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Examiners' Report
June 2025

GCSE Combined Science 1SC0 2CH

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Introduction

Paper 2CH is the second of the two chemistry papers for GCSE Combined Science higher tier. The six questions on the paper come from the equivalent GCSE Chemistry paper 2 and the first two questions in this paper are also found on the equivalent foundation tier paper.

The paper is targeted at grades from 4 to 9 and a range of chemistry skills were tested throughout including chemistry knowledge and application, calculations and practical skills. A variety of question styles were used to test the specification.

Overall most questions were attempted and there were few blank responses. The quality and depth of responses varied, as would be expected, but some topics were definitely more familiar to candidates than others.

Question 1(a)

The first question on the paper asked candidates to identify a piece of apparatus used to measure the volume of a solution that would be more accurate than a beaker. Most candidates correctly identified that a measuring cylinder would be a better option although some also (correctly) suggested burettes and pipettes here. The most common mistake was for candidates to suggest a beaker, even though this was the equipment given in the question.

Question 1(b)(i)

This question told candidates that concentration remained constant during the investigation and asked for another control variable to be identified.

It was expected that the majority of candidates would choose the volumes of the solution, but there were a variety of responses given. Many gave answers relating the the cross itself, or the distance between the observer and the cross which were credited. Whilst the majority of learners scored the mark for this question some answers were not credited. Common errors suggested using the same beaker, keeping the same temperature (even though this was given as the independent variable) and using the same concentration (even though this was given in the question).

(i) The concentrations of the solutions are kept constant in each experiment.

State **one** other variable that should be kept constant.

(1)

volume of solutions

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Examiner Comments

This response scored one mark. The preferred response related to the volumes of the solutions used. Amount of solution was also accepted although mass was not.

(i) The concentrations of the solutions are kept constant in each experiment.

State **one** other variable that should be kept constant.

(1)

use the Same piece of equipment to meause the Solutions.

ResultsPlus
Examiner Comments

This response did not score the mark.

The term 'equipment' here is too vague to score, although the same conical flask would have been worth a mark.

(i) The concentrations of the solutions are kept constant in each experiment.

State **one** other variable that should be kept constant.

(1)

ph of the Solutions

ResultsPlus
Examiner Comments

This response did not score the mark.

Some candidates appear to have confused this investigation with one of the biology core practicals. The pH of the solution is not relevant in this case and therefore not creditworthy.

Question 1(b)(ii)

Candidates were given some data about the reaction time at different temperatures and asked to explain what would happen if the temperature was increased further.

Questions about factors affecting the rate of reaction are common, with most candidates scoring two or three marks here. However, the same common errors appear frequently where marks are lost. These are usually related to candidates repeating the same point more than once or not stating that the collisions would be more **frequent** or more **successful** – stating only that there would be more collisions.

Most candidates recognised that increasing temperature would increase the rate of reaction because the particles would have more energy, but some explanations then incorrectly linked this to activation energy, or to a decrease in density that would allow the cross to be seen more easily.

A significant number of responses incorrectly referred to the disappearing cross practical rather than the practical given in the question, but this was not penalised if the explanation was correct.

(ii) State, and explain in terms of particles, how the time taken for the cross to become visible would change if a temperature of 80 °C was used.

(3)

time taken would decrease, because rate of reaction would increase due to temperature increase. Particles would have more kinetic energy (so move more +faster) and therefore have a greater frequency of ~~Successfull~~ Successful collisions and activation energy would be reached faster so precipitate product forms faster

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Examiner Comments

This response scored three marks.

The candidate states that the time taken would decrease and that the rate of reaction would increase (giving the same marking point twice).

They then go on to say that the particles would have more kinetic energy, move more and move faster – giving the same marking point three times.

The response then also states that there would be more frequent collisions and more successful collisions – either of these points would have gained a mark.

There is some incorrect information about activation energy and the formation of a precipitate. This is ignored as it does not contradict or negate the correct information that has already been given in the response.

(ii) **State, and explain in terms of particles, how the time taken for the cross to become visible would change if a temperature of 80 °C was used.**

(3)

The particles would have more energy at 80°c So would therefore move quicker. This cncreases the amount of Colussions that are happening, which increases the rate of reaction.

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has correctly identified that the particles have more energy and would move faster at the higher temperature – this is the same marking point twice. They have then gone on to link this to an increased rate of reaction.

Increasing the amount of collisions is not enough to score the third mark. The increase is in the **rate** of collisions rather than the total number of collisions.

(ii) State, and explain in terms of particles, how the time taken for the cross to become visible would change if a temperature of 80 °C was used.

(3)

Because of a higher temperature, particles will react more fast and collide with eachother, this will make the solution cloudy very fast, and then you cannot see the x.

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Examiner Comments

This response scored one mark.

The candidate has referred to the disappearing cross practical rather than the appearing cross practical, but this is not penalised. The response states that particles will 'react more fast'. It is not well worded but enough for the first marking point. There is no reference to the increased energy or movement of the particles and no mention of the frequency or success of the collisions – just that there will be collisions.

(ii) State, and explain in terms of particles, how the time taken for the cross to become visible would change if a temperature of 80 °C was used.

(3)

It would most likely slow down as the extreme heat would denature the particles and prevent them from reacting.

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Examiner Comments

This response scored zero marks.

A number of responses throughout question 1 seemed to refer to the biology practicals about enzymes. There is nothing creditworthy in this response.

Question 1(c)

In this question, candidates were asked to calculate the mass of solute that would be dissolved in 25 cm^3 of a solution of a given concentration.

The relevant calculation was given in the question, although it needed to be rearranged in order to calculate the correct response. Candidates also needed to perform a unit conversion in order to obtain the correct mass of solute.

The vast majority of candidates managed to successfully rearrange the equation to be able to correctly calculate the mass. However, most candidates either failed to recognise that the units needed to be converted or made errors with the conversion and power of ten errors were very common. It was not unusual to see answers suggesting that 670 000g of solute had been dissolved in 25 cm^3 of water.

(c) The concentration of solution **Q** is 26.8 g dm^{-3}.

Calculate the mass of solid **Q** present in 25 cm^3 of solution **Q**.

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

(2)

25 ÷ 1000 = 0.025

26.8 × 0.025 = 0.67 g

mass of solid **Q** = 0.67 g

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Examiner Comments

This answer scored two marks.

The candidate has clearly shown all working out. The conversion from cm^3 to dm^3 is correct, and the calculation has been rearranged with the correct answer on the answer line.

ResultsPlus
Examiner Tip

Make sure that working out for all calculations is shown.

(c) The concentration of solution **Q** is 26.8 g dm^{-3}.

Calculate the mass of solid **Q** present in 25 cm^3 of solution **Q**.

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

(2)

Volume x concentration = mass

26.8 x 25 = 670

mass of solid **Q** = 670 g

ResultsPlus
Examiner Comments

This response scored one mark.

This was the most commonly seen answer. The calculation has been rearranged correctly but there is no conversion of the units.

Candidates seem to lack the skills to be able to determine whether or not their answer is reasonable.

It would be very unusual to be able to dissolve 670g of solute in 25 cm^3 of solvent.

ResultsPlus
Examiner Tip

Double check that calculation answers seem plausible.

(c) The concentration of solution **Q** is 26.8 g dm^{-3}.

Calculate the mass of solid **Q** present in 25 cm^3 of solution **Q**.

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

(2)

$25cm^3 \rightarrow dm^3$ $\quad \frac{26.8}{0.025}$

$25cm^3 \rightarrow 0.025$

mass of solid **Q** = 1072 g

ResultsPlus
Examiner Comments

This response scored one mark.

In this response, the candidate has correctly converted the volume of solvent from cm^3 to dm^3 and so scores a mark. The calculation is not correct and therefore a second mark cannot be awarded.

(c) The concentration of solution **Q** is $26.8\,g\,dm^{-3}$.

Calculate the mass of solid **Q** present in $25\,cm^3$ of solution **Q**.

$$\text{concentration } (g\,dm^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution } (dm^3)}$$

(2)

$26.8 \div 25 = 1.072$

mass of solid **Q** = 1.072 g

ResultsPlus
Examiner Comments

This response scored zero marks.

The calculation has not been rearranged correctly and there is no attempt to convert the units.

ResultsPlus
Examiner Tip

Try placing the numbers into the equation before attempting to rearrange anything.

Question 1(d)

This question asked candidates to explain how adding a catalyst affects the rate of a chemical reaction.

Most candidates were able to state that catalysts increase the rate of reaction but many could not explain how they do this. Lots of answers suggested that the addition of a catalyst gave the particles more energy, rather than lowering the activation energy of the reaction and there seems to be a poor understanding of the difference between particle energy and activation energy.

There were also a significant number of responses discussing the denaturing of particles suggesting more confusion with biology and enzymes.

(d) The student repeats the experiment at 20 °C, with the addition of a catalyst.

Explain how the addition of a catalyst will affect the rate of reaction.

(2)

A catalyst will increase the rate of reaction because it provides particles with an alternative pathway with a lower activation energy.

ResultsPlus
Examiner Comments

This response scored two marks.

The response scores one mark for identifying that the rate of reaction increases and a second mark either for a lower activation energy or an alternative pathway.

(d) The student repeats the experiment at 20 °C, with the addition of a catalyst.

Explain how the addition of a catalyst will affect the rate of reaction.

(2)

the addition of a catalyst would decrease the activation energy as the catalyst finds an alternative pathway

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has given a good explanation of how catalysts work but not mentioned how the rate of reaction is changed and so cannot score both marks.

ResultsPlus
Examiner Tip

Don't forget to answer all parts of the question.

(d) The student repeats the experiment at 20 °C, with the addition of a catalyst.

Explain how the addition of a catalyst will affect the rate of reaction.

(2)

Catalysts speed up the rate of reaction without being used up

ResultsPlus
Examiner Comments

This response scored one mark.

It was common to see the definition of a catalyst, which was enough for a mark. Unfortunately there is no explanation here.

ResultsPlus
Examiner Tip

Candidates often do not understand the difference between the command words 'describe' and 'explain'.

(d) **The student repeats the experiment at 20 °C, with the addition of a catalyst.**

Explain how the addition of a catalyst will affect the rate of reaction.

(2)

The addition of the catalyst will speed up the rate of reaction, increasing the time it takes for the cross to become visible.

ResultsPlus
Examiner Comments

This response did not score any marks.

The candidate has contradicted themselves by stating that the rate of reaction would increase but then that the time taken would also increase.

Question 2(a)(i)

This question required the recall of information about hydrocarbons in crude oil and it was surprising to see that fewer than half of candidates were correctly able to identify the alkane homologous series.

Common incorrect responses included 'crude oil', 'hydrocarbons' and 'fractional distillation'.

Question 2(b)

Candidates were asked to draw a dot and cross diagram of water.

Overall this was well answered with most responses scoring at least one mark and many scoring both marks.

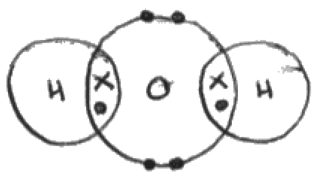
Some candidates did not score any marks at all because they drew the wrong dot and cross diagram (usually oxygen) or the wrong type of formula – usually a displayed formula.

(b) When hydrocarbons undergo combustion, water is produced.

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

(2)

H_2O



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Examiner Comments

This response scored two marks.

There are two shared pairs of electrons between the oxygen atom and two hydrogen atoms. The remaining number and location of electrons is correct and the atoms are correctly labelled.

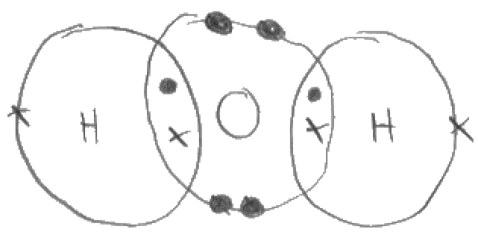
ResultsPlus
Examiner Tip

Only outer shell electrons are required when drawing dot and cross diagrams.

(b) When hydrocarbons undergo combustion, water is produced.

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

(2)



ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly drawn two shared pairs of electrons between the oxygen atom and two hydrogen atoms. Unfortunately the remaining electrons are not correct with each hydrogen atom having a total of three electrons.

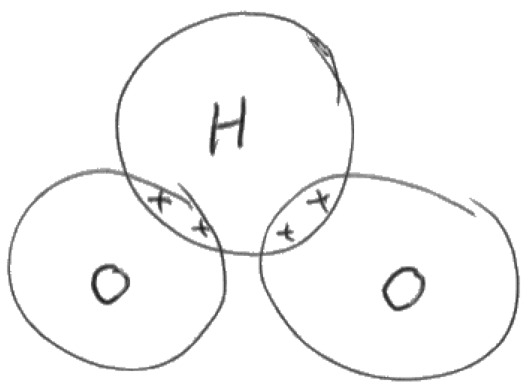
ResultsPlus
Examiner Tip

Each hydrogen atom in a dot and cross diagram will have **only** the shared pair of electrons. Other atoms will have a total of 8 electrons including any shared pairs.

(b) When hydrocarbons undergo combustion, water is produced.

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

(2)



ResultsPlus
Examiner Comments

This response scored one mark.

This error was commonly seen, with two oxygen atoms and one hydrogen atom rather than H_2O. One mark was awarded for a shared pair of electrons.

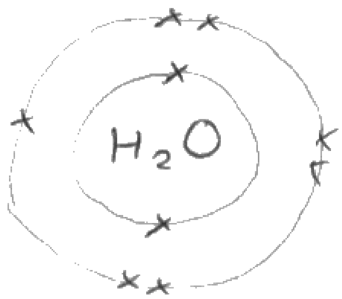
Atom labels are not necessary, but if added then they must be correct.

→ react with oxygen

(b) When hydrocarbons undergo combustion, water is produced.

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

(2)



ResultsPlus
Examiner Comments

This response scored zero marks.

One shared pair of electrons was the minimum requirement for a mark to be awarded.

Other common incorrect responses included displayed formula and attempts to draw ions.

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Examiner Tip

Learn the difference between empirical formula, molecular formula, dot and cross diagrams and displayed formula.

Question 2(c)

Empirical formula calculations are a common question in chemistry, but continue to be poorly answered by a lot of candidates. While most candidates attempted this question, fewer than half scored full marks.

The best responses showed a clear method, step by step working and the correct answer given on the line. In cases where the final answer was incorrect, candidates that had shown their calculation processes often still scored some marks.

The most commonly seen errors here were usually related to the initial step when calculating the number of moles of each element, with a large number of inverted division calculations and some multiplying the numbers together rather than dividing.

Some candidates correctly calculated the simplest ratio of elements but then lost a mark by not writing the actual formula.

(c) One compound in crude oil contains 0.96 g of carbon atoms combined with 0.32 g of hydrogen atoms.

Calculate the empirical formula of this compound.

(relative atomic masses: C = 12, H = 1.0)

(3)

$$C - \frac{0.96}{12} = 0.08 \qquad H - \frac{0.32}{1} = 0.32$$

$$1:4$$

$$\frac{0.08}{0.08} = 1 \qquad \frac{0.32}{0.08} = 4$$

empirical formula of this compound = CH_4

ResultsPlus
Examiner Comments

This response scored three marks.

Each step of the calculation is written down and clearly set out, with the correct formula given.

(c) One compound in crude oil contains 0.96 g of carbon atoms combined with 0.32 g of hydrogen atoms.

Calculate the empirical formula of this compound.

(relative atomic masses: C = 12, H = 1.0)

(3)

0.96/12 = 0.08 ~~0.32/0.32~~ = 3.125

0.32/1 = 0.32

0.08 : 0.32

4 : 16

empirical formula of this compound = C_4H_{16}

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Examiner Comments

This response scored two marks.

The candidate has correctly calculated the number of moles of each element but has not given this as the simplest whole number ratio. The response goes on to write a formula based on the ratio that the candidate has calculated in their calculation. Two marks were able to be awarded here because the candidate has shown the working for each step of the calculation.

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Examiner Tip

The empirical formula is the simplest whole number ratio of elements in a compound.

(c) One compound in crude oil contains 0.96 g of carbon atoms combined with 0.32 g of hydrogen atoms.

Calculate the empirical formula of this compound.

(relative atomic masses: C = 12, H = 1.0)

(3)

$\frac{0.96}{12} : \frac{0.32}{1}$

0.08 : 0.32

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly calculated the number of moles of each element but has not done any further calculation or written a formula.

(c) One compound in crude oil contains 0.96 g of carbon atoms combined with 0.32 g of hydrogen atoms.

Calculate the empirical formula of this compound.

(relative atomic masses: C = 12, H = 1.0)

(3)

0.96 × 12 = 11.52 0.32 × 1 = 0.32 11.52 + 0.32 = 11.84

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Examiner Comments

This response did not score any marks.

The candidate has multiplied mass by atomic mass rather than dividing and cannot score the first marking point. They have then gone on to add these numbers together rather than attempting to calculate whole number ratio or write a formula.

Candidates often incorrectly multiplied the numbers together rather than dividing.

Question 3(b)(i)

This question asked about visual observations when a piece of potassium is added to water. This is a commonly asked question with a lot of accepted marking points and was answered very well overall. Almost all candidates scored at least one mark and more than half scored both marks.

The most commonly seen correct responses related to effervescence, a flame or an explosion. It was less common to see responses relating to the potassium floating, moving and disappearing.

Where marks were lost it was often due to repeating the same marking point – bubbles and fizzing, or an incorrect flame colour – pink rather than lilac. Responses were sometimes too vague to score, suggesting a colour change to purple without any further detail, sparks being given off or smoke. Some responses also stated that hydrogen gas would form, but this was not creditworthy as it did not link to something that could be seen.

(b) The alkali metals react with water.

(i) A teacher adds a small piece of potassium to water.

Give **two** observations that would be seen.

(2)

The potassium would stay afloat and fizz across the water at high speed (1 point)

The potassium would slowly dissapear due to it reacting with the water and mixing within as a liquid. (1 point)

ResultsPlus
Examiner Comments

This response scored two marks.

There are actually four correct marking points in this response. Floating, fizzing, moving across the water and the potassium disappearing.

(b) The alkali metals react with water.

(i) A teacher adds a small piece of potassium to water.

Give **two** observations that would be seen.

(2)

You would see a lilac flame and
hear popping.

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly stated that a lilac flame would be seen. It is likely that popping sounds would be heard but this does not answer the question, which asks for observations that would be **seen**.

(b) The alkali metals react with water.

(i) A teacher adds a small piece of potassium to water.

Give **two** observations that would be seen.

(2)

Alkali metals react vigorously with water. There will ~~pe~~ be fizzing and bubbles produced. There is also a yellow flame produced.

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has given the same marking point twice in terms of fizzing and bubbles. They have given the incorrect flame colour and so a second mark cannot be awarded.

ResultsPlus
Examiner Tip

Potassium and its compounds burn with a lilac (or purple) flame.

(b) The alkali metals react with water.

(i) A teacher adds a small piece of potassium to water.

Give **two** observations that would be seen.

(2)

- Colour change
- it will react Fast.

ResultsPlus
Examiner Comments

This response did not score any marks.

Colour change is too vague to award a mark. Candidates often refer to the water turning purple, but this would only be the case if universal indicator had been added to the water at the beginning of the reaction.

The idea of a fast reaction is not related to any visual observation and so no mark can be awarded here either.

Question 3(b)(ii)

This question asked candidates to explain why lithium is less reactive than potassium.

Again this was well attempted by the majority of candidates, with most scoring at least one mark. Where marks were lost it was often due to lack of detail in the response or incorrect scientific language. It was not uncommon to see responses suggesting that lithium and potassium have multiple outer shells of electrons or referring to intermolecular forces between the nucleus and outer electron. Responses were sometimes confused and incorrectly suggested that the lower reactivity of lithuim was related to a small amount of energy being needed to remove the outer electron because it was closer to the nucleus.

Some candidates did not offer any explanation or refer to the position of the metals in the periodic table and gave a simple statement of the reactivity increasing down the group, while other responses referred to different metals in the group rather than the two that were asked about.

(ii) The reaction of lithium with water is much less vigorous than the reaction of potassium with water.

Explain why, in terms of their electronic configurations.

(3)

Lithium only has two ~~outer~~ electron shells, and on its outer shell, it only has one electron, so when reacting with something else, it must lose that electron. This is the same with potassium, however potassium has two more electron shells between the outer shell and the nucleus. This means that the atoms radius is larger, meaning theres less attraction between the nucleus and outer shell, and the other shells create a shield effect. This makes it easier for potassium to lose an electron, therefore easier to react so it is quicker and more obvious.

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Examiner Comments

This response scored three marks.

There were five separate marking points available and full marks could be obtained from any three of these points. This is an excellent response that includes all five of the marking points:

- more shells in potassium
- potassium is a larger atom
- increased shielding in potassium
- weaker attraction between outer electron and nucleus in potassium
- easier to lose outer electron in potassium.

(ii) The reaction of lithium with water is much less vigorous than the reaction of potassium with water.

Explain why, in terms of their electronic configurations.

(3)

lithium has less shells compared to potassium. The shells and electrons for lithium are closer to the nucleus, so it is harder to lose them, making it less reactive. Potassium contains more shells so the outer shell is further away from the nucleus. so it can easily be lost.

ResultsPlus Examiner Comments

This response scored two marks.

This is an example of a 'near miss' response. The candidate has correctly stated that lithium has fewer shells than potassium and that the outer shell is further from the nucleus in potassium and scores two marks. There is then an attempt to explain that the outer electron is closer to the nucleus in lithium, but the response refers to electrons in general rather than the outer electron. The response also states that the outer shell rather than outer electron is easily lost in potassium.

ResultsPlus Examiner Tip

When discussing reactivity the response needs to refer to **outer electrons** rather than electrons or outer shells.

(ii) The reaction of lithium with water is much less vigorous than the reaction of potassium with water.

Explain why, in terms of their electronic configurations.

(3)

Lithium is less reactive than potassium as it is higher up on the periodic table, as well as this the attraction between the electron and nucleus is much stronger than potassium as there are less electron shells. Lithium = 2.1 (only 2 shells) whereas Potassium = 2.8.8.1 (has 4 shells)

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Examiner Comments

This response scored one mark.

The candidate has correctly stated that there are fewer electron shells in lithium than potassium, but then does not refer to the attraction between the nucleus and the **outer** electron. There is also a general statement about the reactivity down group 1 but this was not creditworthy.

(ii) The reaction of lithium with water is much less vigorous than the reaction of potassium with water.

Explain why, in terms of their electronic configurations.

(3)

A lithium atom has a stronger intermolecular force with its outer electron than the porassum atom which can look its outer electron quicker with little energy because it has a weak intermolecular force.

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Examiner Comments

This response scored zero marks.

There is correct reference to the attraction between the nucleus and the outer electron but this is negated by the candidate incorrectly identifying this force as an intermolecular force.

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Examiner Tip

The attractive force between the nucleus of an atom and its electrons is electrostatic.

Question 3(b)(iii)

This question was very poorly answered overall with only a few candidates scoring any marks at all.

Most candidates either did not identify water as the second product (commonly suggesting hydrogen) or attempted to add sodium into the ionic equation in some way. It is evident that candidates did not have a good understanding of the difference between an ionic equation and a balanced equation.

(iii) When sodium reacts with water, a solution of sodium hydroxide is formed.

When the solution is left in air, the hydroxide ions react with carbon dioxide, forming carbonate ions, CO_3^{2-}, and one other product.

Complete the ionic equation for this reaction.

(2)

2 OH^- + CO_2 → CO_3^{2-} + H_2O

ResultsPlus
Examiner Comments

This response scored two marks.

Only a small percentage of candidates correctly identified the formulae of both products.

This equation is also correctly balanced.

Na H2O
(iii) When sodium reacts with water, a solution of sodium hydroxide is formed.

When the solution is left in air, the hydroxide ions react with carbon dioxide, forming carbonate ions, CO_3^{2-}, and one other product.

Complete the ionic equation for this reaction.

(2)

$$\ldots\ldots\ OH^- + CO_2 \rightarrow CO_3^{2-} + H_2O$$

ResultsPlus
Examiner Comments

This response scored one mark.

The correct formula for both products is given but there is no attempt at balancing the equation.

It was very unusual to see the correct formulae without the correct balancing as well.

(iii) When sodium reacts with water, a solution of sodium hydroxide is formed.

When the solution is left in air, the hydroxide ions react with carbon dioxide, forming carbonate ions, CO_3^{2-}, and one other product.

Complete the ionic equation for this reaction.

(2)

.......2....... OH^- + ...CO_2....... $\rightarrow$ CO_3^{2-} + ...OH_2^-.......

ResultsPlus
Examiner Comments

This response scored zero marks.

Many candidates did not correctly identify the second product of the reaction and therefore did not score. Common errors included H_2 or OH^- with some responses also adding charges to CO_2 or H_2O.

(iii) When sodium reacts with water, a solution of sodium hydroxide is formed.

When the solution is left in air, the hydroxide ions react with carbon dioxide, forming carbonate ions, CO_3^{2-}, and one other product.

Complete the ionic equation for this reaction.

(2)

Na^+ OH^- + CO_2 → CO_3^{2-} + Na H

ResultsPlus
Examiner Comments

This response did not score any marks.

Any addition of sodium into the equation meant that zero marks were awarded overall.

ResultsPlus
Examiner Tip

Spectator ions are not included in ionic equations.

Question 3(c)

The last part of question 3 asked candidates to determine the mass of a single atom of caesium, given the relative atomic mass.

Whilst this was attempted by most candidates, it was a little disappointing to see that the majority scored only one mark. Errors were most commonly due to issues working with standard form, rounding errors and a lack of awareness about what a sensible answer would be for the mass of one atom of something.

(c) The relative atomic mass of caesium is 132.905.

Calculate the average mass of one atom of caesium

(Avogadro constant = 6.02×10^{23})

(2)

$$\frac{132.905}{6.02 \times 10^{23}}$$

mass = 2.2077×10^{-22} g

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has shown the correct calculation along with the correct evaluation on the answer line.

(c) The relative atomic mass of caesium is 132.905.

Calculate the average mass of one atom of caesium

(Avogadro constant = 6.02×10^{23})

(2)

$132.905 \div 6.02 \times 10^{23} = 2.207724252 \times 10^{24}$

mass = $2.207724252 \times 10^{24}$ g

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has written the correct calculation but it has been evaluated incorrectly. The mark is awarded because the response shows the correct calculation.

This was a commonly seen incorrect answer and is the answer obtained when the calculation is typed into a calculator directly as written, without any consideration of BIDMAS rules.

(c) The relative atomic mass of caesium is 132.905.

Calculate the average mass of one atom of caesium

(Avogadro constant = 6.02×10^{23})

(2)

$6.02 \times 10^{23} \times 132.905 = 8.000881 \times 10^{25}$

mass = 8.000881×10^{25} g

ResultsPlus
Examiner Comments

This response scored one mark.

This was the most commonly seen answer, where candidates have correctly evaluated an incorrect calculation. In this case the numbers have been multiplied together rather than divided.

The final answer of 8 x 10^{25} gives a mass greater than the mass of the Earth. It was surprising that candidates did not consider this to be an unlikely answer for the mass of one atom of caesium.

(c) The relative atomic mass of caesium is 132.905.

Calculate the average mass of one atom of caesium

(Avogadro constant = 6.02×10^{23})

(2)

$\frac{(6.02 \times 10^{23})}{132.905} = 4.529551183 \times 10^{21}$

mass = 4.5296 g

ResultsPlus
Examiner Comments

This response scored zero marks.

The candidate has written an inverted division. They have correctly evaluated it in the question but the final answer on the line does not include the indices and therefore no marks can be awarded.

Question 4(a)

Questions asking why noble gases are inert are often asked, although rarely in the context of the elements lower down in the group.

Most candidates were able to correctly explain that xenon is unreactive due to a full outer shell of electrons and therefore there is no need to gain, lose or share electrons. Where candidates did not score full marks this was usually due to there being no mention of electrons in their response, suggestion of zero electrons in the outer electron shell or incorrect attempts to write an electronic configuration that gave an outer shell containing 4 electrons.

4 This question is about the noble gas xenon.

(a) Xenon is unreactive.

Explain, in terms of its electronic configuration, why xenon is unreactive.

(2)

Because xenon ~~its~~ in in group 0 which is the noble gasses, it is unreactive because it ~~hev~~ has a full outer shell meaning it doesn't gain or lose electrons.

ResultsPlus Examiner Comments

This response scored two marks.

Both marking points are included.

4 This question is about the noble gas xenon.

(a) Xenon is unreactive.

Explain, in terms of its electronic configuration, why xenon is unreactive.

(2)

Xenon is unreactive because it has a full outer electron shell

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly identified the full outer electron shell but there is nothing in the answer to award a second mark.

4 This question is about the noble gas xenon.

(a) Xenon is unreactive.

Explain, in terms of its electronic configuration, why xenon is unreactive.

(2)

As xenon is in group 0, it has an empty outershell. this means it does not need to react with anything to lose or gain electrons for a full outershell, this makes it unreactive.

ResultsPlus
Examiner Comments

This answer scored one mark.

The candidate has correctly identified that xenon does not need to gain or lose electrons but incorrectly states that this is due to an empty outer electron shell. This is a common misconception about the elements in group 0.

ResultsPlus
Examiner Tip

Elements in group 0 have a full outer shell, not an empty one.

4 This question is about the noble gas xenon.

(a) Xenon is unreactive.

Explain, in terms of its electronic configuration, why xenon is unreactive.

(2)

Xenon is unreactive as it's in group 0. It has 8 electron shells with 4 in it's outer shell, therefore it makes it less reactive.

ResultsPlus
Examiner Comments

This response scored zero marks.

The candidate has incorrectly stated that there are 4 electrons in the outer shell of xenon.

GCSE candidates are not expected to know the electronic configuration of any element after calcium in the periodic table but they are expected to be able to explain the physical and chemical properties of the elements in groups 1, 7 and 0.

Question 4(b)(i)

Candidates were asked to write the balanced equation for the formation of xenon tetrafluoride.

In order to score the mark, candidates needed to give the correct formula for both reactants as well as the correct balancing of the equation. This proved too challenging for the majority of candidates, with most not scoring the mark.

(b) Under extreme conditions, xenon can be made to react with fluorine to form xenon tetrafluoride, XeF_4.

(i) Write the balanced equation for this reaction.

(1)

$Xe + 2F_2 \rightarrow XeF_4$

ResultsPlus
Examiner Comments

This response scored the mark.

Both reactant formulae are correct and the equation is balanced.

(b) Under extreme conditions, xenon can be made to react with fluorine to form xenon tetrafluoride, XeF_4.

(i) Write the balanced equation for this reaction.

(1)

$Xe + F_4 \rightarrow XeF_4$

ResultsPlus
Examiner Comments

This response did not score the mark.

By far the most common error was to give the formula of fluorine as either F or F_4.

ResultsPlus
Examiner Tip

All group 7 elements form diatomic molecules.

(b) Under extreme conditions, xenon can be made to react with fluorine to form xenon tetrafluoride, XeF_4.

(i) Write the balanced equation for this reaction.

(1)

$4F_2 + Xe_2 \longrightarrow 2XeF_4$

Examiner Comments

This response did not score the mark.

A few responses suggested that xenon is a diatomic molecule.

Question 4(b)(ii)

Candidates were given information about the melting point and electrical conductivity of xenon tetrafluoride and asked to state and explain the structure and bonding present.

This was not well answered at all, with most candidates scoring either zero or one mark.

Candidates could often recognise that the xenon tetrafluoride is covalently bonded, but far fewer identified the structure as simple molecular. Most seemed to think that a melting point of 117°C is high, which led to errors in terms of structure and the explanation of properties, suggesting giant covalent molecules with strong bonds requiring a lot of energy to break. Unfortunately, any suggestion of a high melting point meant that the third marking point could not be awarded.

(ii) Some information about xenon tetrafluoride is shown in Figure 3.

colour of solid	melting point in °C	conductor of electricity?
colourless	117	no

Figure 3

State and explain, with reasons, the type of structure and bonding in xenon tetrafluoride.

(3)

Xenon tetraflouride is a simple molecule because it must have covalent bonding since it is made up of 2 non-metals. It also doesn't conduct electricity, so it is likely a simple molecule. It also has a low melting point as little energy is needed to overcome weak intermolecular forces.

ResultsPlus
Examiner Comments

This response scored three marks.

It was very unusual to see a response scoring full marks. In this example the candidate has identified both the structure and bonding, stated that it is a non-conductor and correctly explained the low melting point.

ResultsPlus
Examiner Tip

Learn the difference between structure and bonding.

(ii) Some information about xenon tetrafluoride is shown in Figure 3.

colour of solid	melting point in °C	conductor of electricity?
colourless	117	no

Figure 3

State and explain, with reasons, the type of structure and bonding in xenon tetrafluoride.

(3)

In xenon tetrafluoride they would be covalently bonded to eachother; sharing electrons to have a full outer shell. The structure would be of a simple molecular as it has only a few bonds.

ResultsPlus
Examiner Comments

This response scored two marks.

In this example the candidate has correctly identified the structure and bonding in xenon tetrafluoride but not given any explanation relating to the properties.

(ii) Some information about xenon tetrafluoride is shown in Figure 3.

colour of solid	melting point in °C	conductor of electricity?
colourless	117	no

Figure 3

State and explain, with reasons, the type of structure and bonding in xenon tetrafluoride.

(3)

Xenon tetrafluoride must be ~~a~~ simple molecular structure, as it has a relatively low melting point due to it's weak intermolecular bonds, and not conducting electricity due to it~~s~~ not having any delocalised electrons to pass it through.

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has correctly identified the structure of the molecule, explained why it is a non-conductor and why it has a low melting point. Unfortunately there is no reference to covalent bonds at all in the response.

(ii) Some information about xenon tetrafluoride is shown in Figure 3.

colour of solid	melting point in °C	conductor of electricity?
colourless	117	no

Figure 3

State and explain, with reasons, the type of structure and bonding in xenon tetrafluoride.

(3)

xenon tetrafluoride cannot conduct electricity because there is no delocalised electrons as ~~because~~ the outer shell is full.
The melting point and boiling point is high because ~~[illegible]~~ of strong covalent bonds which require a lot of energy to break apart.

ResultsPlus
Examiner Comments

This response scored one mark.

Although the response has correctly explained why xenon tetrafluoride does not conduct electricity, this has been negated by the suggestion that it has a high melting point. An explanation of either property would have scored the third mark but the incorrect explanation cannot be ignored in this case.

Although the explanation is incorrect, the response mentions that there are strong covalent bonds and this is enough to award one mark.

(ii) Some information about xenon tetrafluoride is shown in Figure 3.

colour of solid	melting point in °C	conductor of electricity?
colourless	117	no

Figure 3

State and explain, with reasons, the type of structure and bonding in xenon tetrafluoride.

(3)

Giant ionic compound - has high melting point due to a huge structure to break down. It's not a conductor of electricity due to limited / no movement of electrons in the compound.

ResultsPlus
Examiner Comments

This response scored zero marks.

Any mention of ionic or metallic bonding meant that no marks could be awarded.

Question 4(c)

There was a lot of variation in answers to this question. Most candidates showed a good understanding of the question but lost marks due to carelessness or small mistakes.

The majority of candidates could draw an exothermic reaction profile but there were issues with the labelling of the axis as well as identifying the activation energy and overall energy change in the reaction.

(c) Under extreme conditions, xenon reacts with fluorine to form xenon hexafluoride.

The reaction is exothermic.
The energy change for the reaction is $-400\,kJ\,mol^{-1}$. exothermic

On Figure 4

- add a label to the y-axis
- draw the reaction profile for this reaction
- label the energy change and the activation energy for the reaction.

(3)

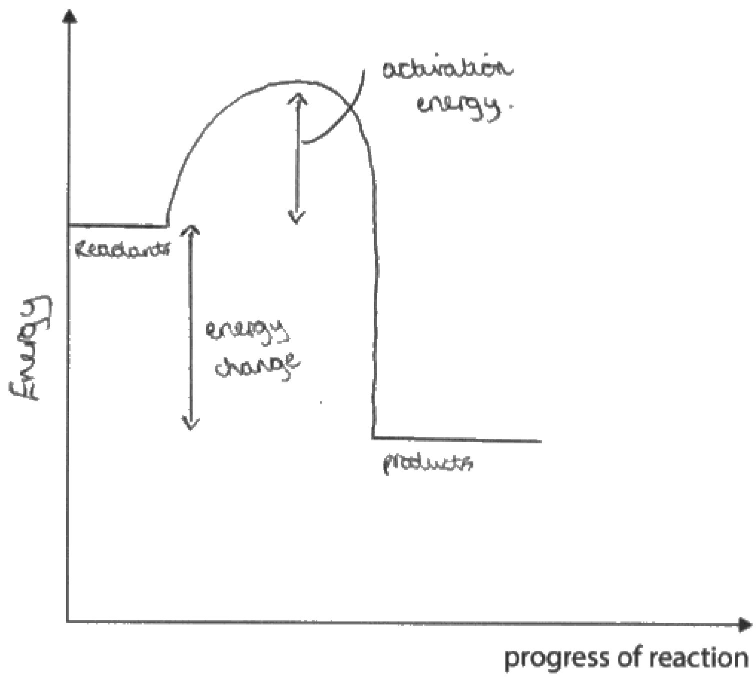

Figure 4

ResultsPlus
Examiner Comments

This response scored three marks.

Only a small minority of responses scored full marks for this question. The best responses were clearly and correctly labelled, with lines drawn with a ruler where appropriate.

Arrow heads were ignored in all cases, whether or not they were correct, as long as the lines were correct.

(c) Under extreme conditions, xenon reacts with fluorine to form xenon hexafluoride.

The reaction is exothermic.
The energy change for the reaction is $-400\,\text{kJ mol}^{-1}$.

On Figure 4

- add a label to the y-axis
- draw the reaction profile for this reaction
- label the energy change and the activation energy for the reaction.

(3)

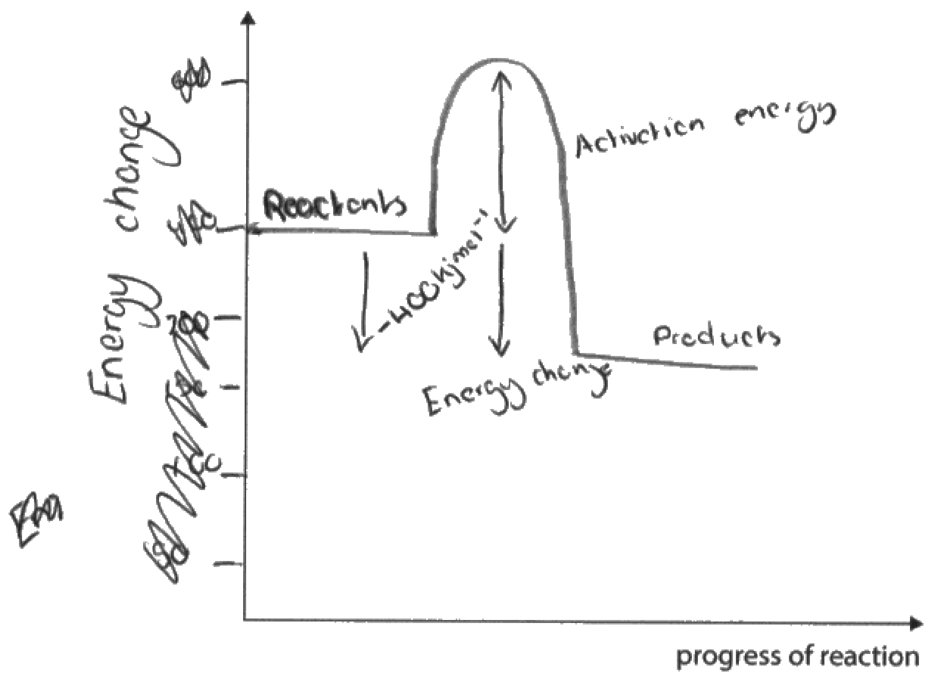

Figure 4

ResultsPlus
Examiner Comments

This response scored two marks.

Candidates often incorrectly labelled the x-axis as energy change rather than 'energy' alone. Other incorrect responses included 'potential energy', 'kinetic energy', 'temperature' and 'reaction time'.

Labels for the reactants and products were not required, but if added then they needed to be correct.

(c) Under extreme conditions, xenon reacts with fluorine to form xenon hexafluoride.

The reaction is exothermic.
The energy change for the reaction is $-400\,kJ\,mol^{-1}$.

On Figure 4

- add a label to the y-axis
- draw the reaction profile for this reaction
- label the energy change and the activation energy for the reaction.

(3)

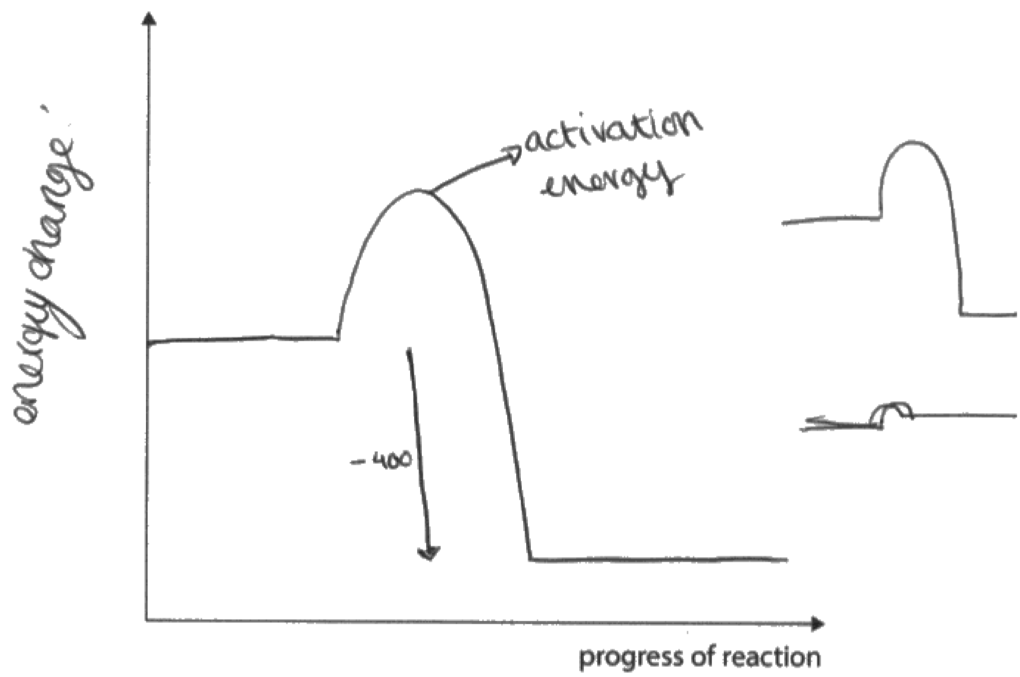

Figure 4

ResultsPlus
Examiner Comments

This response scored one mark.

The axis is incorrectly labelled and the arrow indicates the top of the curve as the activation energy. The shape of the profile is correct and scores a mark. The energy change is also correct but this mark cannot be awarded without the activation energy being correctly marked.

ResultsPlus
Examiner Tip

The activation energy always goes from the reactants line to the top of the curve.

(c) Under extreme conditions, xenon reacts with fluorine to form xenon hexafluoride.

The reaction is exothermic.
The energy change for the reaction is $-400\,kJ\,mol^{-1}$.

On Figure 4

- add a label to the y-axis
- draw the reaction profile for this reaction
- label the energy change and the activation energy for the reaction.

(3)

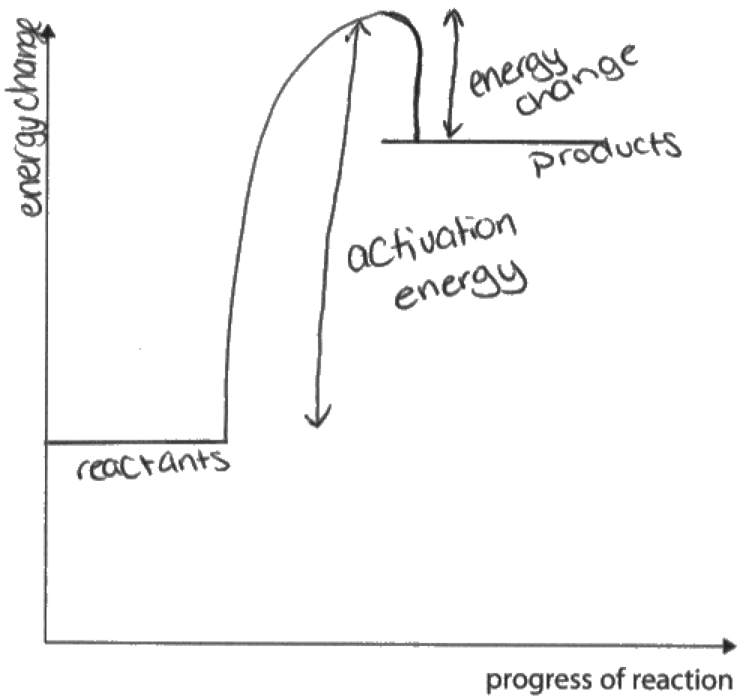

Figure 4

ResultsPlus
Examiner Comments

This response did not score any marks.

The axis is incorrectly labelled, and the response shows an endothermic reaction profile.

In this example the candidate has correctly labelled the activation energy but not the energy change and so this mark cannot score.

Question 5(a)(i)

This question asked candidates to explain why graphite is used as a lubricant.

Just over half of candidates scored at least one mark on this question with many of these scoring both marks.

5 This question is about carbon and some carbon compounds.

(a) Two forms of pure carbon are graphite and Buckminsterfullerene.

(i) Explain why graphite is used as a lubricant.

(2)

It has layers that can slide over each other making it a goal lubricant

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has concisely and clearly explained that graphite has layers that can slide over each other.

The response needed to refer to layers or sheets rather than individual particles or atoms.

5 This question is about carbon and some carbon compounds.

(a) Two forms of pure carbon are graphite and Buckminsterfullerene.

(i) Explain why graphite is used as a lubricant.

(2)

It has layers so is therefore a perfect lubricant

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly identified that graphite has layers but has not explained how this makes it suitable as a lubricant.

ResultsPlus
Examiner Tip

Questions that use the command word 'explain' need to have linked ideas in the answer.

5 This question is about carbon and some carbon compounds.

(a) Two forms of pure carbon are graphite and Buckminsterfullerene.

(i) Explain why graphite is used as a lubricant.

(2)

It has a less protective structure, a low melting point and the atoms can move around more freely, meaning more collisions.

ResultsPlus
Examiner Comments

This response scored zero marks.

The candidate has attempted to describe some sort of movement but this reads like the movement of particles in a liquid rather than layers moving over each other.

5 This question is about carbon and some carbon compounds.

(a) Two forms of pure carbon are graphite and Buckminsterfullerene.

(i) Explain why graphite is used as a lubricant.

(2)

graphite is used as a lubricant as its inert so theres no risk of reaction with other elements, its also slippery therefore providing a good lubricant.

ResultsPlus
Examiner Comments

This response scored zero marks.

A lot of responses gave irrelevant or incorrect properties. In this case the candidate has stated that graphite is slippery, which is not enough to score. The fact that graphite is also inert is not relevant to its use as a lubricant.

A number of candidates incorrectly suggested that graphite has a low melting point and is a liquid or that it is malleable.

Question 5(a)(ii)

This question asked for the mass, in kg, of 5 moles of Buckminsterfullerene.

There was one mark available for the correct calculation and one mark for converting the answer into kg.

This should have been a straightforward calculation but fewer than half of candidates scored any marks at all.

(ii) Calculate the mass, in kg, of five moles of Buckminsterfullerene, C_{60}.

(relative atomic mass: C = 12)

(2)

60 x 12 = 720

720 x 5 = 3600

3600 ÷ 1000 = 3.6

mass = 3.6 kg

ResultsPlus
Examiner Comments

This response scored two marks.

In order to correctly calculate the mass, candidates were required to find the mass of relative formula mass of Buckminsterfullerene and then multiply this by the number of moles in the question. This would give the mass in grams which would then need to be converted into kilograms.

The candidate has shown their working out for every step of the calculation and the correct answer is on the answer line.

(ii) Calculate the mass, in kg, of five moles of Buckminsterfullerene, C_{60}.

(relative atomic mass: C = 12)

(2)

$12 \times 60 = 720$

~~Mr~~

$\text{moles} = \frac{\text{mass}}{\text{mr}}$

$5 = \frac{\text{mass}}{12}$

$60 \times 5 = 300$

$5 \times 720 = 3600$

mass = 3600 kg

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly calculated the mass in g but there is no conversion to kg and therefore only one mark is awarded.

(ii) Calculate the mass, in kg, of five moles of Buckminsterfullerene, C_{60}.

(relative atomic mass: C = 12)

(2)

60 x12 = 720 ÷ 1000

0 .72

mass = 0.72 kg

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has correctly calculated the mass of 1 mole of Buckminsterfullerene, which does not score. However, the correct conversion of this mass into kg was awarded one mark.

(ii) Calculate the mass, in kg, of five moles of Buckminsterfullerene, C_{60}.

(relative atomic mass: C = 12)

(2)

$12 \times 60 = 720$ $\quad (6.02 \times 10^{23}) \times 5 = \frac{3.01 \times 10^{23}}{720}$

$= 4.18 \times 10^{21}$

mass = 4.18×10^{21} kg

ResultsPlus
Examiner Comments

This response scored zero marks.

Any responses that included use of the Avogadro constant did not score.

ResultsPlus
Examiner Tip

Use the information given in the question for calculations.

Question 5(c)

This should have been a relatively straightforward question about complete and incomplete combustion but many candidates did not seem to recognise the context when related to the Bunsen burner.

Almost half of candidates scored no marks at all, with a lot of confusion about the temperatures of the different flames and a lack of understanding about the function of the air hole on the Bunsen.

There were also a number of incorrect responses that stated reducing the heat of the Bunsen burner would prevent the formation of carbon.

(c) A Bunsen burner burns methane gas, CH_4.

A student investigates the time taken to heat up a beaker of water using this Bunsen burner.

Figure 5 shows the apparatus used.

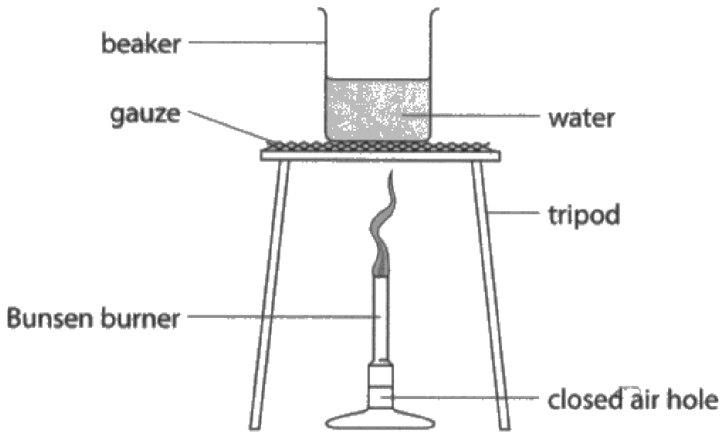

Figure 5

The student sees that a large amount of carbon forms as a black solid on the underside of the gauze.

The teacher said that the investigation would be improved if no carbon forms.

Explain what the student should do to stop carbon forming on the underside of the gauze.

(2)

Open the air hole of the bunsen burner to let in more oxygen so that complete combustion takes place instead of incomplete combustion.

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has explained that opening the air hole will allow complete combustion to occur.

Allowing **more** oxygen in would also have scored if the candidate had not mentioned complete combustion.

(c) A Bunsen burner burns methane gas, CH_4.

A student investigates the time taken to heat up a beaker of water using this Bunsen burner.

Figure 5 shows the apparatus used.

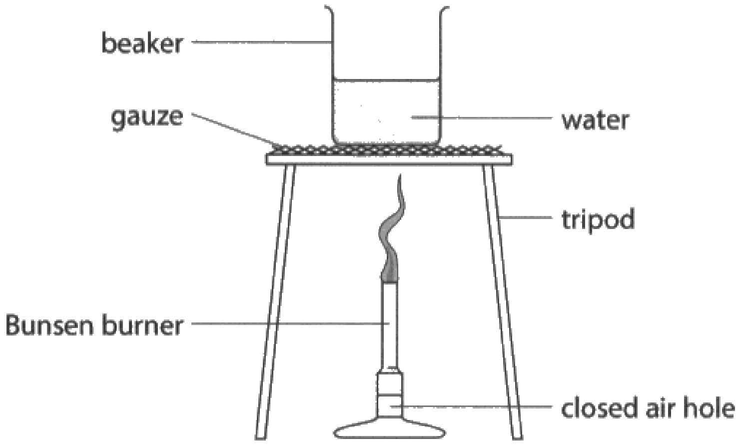

Figure 5

The student sees that a large amount of carbon forms as a black solid on the underside of the gauze.

The teacher said that the investigation would be improved if no carbon forms.

Explain what the student should do to stop carbon forming on the underside of the gauze.

(2)

open the air hole to ensure oxygen is present, the flame will be roaring blue. The oxygen will break down the carbon atoms.

ResultsPlus
Examiner Comments

This response scored one mark.

The candidate has given the same marking point twice by suggesting opening the air hole and using a blue flame.

The suggestion that the oxygen will break down the carbon atoms is not enough for a second mark.

Some responses suggested that opening the air hole on the Bunsen would allow the carbon to escape.

Some responses suggested that opening the air hole would give a yellow flame – this is a contradiction and did not score.

(c) A Bunsen burner burns methane gas, CH_4.

A student investigates the time taken to heat up a beaker of water using this Bunsen burner.

Figure 5 shows the apparatus used.

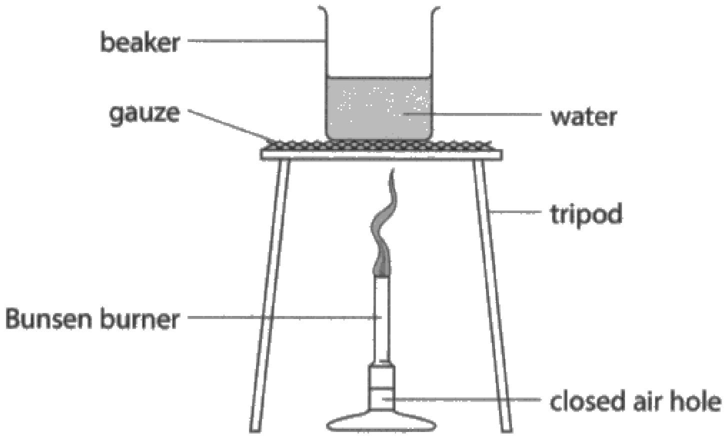

Figure 5

The student sees that a large amount of carbon forms as a black solid on the underside of the gauze.

The teacher said that the investigation would be improved if no carbon forms.

Explain what the student should do to stop carbon forming on the underside of the gauze.

(2)

By moving the bunsen burner a little lower so the flame isn't meeting the gauze so quickly.

ResultsPlus
Examiner Comments

This response did not score any marks.

There were a number of responses that suggested increasing the distance between the Bunsen and the gauze, adding some sort of lubricant or barrier to prevent carbon from sticking to the gauze, cleaning the gauze or even making the whole practical into a closed system.

Question 5(d)

The six mark question proved to be very accessible for the majority of candidates.

Most gave a minimum of a level 2 response simply by describing different processes that changed the amount of carbon dioxide in the atmosphere or explaining how carbon dioxide contributes to global warming.

In order to access marks in level 3 candidates needed to use the information given in the question as part of their answer, alongside information about processes and the greenhouse effect. Many candidates also did this and over half of candidate responses were in level 3.

There was also a lot of irrelevant and sometimes incorrect information given, which was ignored unless it contradicted the correct response. A large number of candidate responses included references to the ozone layer when discussing the greenhouse effect, while others discussed emissions of methane – which was not asked about in the question.

Weaker candidates scored some marks simply by describing the evolution of the Earth's atmosphere as this includes processes that add and remove carbon dioxide from the atmosphere and mistakenly linked this to the information in the graphs, assuming that the Earth's earliest atmosphere was some time in the 1960's.

*(d) Natural processes and human activities change the amount of carbon dioxide in the atmosphere.

Figure 6 shows the concentration of carbon dioxide in the atmosphere measured in one location and the mean global temperature from 1960 to 2000.

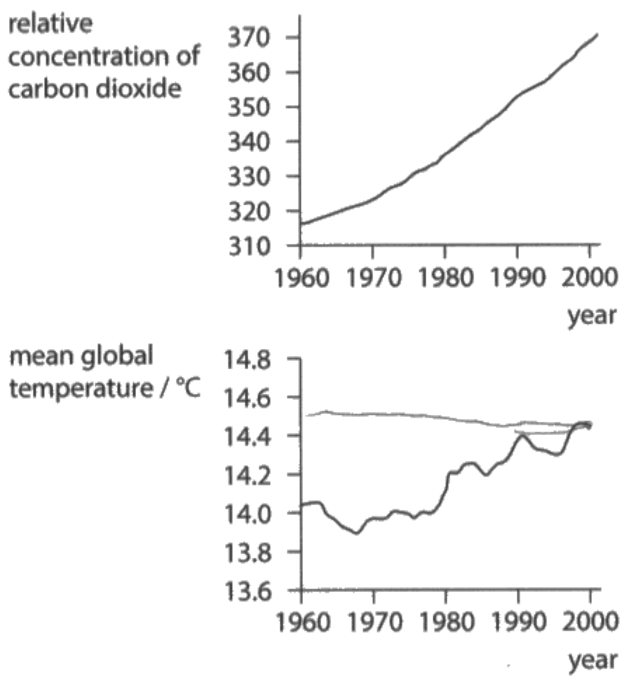

Figure 6

Evaluate whether the data in Figure 6 shows that the change in the amount of carbon dioxide is leading to climate change.

Your answer should include

- the natural processes that change the amount of carbon dioxide in the atmosphere
- the human activities that change the amount of carbon dioxide in the atmosphere
- how carbon dioxide contributes to the greenhouse effect and climate change.

(6)

natural processes

plants photosynthesise which reduces carbon dioxide as its a reactant. Trees and greenery are also examples of carbon sinks. This further reduces carbon in the air.

All animals respire and release carbon dioxide. this greatly increases CO_2 levels in the atmosphere. A population increase between 1960 and 2000 as shown on the graph may be responsible for the increase in CO_2 levels.

Human activities

↳ burning fossil fuels through complete combustion releases lots of CO_2 as its a product.

↳ excessive deforestation and removal of trees ~~reduces~~ destroys a natural carbon sink meaning more CO_2 is pushed into the atmosphere.

↳ motor vehicles release CO_2 which increasingly affects the ~~greenhouse~~ levels of CO_2 in the air.

greenhouse effect and climate change

the greenhouse effect is increased due to the CO_2 getting stuck in the atmosphere. This increase of gases blocks sunrays from escaping the Earths atmosphere and instead reflects back onto Earth. This increases the Earths atmospheric temperature and warms the planet → global warming

From 14.02°c globally in 1960 with CO_2 levels at 315, to 14.4°c globally and over 370 (2000)

↳ clearly the sudden increase of CO_2 has increased the effects of climate change.

ResultsPlus
Examiner Comments

This is an example of a level 3 response.

The candidate has given a number of detailed descriptions of processes that change the amount of carbon dioxide in the atmosphere. The information about the greenhouse effect is brief but correct.

The response then quotes some information from the graph, briefly describes the increase in carbon dioxide concentration and then deduces that this has contributed to climate change. The discussion is weak but there is enough information to award marks in level 3.

*(d) Natural processes and human activities change the amount of carbon dioxide in the atmosphere.

Figure 6 shows the concentration of carbon dioxide in the atmosphere measured in one location and the mean global temperature from 1960 to 2000.

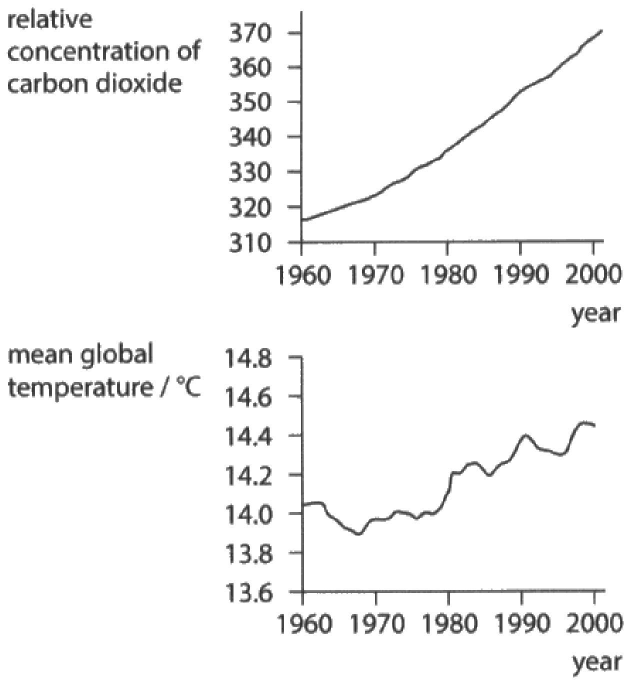

Figure 6

Evaluate whether the data in Figure 6 shows that the change in the amount of carbon dioxide is leading to climate change.

Your answer should include

- the natural processes that change the amount of carbon dioxide in the atmosphere
- the human activities that change the amount of carbon dioxide in the atmosphere
- how carbon dioxide contributes to the greenhouse effect and climate change.

(6)

The natural processes that change the amount of carbon dioxide in the atmosphere is volcanic activity and methane gas produced by livestock. These impact the atmosphere negatively by adding to carbon dioxide concentration but photosynthesis changes the amount of carbon dioxide positively by taking that gas and turning it into oxygen.

The human activities that change the amount of carbon dioxide in the atmosphere is by deforestation, burning fossil fuels and increasing the population of livestock.

Carbon dioxide contributes to the greenhouse effect and climate change because if the concentration of carbon dioxide increases then the atmosphere will trap more heat from the suns rays, ultimately heating up the planet through the greenhouse effect and causing climate change.

ResultsPlus
Examiner Comments

This is an example of a level 2 response.

The candidate has given a description of how volcanic activity and photosynthesis affect the concentration of carbon dioxide in the atmosphere (along with some irrelevant information about methane). There is a statement about deforestation and a very brief description of the greenhouse effect.

There is enough information in the response for level 2, but no reference to the data and so the response cannot reach level 3.

ResultsPlus
Examiner Tip

Use all of the information given to answer the question.

- long wave lengths of ~~radiation~~ radiation are absorbed by green house gases into the earth's atmosphere
- one of these green house gases is CO_2
- the more ~~CO_2~~ if the CO_2 absorbs more radiation from the sun, the planet will get hotter (increase in temp)

ResultsPlus
Examiner Comments

This is an example of a level 1 response.

The candidate has given a simple description of how carbon dioxide in the atmosphere leads to the greenhouse effect. There is no mention of any processes that change the concentration of atmospheric carbon dioxide or any reference to the data in the graphs.

Question 6(a)

This question asked candidates to suggest a more accurate method for collecting a gas than an upturned measuring cylinder in water.

Questions about changing equipment to improve results are quite common and most candidates correctly identified a gas syringe.

Where mistakes were made it was usually due to candidates incorrectly identifying the equipment as a syringe, gas meter, gas chamber or describing a potometer.

A very few responses suggested an upturned burette in water, and this was accepted for the mark. However, recording the mass of the gas using a balance did not score.

6 This question is about molecules containing two atoms.

(a) In an experiment, hydrochloric acid is reacted with zinc.

The volume of gas produced is measured by collecting the gas in an upturned measuring cylinder over water.

Give a method of collecting and measuring the gas that would give a more accurate volume of gas.

(1)

Using a gas syringe

ResultsPlus
Examiner Comments

This response scored the mark.

6 This question is about molecules containing two atoms.

(a) In an experiment, hydrochloric acid is reacted with zinc.

The volume of gas produced is measured by collecting the gas in an upturned measuring cylinder over water.

Give a method of collecting and measuring the gas that would give a more accurate volume of gas.

(1)

using a gas tube and a delivery pippete / tube.

ResultsPlus
Examiner Comments

This response did not score the mark.

The candidate has attempted to describe the set up of a gas syringe with a delivery tube but incorrectly named it as a gas tube.

Question 6(c)

This question was very poorly answered with only the most able candidates scoring any marks at all.

Candidates were required to recognise that when hydrogen halides dissolve in water then ions are formed and that these ions will be mobile in solution.

Many candidates stated that hydrogen iodide solution is a non conductor and did not score any marks. Explanations ranged from it being a covalent compound to having no free electrons to being formed from two non-metals.

Where candidates did state that the solution conducts electricity, an explanation linked to ions was required to award any marks.

(c) Iodine reacts with hydrogen to form hydrogen iodide, HI.

Explain whether or not a solution of hydrogen iodide in water conducts electricity.

(2)

yes since the H^+ ions conduct
electricity ~~to~~ when in a solution
as it's positive and free moving

ResultsPlus
Examiner Comments

This response scored two marks.

In this example the candidate has correctly identified the formation of H^+ ions, which was very rarely seen. Any response referring to the movement of ions in the solution was enough to score marks.

ResultsPlus
Examiner Tip

Hydrogen halides dissolve in water to form acids, which all contain H^+ ions.

(c) Iodine reacts with hydrogen to form hydrogen iodide, HI.

Explain whether or not a solution of hydrogen iodide in water conducts electricity.

(2)

It would ~~[illegible]~~ still conduct electricity as water would ~~[illegible]~~ allow electricity to pass through as there are hydrodgen Iodide, ions in the water.

Results Plus
Examiner Comments

This response scored one mark.

It is not well worded or described but the response does refer to the presence of ions in the water. The explanation of conductivity is not correct and does not score any more marks.

(c) Iodine reacts with hydrogen to form hydrogen iodide, HI.

Explain whether or not a solution of hydrogen iodide in water conducts electricity.

(2)

Hydrogen iodide in water does conduct electricity as the electrons are free to move around the liquid and arent packed as densely so electrons can conduct whilst gaining energy.

ResultsPlus
Examiner Comments

This response scored zero marks.

Any responses suggesting that conductivity of the solution was due to movement of electrons did not score any marks.

Question 6(d)(i)

Just over half of the responses correctly identified that the orange colour at the end of the reaction was due to the formation of bromine.

Common incorrect responses were bromide, iodine, potassium and potassium bromide.

Question 6(d)(ii)

Chemical formulae and balanced equations continue to pose a challenge to all but the most able candidates.

More than half of responses scored no marks at all with only a few scoring all three marks for a fully correct, balanced equation. One of the most commonly seen errors was the failure to recognise that the halogens form diatomic molecules and that their chemical formula should reflect this. When candidates did get this correct there were often errors in identifying the products formed in the reaction.

Some candidates lost marks through silly mistakes like using lower case 'b' or upper case 'R' in bromine, or by using iodine rather than chlorine and bromine. A few candidates wrote the equation for the formation of hydrogen iodide which was not linked to this part of the question at all.

(ii) Write the balanced equation for this reaction. **(3)**

$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

ResultsPlus
Examiner Comments

This response scored three marks.

The candidate has all correct formulae and has also correctly balanced the equation.

(ii) Write the balanced equation for this reaction. displacement

(3)

$Cl_2 + KBr \rightarrow KCl + Br_2$

ResultsPlus
Examiner Comments

This response scored two marks.

The candidate has the correct formulae for both reactants and products but there is not attempt to balance the equation.

(ii) Write the balanced equation for this reaction.

(3)

$Cl_2 + 2KBr \rightarrow 2KCl + 2Br$

ResultsPlus
Examiner Comments

This response scored one mark.

The formula of the reactants is correct, but the candidate has the formula for bromine incorrect in the products.

ResultsPlus
Examiner Tip

All halogens form diatomic molecules.

(ii) Write the balanced equation for this reaction.

(3)

Cl + kBr ⟶ Br + Clk ?

ResultsPlus
Examiner Comments

This response scored zero marks.

The candidate has not gotten the correct formula for either of the halogens and so no marks can be awarded.

Question 6(e)

The last question on the paper was a bond energy calculation.

This was slightly more challenging than in previous years in that the question specifically required the candidate to include the unit in order to get the final mark. Very few responses included the correct unit, although overall the calculation was well attempted and the majority of candidates scored some marks.

Commonly seen mistakes other than missing or incorrect units included doubling the oxygen bonds in the reactants, doubling the iodine bonds in the products and halving the number of O-H bonds in the products. Candidates also often performed the subtraction backwards and therefore giving an incorrect sign on the final answer.

(e) Hydrogen iodide reacts with oxygen to form water and iodine.

The equation for this reaction is

$$4HI + O_2 \rightarrow 2H_2O + 2I_2$$

Calculate the energy change for this reaction using the bond energies in Figure 7.

	bond	bond energy in kJ mol^{-1}
4	H—I	299
1	O=O	495
4	H—O	464
2	I—I	151

Figure 7

Include a sign and unit in your answer.

(4)

breaking

$4HI = 4 \times 299$
$= 1196$

$O_2 = 495$

$1196 + 495 = 1691$

making

$2H_2O = 4 \times 464$
$= 1856$

$2I_2 = 2 \times 151$
$= 302$

$1856 + 302 = 2158$

$1691 - 2158 = -467$

energy change = -467 kJ/mol

ResultsPlus
Examiner Comments

This response scored four marks.

The candidate has shown all working out clearly, carried out the correct calculations and included a correct sign and unit in their answer.

(e) Hydrogen iodide reacts with oxygen to form water and iodine.

The equation for this reaction is

$$4HI + O_2 \rightarrow 2H_2O + 2I_2$$

Calculate the energy change for this reaction using the bond energies in Figure 7.

bond	bond energy in kJ mol^{-1}
H—I	299
O═O	495
H—O	464
I—I	151

Figure 7

Include a sign and unit in your answer.

(4)

1196 495 1856 302

$4HI + O_2 \rightarrow 2H_2O + 2I_2$

1691 2158

energy change = −467

ResultsPlus
Examiner Comments

This response scored three marks.

The candidate has done all of their calculations correctly but not included a unit and so the final marking point cannot be awarded.

(e) Hydrogen iodide reacts with oxygen to form water and iodine.

The equation for this reaction is

$$4HI + O_2 \rightarrow 2H_2O + 2I_2$$

Calculate the energy change for this reaction using the bond energies in Figure 7.

bond	bond energy in kJ mol^{-1}
H—I	299
O═O	495
H—O	464
I—I	151

Figure 7

Include a sign and unit in your answer.

(4)

reactants: (299 × 4) + (495) = 1691

products: (464 × 2) + (151 × 2) = 1230

1691 − 1230 = 461

energy change = + 461 kJ mol^{-1}

ResultsPlus Examiner Comments

This response scored three marks.

There is only one mistake in this calculation. The candidate has correctly calculated the bond energy in the reactants but has made a mistake with the bond energy of the products by calculating only one mole of water rather than the two indicated in the balanced equation.

The rest of the calculation is correct based on the candidate's numbers and the correct unit has been included.

ResultsPlus Examiner Tip

Always include a sign in the answer to bond energy calculations, whether positive or negative.

(e) Hydrogen iodide reacts with oxygen to form water and iodine.

The equation for this reaction is

$$4HI + O_2 \rightarrow 2H_2O + 2I_2$$

Calculate the energy change for this reaction using the bond energies in Figure 7.

bond	bond energy in kJ mol^{-1}
H—I	299
O═O	495
H—O	464
I—I	151

Figure 7

Include a sign and unit in your answer.

(4)

Making

4 × HI = 299 × 4 = 1196

O=O × 2 = 495 × 2 = 990

1196 + 990 =

2186

Breaking

4 × H-O = 464 × 4 = 1856

4 × I-I = 151 × 4 = 604

1856 + 604 =

2460

2186 − 2460

= −274

energy change = −274 kJ mol^{-1}

ResultsPlus
Examiner Comments

This response scored two marks.

The bond energy in the reactants has been incorrectly calculated, with double the number of oxygen bonds. The bond energy in the products is correctly calculated.

The difference between the energy values has been correctly calculated based on these numbers but the unit is not correct (lower case j cannot be accepted for Joules) and so the final mark cannot be awarded.

(e) Hydrogen iodide reacts with oxygen to form water and iodine.

The equation for this reaction is

4H 20

$$4HI_4 + O_2 \rightarrow 2H_2O_2 + 2I_2$$

Calculate the energy change for this reaction using the bond energies in Figure 7.

bond	bond energy in kJ mol^{-1}
H—I	299
O═O	495
H—O	464
I—I	151

Figure 7

Include a sign and unit in your answer.

(4)

4 HI = 4 × 299 = 1196

O_2 = 495

$2H_2O_2$ = 4 × 464 = 1856

$2 I_2$ = (151 × 2) × 2 = 604

1196 + 495 = 1691

1856 + 604 = 2460 2460 − 1691 = $\boxed{769}$

energy change = ...

ResultsPlus Examiner Comments

This response scored one mark.

The candidate has correctly calculated the bond energy of the reactants.

The bond energy of the products is incorrect as there are double the number of iodine bonds.

The subtraction is reversed and there are no units, therefore only the first mark can be awarded.

Paper Summary

Based on their performance in this paper candidates should:

- Write their responses clearly and legibly. Examiners can only mark what they are able to read.
- Learn the differences between word, balanced and ionic equations.
- Show working for all calculations and round correctly to the specified number of decimal places or significant figures asked for in the question.
- Learn how to use standard form in calculations and remember that calculators follow BIDMAS rules.
- Understand the difference between the command words 'describe', 'explain' and 'evaluate'.
- Learn as much as possible the halogens and their reactions.
- Remember that the halogens are diatomic molecules and include this when writing their chemical formulae.
- Understand the difference between structure and bonding when describing substances.
- Practise using scientific vocabulary and avoid using generalised terms such as 'polluting' and 'dangerous' when answering questions.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link: https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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