is a metal.

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

**(2)**

gains 2 electrons so it has full outer shells. ~~So therefore~~

**Results Plus: Examiner Comments**

In this example. one mark was awarded for showing an understanding that two electrons were involved.

(ii) Nickel is a metal.

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

**(2)**

The structure of a nickel atom changes when it forms a nickel ion is, the nickel ion has ~~lots~~ lost an electron so it has become positive.

**Results Plus: Examiner Comments**

This candidate knew that the ion has lost electrons but did not mention how many and so gained just 1 mark.

Q22.

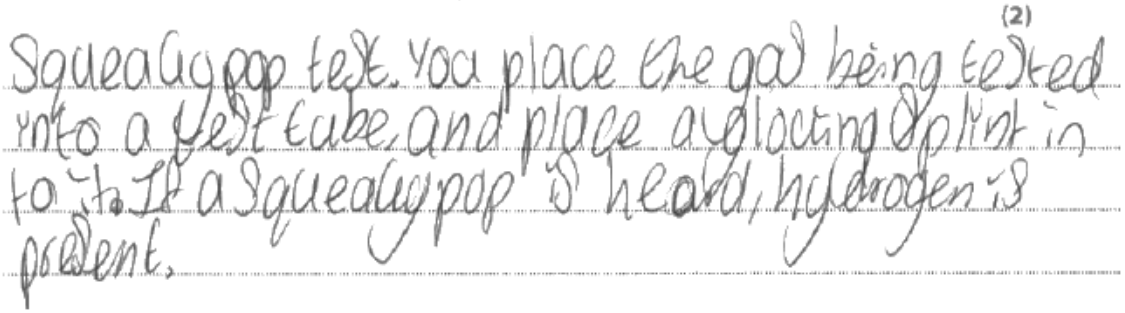
**(i)**

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

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

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

**(2)**




**Results Plus: Examiner Comments**

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

**Results Plus: Examiner Tip**

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

(a) how to carry out the test

(b) the positive result of the test

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

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

**(2)**

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

**Results Plus: Examiner Comments**

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

**Results Plus: Examiner Tip**

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

**(ii)**

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

(ii) Nickel is a metal.

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

**(2)**

It gains 2 positive electrons on the outer shell making it 2,8,8,14

**Results Plus: Examiner Comments**

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

**Results Plus: Examiner Tip**

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

(ii) Nickel is a metal.

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

(2)

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

**Results Plus: Examiner Comments**

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

Q23.

The answers given to this question were quite varied. The more successful candidates started their answer by stating what would happen to the light bulb when each solution was tested and then went on to explain the observations. The examiners reported seeing very answers of this type. Quite a few candidates stated what happened to the light bulb in each case, but did not go on to account for the observations. A similar number gave the explanation correctly that the sodium chloride solution does conduct and the sucrose solution does not conduct but did not include how they knew this (i.e. whether the light bulb was glowing or not).

Common misconceptions included that the sucrose solution conducted, the correct observation about the bulb with the explanation that sodium chloride was covalent and the sucrose was ionic as well as the bulb not lighting because the sodium chloride was ionic. A significant number talked of delocalised electrons here when trying to explain conductivity; very few mentioned the presence of mobile ions. Some responses didn't refer to the specific solutions and gave a generic answer e.g. if it conducts the bulb will light, if it doesn't conduct it won't. Occasionally examiners saw answers of the type 'the sodium chloride lit the bulb brighter than sucrose' - a comparison of brightness so both were conducting. Some cited sodium chloride conducting electricity as it has a metal in it.

Explain what happens when each solution is tested in the circuit shown.

(3)

The sodium chloride will be found to not conduct electricity, This is due to it being an ionic compound. The sucrose will be found to conduct electricity, this is because Covalent compounds conduct electricity when molten or dissolved.

**Results Plus: Examiner Comments**

This candidate had confused the properties of ionic compounds with those of covalent, molecular compounds. Nothing was given in terms of observations and so this answer was given 0 marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

~~when the mixture is~~ when the two solutions are mixed and poured into the beaker if ~~the~~ they conduct electricity the circuit will be complete and the bulb will light up. ~~this~~

**Results Plus: Examiner Comments**

The question had asked for what happened when each solution was tested; so mixing the solutions does not score. Although the answer indicates that the bulb lights, it is not clear which component would cause the bulb to light up. So this answer could not be awarded any marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

As sodium chloride is tested, the bulb would illuminate yet as sucrose is tested the bulb would not.

**Results Plus: Examiner Comments**

Here the candidate had just given the observation and had not given an explanation of what happened. Only one mark could be given here.

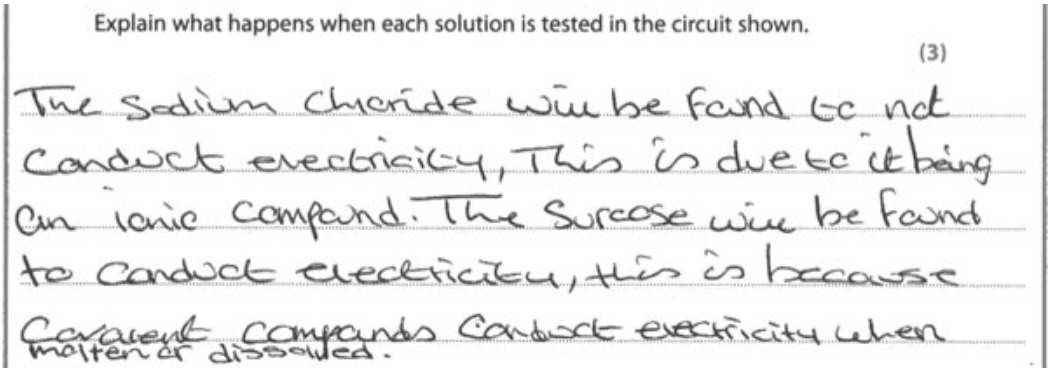
**Results Plus: Examiner Tip**

Learn the characteristic properties of ionic and molecular, covalent compounds.

Q24.

The answers given to this question were quite varied. The more successful candidates started their answer by stating what would happen to the light bulb when each solution was tested and then went on to explain the observations. The examiners reported seeing very answers of this type. Quite a few candidates stated what happened to the light bulb in each case, but did not go on to account for the observations. A similar number gave the explanation correctly that the sodium chloride solution does conduct and the sucrose solution does not conduct but did not include how they knew this (i.e. whether the light bulb was glowing or not).

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**Results Plus: Examiner Comments**

This candidate had confused the properties of ionic compounds with those of covalent, molecular compounds. Nothing was given in terms of observations and so this answer was given 0 marks.

Explain what happens when each solution is tested in the circuit shown.

(3)

when the mixture is when the two solutions are mixed and poured into the beaker if they conduct electricity the circuit will be complete and the bulb will light up.

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Explain what happens when each solution is tested in the circuit shown.

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**Results Plus: Examiner Comments**

Here the candidate had just given the observation and had not given an explanation of what happened. Only one mark could be given here.

**Results Plus: Examiner Tip**

Learn the characteristic properties of ionic and molecular, covalent compounds.

Q25. No Examiner's Report available for this question

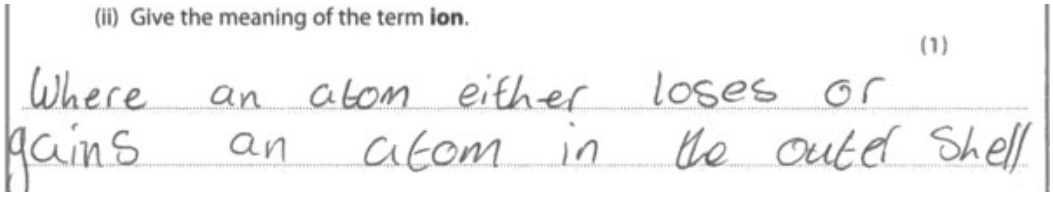
Q26.

***(i)***

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

***(ii)***

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

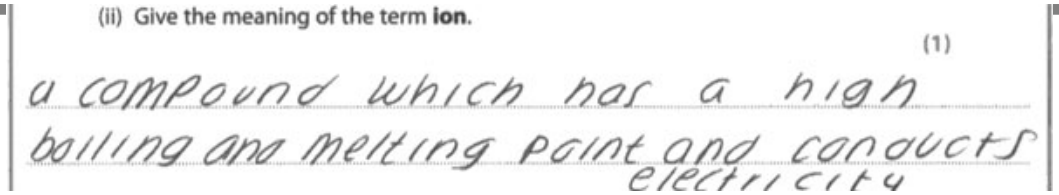

(ii) Give the meaning of the term **ion**.

(1)

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

**Results Plus: Examiner Comments**

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

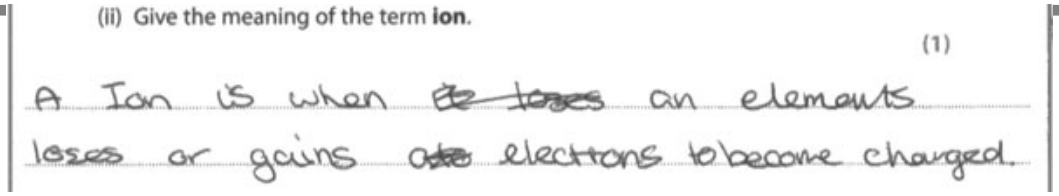

(ii) Give the meaning of the term **ion**.

(1)

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

**Results Plus: Examiner Comments**

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


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

(1)

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

**Results Plus: Examiner Comments**

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

**Results Plus: Examiner Tip**

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

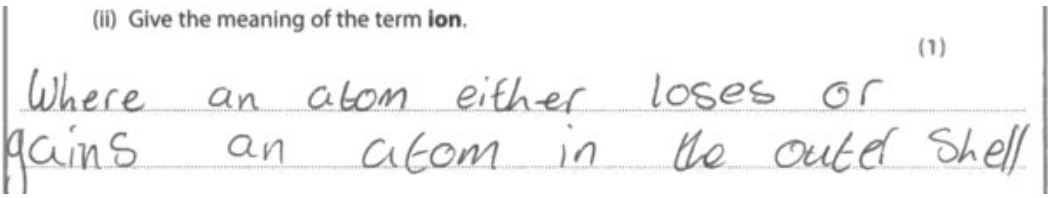
Q27.

***(i)***

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***(ii)***

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

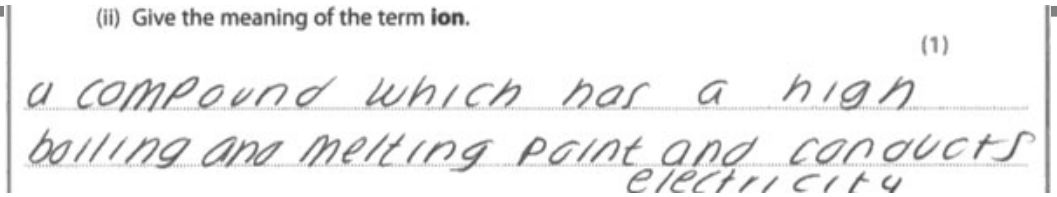

(ii) Give the meaning of the term **ion**.

(1)

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

**Results Plus: Examiner Comments**

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


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

(1)

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

**Results Plus: Examiner Comments**

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

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

(1)

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

**Results Plus: Examiner Comments**

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

**Results Plus: Examiner Tip**

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

Q28. No Examiner's Report available for this question

Q29. No Examiner's Report available for this question

Q30. No Examiner's Report available for this question

Q31.

It was very pleasing to see so many good responses with nearly half of the candidates reaching Level 2. The basic structure of the periodic table was generally well known with many correctly identifying and naming some groups. There was however a lot of confusion evident from weaker candidates with groups being described as being rows, and the stepped line on the diagram was sometimes thought to be separating solids and liquids or gases.

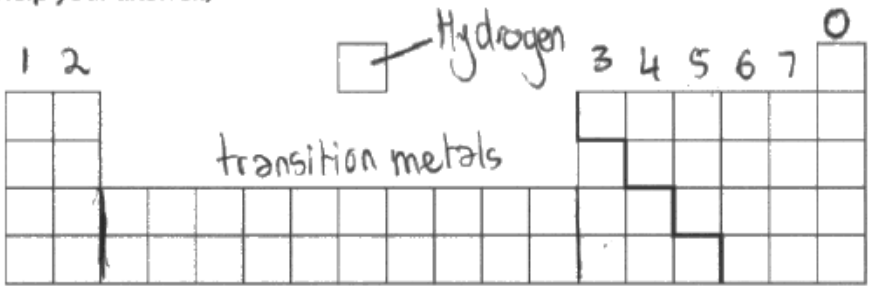
Good information about the atomic structure and chemical properties aspects was much less common than information about parts of the periodic table. The increasing reactivity down group 1 and the inertness of the noble gases were the most frequently mentioned points about chemical properties. A number of candidates failed to gain much credit as they mainly wrote about Mendeleev and the history of the periodic table. Only the best candidates described the elements as being arranged in order of increasing atomic number and the link between the period number and the number of shells.

*(d) Here is some information about the periodic table.

In the periodic table elements are arranged in rows and columns.
The position of an element in the periodic table depends on its atomic structure.
Elements with similar chemical properties are found in the same parts of the periodic table.

Identify different parts of the periodic table and explain how the position of an element in the periodic table is linked to its chemical properties and atomic structure.

(You are provided with an outline of the periodic table below and you may use this to help your answer.)




8-3=5

(6)

On the left hand side of the periodic table the it is all metals & on the right hand side it is gases, now in group elements in Group 1 all contain 1 electron in there outer shell, furthermore also Group 1 elements are called alkali metals, so as you go down the group the more reactive soft they are. In Group 2, elements have 2 electrons there outer shell. In Group 3 they all contain 3 electrons in there outer shell, Group 4 have 4 electrons in there outer shells. Group 5 contain 5 electrons in the outer shell, as well as Group 6 have 6 electrons in there outer shells. In Group 7, the elements are called Halogens, and as you go down the group the reactivity decreases as well as the softness, furthermore they have 7 electrons in there outer shell. In Group 0 the elements are called Noble Gases, and they are inert which means that they have a full outer shell, which means the atoms are stable compared to the others.

**Results Plus: Examiner Comments**

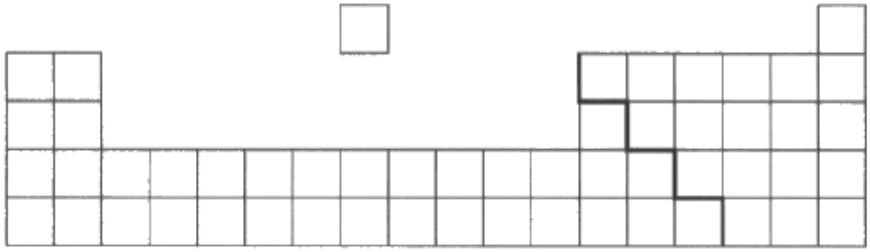
There is a lot of correct information in this answer with reference to different parts of the periodic table, including on the diagram. Also the link between the position of an element in a group and its electronic configuration was very well made as was a link to trends in chemical reactivity. Hence the candidate was awarded a Level 3 and 6 marks.

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(You are provided with an outline of the periodic table below and you may use this to help your answer.)



(6)

Group 7 of the periodic table contains the halogens, for example, iodine and bromine.
The vertical columns are known as groups, and the horizontal rows are known as periods.
The elements included in the periodic table are ordered by atomic number.
The metals are placed to the left of the periodic table.

**Results Plus: Examiner Comments**

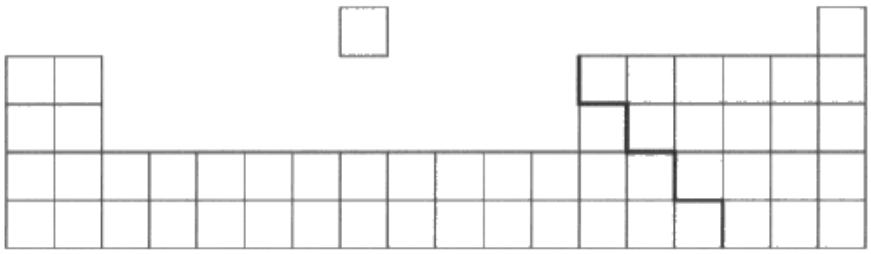
This answer contains references to several parts of the periodic table but in addition only one other relevant aspect i.e. elements ordered by atomic number. It was worthy of Level 2 and awarded 4 marks.

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(6)

The numbers on the side of periodic table tells us how many ~~shells~~ electrons each element has. ~~The numbers on the top of the periodic table show us how many~~ the outer shell. The group numbers on the top of the periodic table show us how many shells each element has.

Between group 2 and 3, the periodic table shows us the transition metals, giving us an insight into how they relate to each other when it comes to chemical properties.

From group 7, the periodic table shows the non metals, ~~go~~ giving people the ability to compare the non-metals to the metals and the different properties.

This is also the case for the gases, which are found from group 1 to just over group 2. This also allows us to compare different properties to the metals and non-metals.

**Results Plus: Examiner Comments**

This candidate correctly identified the position of transition metals but unfortunately mixed up groups and periods. The identification of non-metals as only group 7 is not totally correct.

It was awarded Level 1 and 2 marks.

Q32.

It was very pleasing to see so many good responses with nearly half of the candidates reaching Level 2. The basic structure of the periodic table was generally well known with many correctly identifying and naming some groups. There was however a lot of confusion evident from weaker candidates with groups being described as being rows, and the stepped line on the diagram was sometimes thought to be separating solids and liquids or gases.

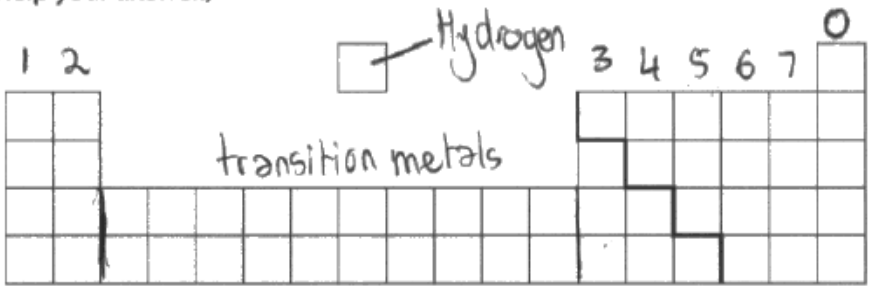
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**Results Plus: Examiner Comments**

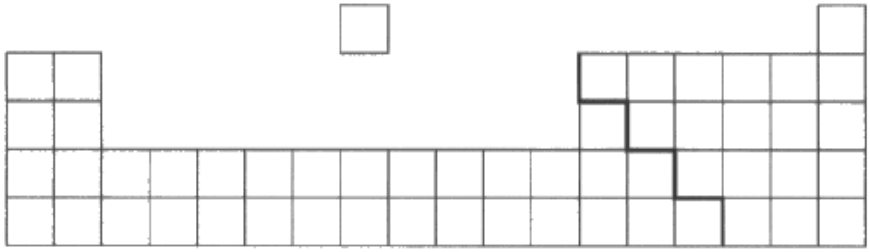
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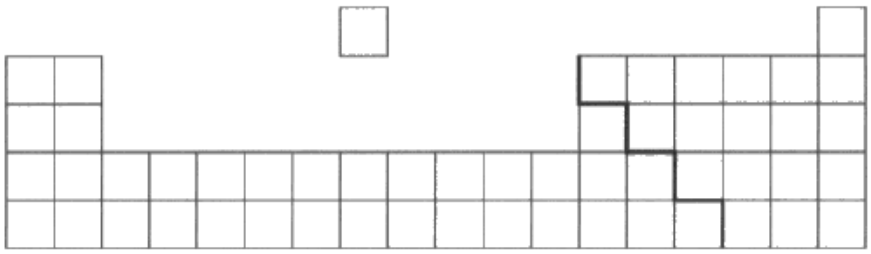
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**Results Plus: Examiner Comments**

This candidate correctly identified the position of transition metals but unfortunately mixed up groups and periods. The identification of non-metals as only group 7 is not totally correct.

It was awarded Level 1 and 2 marks.

## Mark Scheme

Q1.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | B elements | | **(1)** |

Q2.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | B elements | | **(1)** |

Q3.

| Question number | Answer | Mark |
|---|---|---|
| (i) | • atomic number is 16 because 16 protons (1)<br>• mass number is 32 because 16 protons and 16 neutrons (1) | (2) |

| Question number | Answer | Mark |
|---|---|---|
| (ii) | 2.8.6 | (1) |

Q4.

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

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

Q5.

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

Q6.

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

Q7.

| Question number | Answer | Mark |
|---|---|---|
| * | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>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.<br><br>**AO2 (6 marks)**<br><br>**relative atomic mass of magnesium is 24.3** (and not 24) **due to**<br>• the existence of more than one isotope<br>• accurate relative mass is calculated using weighted mean<br>• magnesium-25 and magnesium-26 are both heavier isotopes than magnesium-24<br>• magnesium-24 has highest percentage<br>• (therefore) the relative atomic mass is closer to 24 than 25 or 26<br><br>**calculation of relative atomic mass**<br>• consider 100 atom sample<br>• in the given sample 79 atoms have a mass of 24<br>• in the given sample 10 atoms have a mass of 25<br>• in the given sample 11 atoms have a mass of 26<br>• calculate total mass of 100 atoms<br>• divide by 100 to find relative atomic mass<br>OR<br>• fraction of magnesium-24 = 79/100<br>• fraction of magnesium-25 = 10/100<br>• fraction of magnesium-26 = 11/100<br>• relative atomic mass<br>= (79/100 x 24) + (10/100 x 25) + (11/100 x 26)<br>= 18.96 + 2.5 + 2.86<br>= 24.3 | **(6)**<br><br>**EXP** |

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

Q8.

| Question Number | Answer | Mark |
|---|---|---|
| | **B** lighter because silver atoms are lighter than gold atoms | **(1)** |

Q9.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)** | A description to include two from<br>• allow layers to {form / separate} / liquids to separate(1)<br>• operate tap / OWTTE(1)<br>• run out one layer / OWTTE(1)<br>• pour remaining upper layer from top / run out second layer(1) | ignore inverted oil/water layers<br>discard interface | **(2)** |
| **(b)** | A description to include<br>• green (1)<br>• (and) red (1) | {combination of / mixture of / two} colours (1)<br>note: if all three colours mentioned (1) | **(2)** |
| **(c)** | An explanation to include three from<br>• {sodium chloride / ionic compound} – bulb lights / {sucrose / covalent compound} – bulb does not light up (1)<br>• sodium chloride (solution) {conducts / ions present} (1)<br>• sucrose (solution) {does not conduct / no ions present (1) | ignore references to electrolytic processes<br>circuit will work (in place of bulb lights) / ORA | **(3)** |
| **(d)** | 2x1 + 16 (=18) | | **(1)** |

Q10.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)** | A description to include two from | | |

| | | | |
|---|---|---|---|
| | • allow layers to {form / separate} / liquids to separate(1)<br>• operate tap / OWTTE(1)<br>• run out one layer / OWTTE(1)<br>• pour remaining upper layer from top / run out second layer(1) | ignore inverted oil/water layers<br><br><br><br>discard interface | **(2)** |
| **(b)** | A description to include<br><br>• green (1)<br>• (and) red (1) | {combination of / mixture of / two} colours (1)<br>note: if all three colours mentioned (1) | **(2)** |
| **(c)** | An explanation to include three from<br><br>• {sodium chloride / ionic compound} – bulb lights / {sucrose / covalent compound} – bulb does not light up (1)<br><br>• sodium chloride (solution) {conducts / ions present} (1)<br><br>• sucrose (solution) {does not conduct / no ions present (1) | <br><br>ignore references to electrolytic processes<br><br>circuit will work (in place of bulb lights) / ORA | **(3)** |
| **(d)** | 2x1 + 16 (=18) | | **(1)** |

Q11.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(i)** | C cations in a sea of electrons | | **(1)** |
| **(ii)** | (metals have) high melting <u>point</u> | <br><br>a lot of energy needed to break/overcome (metallic) bonds<br><br>energy needed to break/overcome strong (metallic) bonds<br><br>Ignore references to boiling point<br>Reject reference to intermolecular forces/covalent (bonds) /attraction between ions/breaking ionic bonds/ breaking covalent bonds | **(1)** |
| **(iii)** | An explanation including two of the following points | | |

| | | | |
|---|---|---|---|
| | • argon is inert/does not react/is unreactive (1)<br><br>• because it has 8 electrons in its outer shell (1)<br><br>• metals would react in/with air/oxygen (1)<br><br>• argon will exclude air from welding point (1) | Ignore argon is in group 0/8 argon is a noble gas<br>Ignore argon does not burn<br><br>does not {gain/lose/share} electrons<br><br>has a full outer shell (of electrons)<br><br>has a stable electron configuration<br><br>form (metal) oxide<br><br>prevents oxidation | **(2)** |

Q12.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(i)** | C cations in a sea of electrons | | **(1)** |
| **(ii)** | (metals have) high melting <u>point</u> | a lot of energy needed to break/overcome (metallic) bonds<br><br>energy needed to break/overcome strong (metallic) bonds<br><br>Ignore references to boiling point<br>Reject reference to intermolecular forces/covalent (bonds) /attraction between ions/breaking ionic bonds/ breaking covalent bonds | **(1)** |
| **(iii)** | An explanation including two of the following points<br><br>• argon is inert/does not react/is unreactive (1)<br><br>• because it has 8 electrons in its outer shell (1) | Ignore argon is in group 0/8 argon is a noble gas<br>Ignore argon does not burn<br><br>does not {gain/lose/share} electrons<br><br>has a full outer shell (of electrons) | **(2)** |

| | | | |
|---|---|---|---|
| | • metals would react in/with air/oxygen (1)<br>• argon will exclude air from welding point (1) | has a stable electron configuration<br>form (metal) oxide<br>prevents oxidation | |

Q13.

| Question Number | Answer | Mark |
|---|---|---|
| | An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (2 marks):<br>• weak, intermolecular forces (1)<br>**AND**<br>**EITHER**<br>• molecules have enough energy (at room temperature) (1)<br>• overcome these forces (1)<br>**OR**<br>• forces are not strong enough (1)<br>• to hold molecules together in lattice/solid (at room temperature) (1) | **(3)** |

Q14.

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

Q15.

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

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

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

Q16.

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (i) | $K_2SO_4$ | allow $SO_4K_2$<br>allow $(K^+)_2SO_4^{2-}$<br>(both charges needed & allow in reverse)<br>reject incorrect subscript and superscripts<br>(both charges needed & allow in reverse)<br>reject incorrect subscript and superscripts | (1) |
| (ii) | 5.22 with or without working scores 2<br><br>$\frac{5.22 + 5.24 + 5.21}{3}$ (= 5.2233) (1)<br>= 5.22 (1) | 5.22 + 5.24 + 5.21 = 15.67 (MP1 does not score)<br>allow 15.67 (1) (*ie* not divided by 3 but MP2 scores as answer to 2dp) | (2) |

Q17.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| | A description to include<br><br>• both have 18 electrons/2.8.8 (in shells /orbits) (1)<br><br>• both have 18 protons (in the nucleus) (1)<br><br>• argon-38 has 20 neutrons AND argon-40 has 22 neutrons (in the nucleus) (1) | allow argon 40 has **two** more neutrons than argon 38 / ORA<br><br>ignore generic definition of an isotope | **(3)**<br><br>AO 3 1a<br>AO 3 1b |

Q18.

| Question Number | Indicative content | Mark |
|---|---|---|
| * | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>• in all structures the carbon atoms bonded by single covalent bonds<br>• shared pair of electrons<br>• strong bonds<br><br>• in diamond each carbon atom joined to four others<br>• diamond has a giant covalent {structure/lattice}<br>• graphene has a giant covalent {structure/lattice}<br>• fullerene has a molecular structure<br>• in graphene and fullerene each carbon atom joined to three others<br>• in diamond and graphene many bonds need to be broken to melt<br>• need lots of energy<br>• therefore very high melting / sublimation points<br><br>• in fullerene weak forces between molecules<br>• less energy needed to separate molecules<br>• fullerene has the lowest melting / sublimation point<br>• because diamond and graphene have lots of strong covalent bonds so both are very strong materials<br>• because weak forces between fullerene molecules so its strength is very low<br><br>• in diamond there are no free electrons<br>• so diamond does not conduct<br><br>• in graphene and fullerene each carbon atom has one free electron<br>• hence delocalised electrons<br>• graphene conducts electricity<br><br>• fullerene only conducts electricity across the surface of the molecule<br>• no/little movement of electrons between molecules<br>• so fullerene is poor conductor of electricity ( / semi conductor) | **(6)**<br><br>AO 1 1 |

| Level | Mark | Descriptor |
|---|---|---|
| | 0 | No rewardable material. |
| Level 1 | 1–2 | • Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas, enquiry, techniques and procedures lacks detail. (AO1)<br>• Presents an explanation with some structure and coherence. (AO1) |
| Level 2 | 3–4 | • Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and fully devolved. (AO1)<br>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1) |
| Level 3 | 5–6 | • Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully devolved. (AO1)<br>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1) |

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Q19.

| Question number | Answer | Mark |
|---|---|---|
| | particle **A** proton<br>particle **B** neutron<br>particle **C** electron<br><br>all three correct 2 marks<br>one or two correct 1 mark | **(2)** |

Q20.

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| | • heat remaining solid/ heat it for longer / heat it again (1)<br>• and determine mass (1)<br>• repeat until mass after heating stays the same (1) | allow heat to a constant mass (3)<br><br>allow<br>remove sample (1)<br>add acid (1)<br>no fizz (1) | **(3)**<br>**AO3** |

Q21.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (i) | A description including<br><br>• apply lighted splint (1)<br><br>• (squeaky) pop (1) | <br><br>allow flame / ignite gas / fire<br><br>ignore 'squeaky pop test' / glowing splint<br><br>second mark is dependent on first | (2)<br><br>AO 1 1 |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (ii) | An explanation linking<br><br>• loss of electron(s) (1)<br><br>• two electrons (1) | <br><br>allow gains two electrons for 1 mark<br><br>zero marks overall if sharing of electrons / gain or loss of protons / positive electrons<br><br>marks can be awarded for suitably drawn diagram / half equation | (2)<br><br>AO 1 1 |

Q22.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (i) | A description including<br><br>• apply lighted splint (1)<br><br>• (squeaky) pop (1) | <br><br>allow flame / ignite gas / fire<br><br>ignore 'squeaky pop test' / glowing splint<br><br>second mark is dependent on first | (2)<br><br>AO 2 2 |

| Question Number | Answer | | Mark |
|---|---|---|---|
| (ii) | An explanation linking<br><br>• loss of electron(s) (1)<br><br>• two electrons (1) | allow gains two electrons for 1 mark<br><br>zero marks overall if sharing of electrons / gain or loss of protons / positive electrons<br><br>marks can be awarded for suitably drawn diagram / half equation | (2)<br><br>AO 1 1 |

Q23.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | An explanation to include three from<br><br>• {sodium chloride / ionic compound} – bulb lights / {sucrose / covalent compound} – bulb does not light up (1)<br><br>• sodium chloride (solution) {conducts / ions present} (1)<br><br>• sucrose (solution) {does not conduct / no ions present (1) | ignore references to electrolytic processes<br><br>circuit will work (in place of bulb lights) / ORA | (3) |

Q24.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | An explanation to include three from<br><br>• {sodium chloride / ionic compound} – bulb lights / {sucrose / covalent compound} – bulb does not light up (1)<br><br>• sodium chloride (solution) | ignore references to electrolytic processes<br><br>circuit will work (in place of bulb lights) / ORA | (3) |

| | | | |
|---|---|---|---|
| | {conducts / ions present} (1)<br><br>• sucrose (solution) {does not conduct / no ions present (1) | | |

Q25.

| Question Number | Answer | Mark |
|---|---|---|
| | **B** 2.8.8.2 (1) | **(1)** |

Q26.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(i)** | $BaSO_4$ | $SO_4Ba$<br>ignore charges unless incorrect | **(1)** |
| **(ii)** | charged particle | charged atom / {particle/atom(s)} that has gained or lost electrons<br>ignore any stated charges | **(1)** |

Q27.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(i)** | $BaSO_4$ | $SO_4Ba$<br>ignore charges unless incorrect | **(1)** |
| **(ii)** | charged particle | charged atom / {particle/atom(s)} that has gained or lost electrons<br>ignore any stated charges | **(1)** |

Q28.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(i)** | • group 5 (1)<br>• period 2 (1) | | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(ii)** | reversible (reaction) | allow (reaction that may reach) equilibrium | **(1)** |

Q29.

| Question number | Answer | Mark |
|---|---|---|
| **(i)** | (formula showing) simplest ratio of atoms (of each element in a substance) | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(ii)** | no. S atoms : no. F atoms<br>$= \frac{4.8}{32}$ (0.15) : $\frac{17.1}{19}$ (0.9) (1)<br><br>$= \frac{0.15}{0.15}$ (1) : $\frac{0.9}{0.15}$ (6) (1)<br><br>empirical formula $SF_6$ (1) | correct formula with no working scores 1 | **(3)** |

Q30.

| Question number | Answer | Mark |
|---|---|---|
| **(i)** | (formula showing) simplest ratio of atoms (of each element in a substance) | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (ii) | no. S atoms : no. F atoms<br>$= \frac{4.8}{32}$ (0.15) : $\frac{17.1}{19}$ (0.9) (1)<br><br>$= \frac{0.15}{0.15}$ (1) : $\frac{0.9}{0.15}$ (6) (1)<br><br>empirical formula $SF_6$ (1) | correct formula with no working scores 1 | (3) |

Q31.

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | * | A description and explanation including some of the following points<br><br>**CREDIT CAN BE GIVEN FOR LABELS/ANNOTATIONS ON DIAGRAM**<br><br>**Parts of the periodic table**<br>• periods<br>• (periods) are (horizontal) rows<br>• groups<br>• (groups) are (vertical) columns<br>• group 1 are alkali metals<br>• group 7 are halogens<br>• group 0 are noble gases<br>• transition elements in the middle of the table<br>• metals on the left (and centre)<br>• non-metals on the right<br><br>**Position of element/Atomic structure**<br>• elements arranged in order of increasing atomic number/number of protons<br>• group number is equal to number of electrons in outer shell<br>• period number is equal to the number of shells<br><br>**Position of element/Chemical properties**<br>• elements in same group have similar chemical properties<br>• eg elements in group 1 become more reactive with increasing atomic number/down group<br>• eg elements in group 7 become less reactive with increasing atomic number /down group | **(6)** |

| Level | 0 | No rewardable content |
|---|---|---|
| 1 | 1 - 2 | • a limited description e.g. correctly identifies one part of the periodic table **OR** states one aspect of positioning/atomic structure **OR** one aspect of positioning/chemical property of elements<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | • a simple description e.g. identifies some/several parts of the periodic table **OR** identifies one part of the periodic table and attempts to link the position of an element(s) to either atomic structure or chemical properties<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | • a detailed description e.g. identifies some/several parts of the periodic table **AND** attempts to link the position of an element(s) to at least two aspects of atomic structure and/or chemical properties<br>• relate atomic structure to at least two aspects of positioning and/or chemical properties of the elements<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |

Q32.

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | * | A description and explanation including some of the following points<br><br>**CREDIT CAN BE GIVEN FOR LABELS/ANNOTATIONS ON DIAGRAM**<br><br>**Parts of the periodic table**<br>• periods<br>• (periods) are (horizontal) rows<br>• groups<br>• (groups) are (vertical) columns<br>• group 1 are alkali metals<br>• group 7 are halogens<br>• group 0 are noble gases<br>• transition elements in the middle of the table<br>• metals on the left (and centre)<br>• non-metals on the right<br><br>**Position of element/Atomic structure**<br>• elements arranged in order of increasing atomic number/number of protons<br>• group number is equal to number of electrons in outer shell<br>• period number is equal to the number of shells<br><br>**Position of element/Chemical properties**<br>• elements in same group have similar chemical properties<br>• eg elements in group 1 become more reactive with increasing atomic number/down group<br>• eg elements in group 7 become less reactive with increasing atomic number /down group | **(6)** |

| Level | 0 | No rewardable content |
|---|---|---|
| 1 | 1 - 2 | • a limited description e.g. correctly identifies one part of the periodic table **OR** states one aspect of positioning/atomic structure **OR** one aspect of positioning/chemical property of elements<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | • a simple description e.g. identifies some/several parts of the periodic table **OR** identifies one part of the periodic table and attempts to link the position of an element(s) to either atomic structure or chemical properties<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | • a detailed description e.g. identifies some/several parts of the periodic table **AND** attempts to link the position of an element(s) to at least two aspects of atomic structure and/or chemical properties<br>• relate atomic structure to at least two aspects of positioning and/or chemical properties of the elements<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors |