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Examiners' Report
June 2025

GCSE Chemistry 1CH0 2H

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June 2025

Publications Code 1CH0_2H_2506_ER

Introduction

The examination paper was based on the 9-1 Chemistry specification that was first assessed in 2018. The paper consisted of ten questions, questions 2, 3 and 4 were common with the 1CH0_2F Chemistry (Foundation) tier paper and questions 2,3,5,6,7 and 8 were common with the 1SC0_2CH Combined Science (Higher) tier paper. As with the other examination papers that have assessed the current specification, a wide variety of question types were used that were suitable for this level, which included multiple choice, short open response, interpreting diagrams of apparatus and graphs and calculations appropriate for the Higher tier. This examination paper also assessed writing simple balanced and half (ionic) equations and writing open-ended answers in the 6-mark questions. Paper 2 assesses the following topics:

Topic 1 – Key Concepts in Chemistry – also assessed in Paper 1

Topic 6 – Groups in the Periodic Table

Topic 7 – Rates of reaction and energy changes

Topic 8 – Fuels and Earth Science

Topic 9 – Separate chemistry 2: Qualitative analysis, Hydrocarbons, Polymers, Alcohols and carboxylic acids, and Bulk and surface properties of matter including nanoparticles.

This examination paper targeted grades 4 - 9 with about half the marks targeting grades 4 and 5. It was also noted that on this paper most of the candidates performed extremely well on the two 6-mark questions.

Question 1(b)(ii)

The majority of the candidates understood the meaning of this hazard warning symbol, although many examiners considered it to be 'unfamiliar to most'. A few candidates tried to explain the word explosive or give other hazards alongside which would normally be contradictory.

(ii) A bottle of this substance is labelled with the hazard symbol in Figure 2.

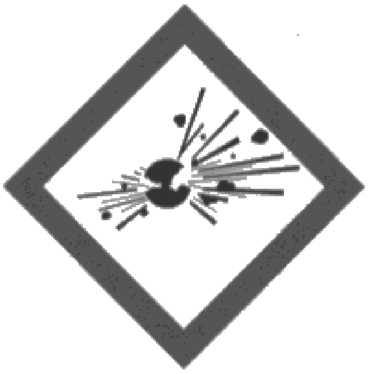


Figure 2

State the danger associated with the contents of this bottle.

Corrosive

ResultsPlus
Examiner Comments

Zero marks.

Other descriptions were ignored.

(ii) A bottle of this substance is labelled with the hazard symbol in Figure 2.

Figure 2

State the danger associated with the contents of this bottle.

Explosive

ResultsPlus
Examiner Comments

One mark.

One word was all that was needed.

ResultsPlus
Examiner Tip

Know what the hazard symbols mean.

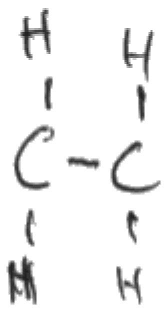
Question 1(c)

The greater majority drew the full displayed formula of ethene correctly. A significant number drew the dot and cross diagram which was also credited.

Of those that scored zero, most missed the double bond between the two C atoms or did not read the question and drew a structure with just one C atom and one hydrogen atom.

(c) Yellow bananas emit ethene gas, C_2H_4.

Draw one molecule of ethene, showing all covalent bonds.



ResultsPlus
Examiner Comments

Zero marks.

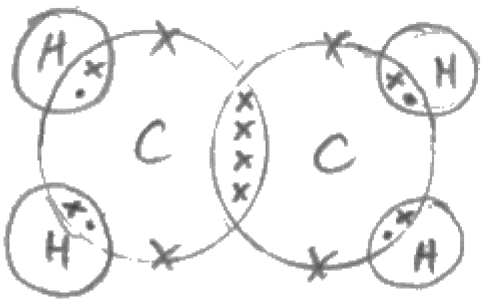
The double bond between the two carbon atoms had to be present to score the first mark.

ResultsPlus
Examiner Tip

Learn the structures and displayed formulae of the alkanes and alkenes as listed in the specification.

(c) Yellow bananas emit ethene gas, C_2H_4.

Draw one molecule of ethene, showing all covalent bonds.



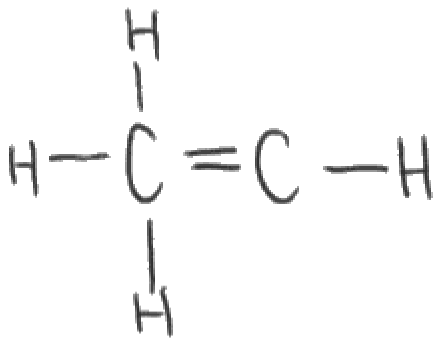
ResultsPlus
Examiner Comments

One mark.

Dot and cross diagrams were accepted, but on this one there was a significant error – too many electrons around each carbon atom. So this scored just for the >C=C<.

(c) Yellow bananas emit ethene gas, C_2H_4.

Draw one molecule of ethene, showing all covalent bonds.



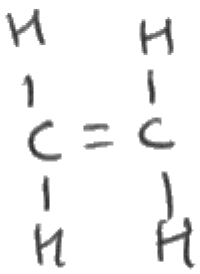
ResultsPlus
Examiner Comments

Zero marks.

There were too many bonds around the left side C atom and too few around the right side. So this could not score for >C=<.

(c) Yellow bananas emit ethene gas, C_2H_4.

Draw one molecule of ethene, showing all covalent bonds.



ResultsPlus
Examiner Comments

Two marks.

A correct answer.

Question 1(d)

This was a very simple calculation and over 90% of candidates obtained the correct answer.

(d) Gold has a yellow colour.

A gold nanosphere has a surface area of 305 nm^2.
The surface area to volume ratio is 1 : 4.60.

Calculate the volume, in nm^3, of the gold nanosphere.

(1)

x 305 (1 : 4·60) x 305

305 : 1403

Results Plus
Examiner Comments

One mark.

A correct answer.

(d) Gold has a yellow colour.

305 :
1 : 4.6

A gold nanosphere has a surface area of 305 nm^2.
The surface area to volume ratio is 1 : 4.60.

Calculate the volume, in nm^3, of the gold nanosphere.

305 × 4.6 = 16.1

ResultsPlus Examiner Comments

Zero marks.

One of the few incorrect answers seen.

Question 2(a)

A wide variety of names for equipment were seen, but the ones that were credited were measuring cylinders, (graduated/volumetric) pipettes and burettes. The piece of equipment named had to measure the volume of a liquid more accurately than a beaker. Names such as measuring beaker, measuring syringe or similar were not credited.

2 When solutions **P** and **Q** are mixed together, a purple mixture forms.
This mixture slowly becomes colourless.

(a) A student pours 25 cm^3 of solution **P** into a conical flask and then adds 25 cm^3 of solution **Q**.

The student uses a beaker to measure out these volumes.

Name a piece of apparatus that could be used to measure these volumes more accurately.

measuring cylinder

ResultsPlus
Examiner Comments

One mark.

This answer along with pipette were the most frequently seen correct answers.

Name a piece of apparatus that could be used to measure these volumes more accurately.

Titration ~~device~~ dropper

ResultsPlus
Examiner Comments

Zero marks.

Presumably this was meant to be 'burette'.

ResultsPlus
Examiner Tip

Learn the names of commonly used equipment in laboratory experiments.

Question 2(b)(i)

The greater majority of the candidates could offer a sensible variable to be controlled as their answer. Most gave volume as their answer, but there were several errors seen such as 'same beakers', 'same temperature' and 'same concentrations of solutions': beakers were not used in the experiment, the objective of the experiment was to investigate the effect of changing the temperature and the question had already said the concentrations of solution were kept constant.

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

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

colour of cross

ResultsPlus
Examiner Comments

One mark.

A valid variable.

ResultsPlus
Examiner Tip

Read the whole question to avoid suggesting a variable when it has already been given in the question as either being controlled or investigated.

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

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

(1)

The person looking at the experiment as different people see differently.

ResultsPlus
Examiner Comments

One mark.

This was another valid variable that should be controlled.

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

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

concentration of both solutions

ResultsPlus
Examiner Comments

Zero marks.

This was already stated as being controlled.

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

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

volume of both solutions.

ResultsPlus Examiner Comments

One mark.

Probably the most frequently correct answer seen.

Question 2(b)(ii)

Very few candidates scored zero on this question. Most candidates gave an answer that scored full marks by linking the increased temperature to particles having more energy leading to more frequent collisions.

Sometimes there was a disconnect between the increased temperature increasing the energy available and particles. Sometimes candidates just referred to ‘more collisions’ rather than the increased frequency of collisions.

1

(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)

At 80°C the temperature would increase beyond optimum causing rate of reaction to slow down as kinetic energy of particles would decrease so there are less successful collisions due to less movement of particles so there are less successful collisions.

ResultsPlus
Examiner Comments

Zero marks.

This answer gave the opposite arguments for a correct answer.

(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)

particles would gain even more energy from the higher temperature but may denature due to the temperature being above optimum, meaning the reaction slows down.

ResultsPlus
Examiner Comments

One mark.

Particles gaining energy scored the mark here. Several candidates tried to use argments about higher temperatures causing inactivity of enzyme reactions.

(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 time taken would decrease - higher temperature means particles have more ~~KE~~ ∴ move faster so there are more frequent collisions. There are also more successful collisions as ~~the~~ particles have more energy to overcome the activation energy. Rate of reaction increases, so time taken decreases.

ResultsPlus
Examiner Comments

Three marks.

This answer scored three marks just for the first sentence – it mentioned time decreasing, particles having more kinetic energy leading to more frequent collisions. The rest of the answer could have also scored as that was relevant material as part of a total answer.

(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)

If a temperature of 80°C is used, the time taken will decrease. This is because the higher temperature increases the energy of the particles, allowing them to gain more kinetic energy and collide more, therefore speeding up the rate of reaction, making the solution see-through in less time.

ResultsPlus
Examiner Comments

Two marks.

This scored for what happened to the time and for the increase in energy for the particles. More collisions alone was insufficient to score a mark.

ResultsPlus
Examiner Tip

Learn the finer details about collision theory and rates of reaction.

Question 2(c)

This was a straightforward calculation of the mass of solid Q given the volume and concentration of its solution. The most frequent seen was in the conversion of units of volume from cm^3 to dm^3.

(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**.

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

$\frac{25}{1000} = 0.025$ $\qquad c \times v = m$

$28.6 \times 0.025 = 0.715$

ResultsPlus
Examiner Comments

One mark.

This answer scored for the conversion of units of volume from cm^3 to dm^3 by dividing the volume by 1000.

There was a transcription error in the second part of the calculation so this lost the second mark.

(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**.

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

$26.8 gdm^{-3} = \frac{\text{mass of solid}}{25cm^3}$

mass = $26.8 \times 25 =$ ~~650~~ 670

Examiner Comments

One mark.

This calculation started by using the rearranged equation (26.8 x 25 = 670) correctly but then did not divide by 1000 to change the unit of volume.

Examiner Tip

Practise this type of calculation with and without access to the mathematical expression.

(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**.

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

$$26.8 = \frac{\text{mass}}{25 \div 1000}$$

$$26.8 \times 0.025 = 0.67$$

Examiner Comments

Two marks.

The correct solution.

Question 2(d)

Most answered this question successfully by referring to the effect of the catalyst on the rate of reaction along with an explanation which was mostly lowering activation energy or following an alternative reaction route. Very few candidates failed to score even one mark on this question, but those who did score only one mark generally described the catalyst as something that increased the rate of reaction without being used up, or referred to the catalyst as being denatured, or provided energy to the particles.

(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)

rate of

The catalyst will speed up the reaction by increasing ~~energy in the particles~~ activation energy in the particles.

ResultsPlus
Examiner Comments

One mark.

This scored for just speeding up the reaction. Not many suggested that the activation energy would be increased by using a catalyst.

*mark ?

(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 Calatesy will increase the Rate of ~~Ractam~~ Reaction by increasing the Number of Sucessful callisons.

ResultsPlus
Examiner Comments

Two marks.

Both marking points were scored here.

(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 will increase the rate of reaction.

ResultsPlus
Examiner Comments

One mark.

There was only a comment about the effect on the rate of reaction.

(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 catalyst will speed up the reaction → increases the rate of reaction as it lowers the activation energy and creates an alternative pathway.

Two marks.

A completely correct answer.

Question 3(a)(i)

Alkanes was the most popular correct answer with alkenes as the most popular incorrect answer.

3 Crude oil is a mixture of hydrocarbons.

(a) (i) The majority of hydrocarbons in crude oil belong to one homologous series.

Give the name of this series.

Alkanes

ResultsPlus
Examiner Comments

One mark.

A correct answer.

3 Crude oil is a mixture of hydrocarbons.

(a) (i) The majority of hydrocarbons in crude oil belong to one homologous series.

Give the name of this series.

Fuels

ResultsPlus Examiner Comments

Zero marks.

'Fuels' is not an homologous series.

3 Crude oil is a mixture of hydrocarbons.

(a) (i) The majority of hydrocarbons in crude oil belong to one homologous series.

Give the name of this series.

alkenes

ResultsPlus
Examiner Comments

Zero marks.

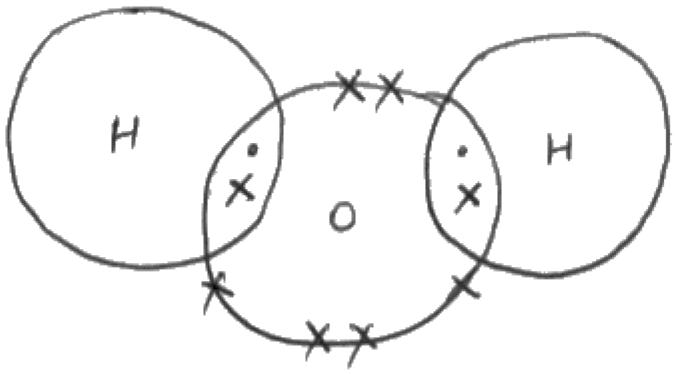
Alkenes was the most common error seen on this question.

Question 3(b)

Most candidates could draw the correct dot and diagram. The errors seen included too many electrons on oxygen, extra electrons on hydrogen and the wrong formula – mostly OH_2.

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

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



ResultsPlus
Examiner Comments

One mark.

The shared pair of electrons between the O atom and a H atom scored the mark.

There were too many electrons around the O atom for the second mark.

ResultsPlus
Examiner Tip

Practise drawing the dot and cross diagrams for those elements and compounds listed in the specification.

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

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

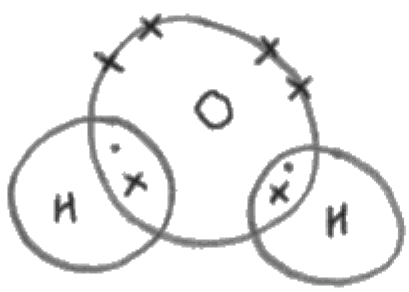
H_2O

One mark.

First mark was scored for a shared pair of electrons between O and H. This time not enough electrons around the O atom for the second mark.

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

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



ResultsPlus
Examiner Comments

Two marks.

A fully correct dot and cross diagram of water.

Question 3(c)

For most candidates, the calculation of the empirical formula of the hydrocarbon was very straightforward. Those that started with calculating the number of moles of each element generally scored full marks. Those that started by adding or multiplying the masses went wrong immediately and often produced little that could be credited. There were some (fewer than previous times) that inverted the fraction for calculating the number of moles and some just calculated just the simplest ratio. Another common mistake seen was where candidates only used the masses of 0.96 g and 0.32 g to obtain the simplest ratio of 3:1.

(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)

H	C
0.32	0.96
1	12

0.32 ÷ 1 = 0.32

0.96 ÷ 12 = 0.08

0.32 ÷ 0.08 = 4

0.08 ÷ 0.08 = 1 CH_4

empirical formula of this compound = CH_4

ResultsPlus
Examiner Comments

Three marks.

A well executed calculation leading to the correct 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)

	carbon	hydrogen
mass	0.96	0.32
RAM	12	2
m/RAM	$\frac{0.96}{12} = 0.08$	$\frac{0.32}{2} = 0.16$
÷small	$\frac{0.08}{0.08} = 1$	$\frac{0.16}{0.08} = 2$
ratio	1	: 2
ANS	CH_2	

empirical formula of this compound = CH_2

ResultsPlus
Examiner Comments

Two marks.

The candidate had divided the mass of hydrogen by the formula mass of hydrogen, H_2, rather than the relative atomic mass of hydrogen.

This led to the simplest whole number ratio as 1:2 and hence the empirical formula from this whole number ratio then scored two marks.

(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)

$12 \times 0.96 \quad + \quad 0.32 \times 1 = 11.84$

empirical formula of this compound = 11.84

(Total for Question 3 = 7 marks)

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Examiner Comments

Zero marks.

Many of weaker candidates did not know how to set about this calculation.

(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)

~~mol~~	C	H	
mass	0.96	0.32	2u
mr	12	1	
mol	0.08	0.32.	
	~~4~~ 4	: 1	

empirical formula of this compound = C_4H

Two marks.

Calculating the number of moles of each element – correct, one mark.

Simplest ratio from number of moles of element – incorrect, so no marks.

Empirical formula from simplest ratio – correct, one mark.

Question 4(a)(ii)

For this cohort, this should have been a very straightforward question by stating that the monomer molecules break open the double bond and then bond together. However, many wrote about and described the process as being addition polymerisation without further detail of what was involved in that process. Several missed scoring the second mark by repeating the question '... combine to make polymers'. It was disappointing to see just over a third of the candidates scoring two marks on what should be a straightforward question.

(ii) Describe how monomer molecules combine to make polymers.

(2)

The ~~[illegible]~~ ~~[illegible]~~ C=C bond breaks to form bonds with the monomer adjacent to it. The monomers are small repeating units and the ~~[illegible]~~ link to each other forming a chain (polymer).

ResultsPlus
Examiner Comments

Two marks.

Marks scored for the C=C bond breaking within a monomer and new bonds being formed with other monomers.

(ii) Describe how monomer molecules combine to make polymers.

(2)

They join in a repeating chain with single bonds between them

ResultsPlus
Examiner Comments

One mark.

There was no mention of the C=C bond breaking but the second mark was given for the joining of the monomers to form a polymer chain.

(ii) Describe how monomer molecules combine to make polymers.

(2)

they create chains ~~&~~ which allow them to become larger Molecules and Polymers

ResultsPlus
Examiner Comments

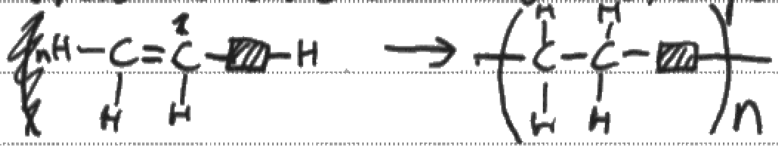
Zero marks.

There was no breaking of a C=C bond or joining of monomers in the answer to gain credit.

(ii) Describe how monomer molecules combine to make polymers.

(2)

~~Addeta~~ monomers with a double carbon bond ~~break~~
break that double bond and joing to anothermonomer



Two marks.

This correct answer was helpfully illustrated with an equation to show what was happening.

Question 4(b)

Given the advantages in the table of data, many candidates opted to use 'hard to tear' and so the crisps 'would not go stale' or 'not fall out'. Those that opted for 'lower relative mass' often became unstuck for the second mark as they then usually referred to the crisp packets being 'easier to carry' or 'lighter to carry' without thinking about the actual difference in mass it would make in reality. Only about a third of the candidates scored two marks on this question.

(b) Crisps go stale when exposed to the atmosphere.

In an experiment some crisp packets were made from aluminium, some from poly(propene) and some from poly(propene) coated with aluminium.
These packets were tested.

Figure 5 shows the results.

crisp packet material	relative porosity to water and oxygen	easily recycled?	relative mass	easily torn?
aluminium	low	yes	high	yes
poly(propene)	high	yes	low	no
poly(propene) coated with aluminium	low	no	low	no

Figure 5

Low porosity is an advantage of using poly(propene) coated with aluminium as it prevents the crisps from becoming damp.

Explain, using Figure 5, **one** other advantage of using poly(propene) coated with aluminium.

(2)

• it is not easily torn
• meaning the packet will not rip and the crisps will not go stale before eating them
• less crisp waste.

ResultsPlus
Examiner Comments

Two marks.

One mark for not easily torn.

One mark for the crisps will not go stale.

Low porosity is an advantage of using poly(propene) coated with aluminium as it prevents the crisps from becoming damp.

Explain, using Figure 5, **one** other advantage of using poly(propene) coated with aluminium.

(2)

It is not easily torn so, it can be transported more easily.

ResultsPlus
Examiner Comments

One mark.

The mark was scored for the packet not being easily torn. There were other factors that allow the crisp packets to be transported safely – these were beyond the scope of the question.

Low porosity is an advantage of using poly(propene) coated with aluminium as it prevents the crisps from becoming damp.

Explain, using Figure 5, **one** other advantage of using poly(propene) coated with aluminium.

(2)

Poly (propene) coated with aluminium is not easily torn as it prevents the crisps to fall out of the ~~pocted~~ pocket easily.

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Examiner Comments

Two marks.

One mark for the bag is less easily torn.

One mark for stops the crisps falling out.

Question 4(c)(i)

Candidates were not particularly successful on this question with less than 10% scoring two marks. Candidates did score for stating that the packets would be lighter or would have lower mass. Many answered the question in terms of recycling, but ignored any difficulties of separating the coating and the poly(propene) materials. Many answers were seen where candidates wrote about how ingesting the crisp packets would present no issue as the nanosheet coating was made from amino acids, forgetting about ingestion of the poly(propene) part of the crisp packet.

(c) The aluminium coating can be replaced by a very thin layer of material called a nanosheet.

The nanosheet is made from amino acids and is less than 100 nm thick.

(i) Explain why the nanosheet layer would be better than aluminium as a coating for crisp packets.

(2)

The nanosheet layer will have a high surface area to volume ratio so will have better coverage than aluminium for less material used. This also means the packet will weigh less.

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Examiner Comments

One mark.

Many candidates wrote about the nanosheet having a high surface area: volume ratio and that only a small amount would then be needed. One mark was given for the packet being of lower mass as a result.

(c) The aluminium coating can be replaced by a very thin layer of material called a nanosheet.

The nanosheet is made from amino acids and is less than 100 nm thick.

(i) Explain why the nanosheet layer would be better than aluminium as a coating for crisp packets.

(2)

It cannot be easily torn meaning that it is more resillant and able to easily withstand transport.

ResultsPlus
Examiner Comments

Zero marks.

Many used information from the table of data in the previous part (Q04(b)) to answer this question, but they had no evidence to suggest that crisp packets coated in the nanosheet would be less or more easily torn.

(c) The aluminium coating can be replaced by a very thin layer of material called a nanosheet.

The nanosheet is made from amino acids and is less than 100 nm thick.

(i) Explain why the nanosheet layer would be better than aluminium as a coating for crisp packets.

(2)

Because aluminium's relative ~~ato~~ mass is high, and nanosheets are less than 100mm thick, making it a lighter packaging method.

ResultsPlus
Examiner Comments

One mark.

This represents the typical answer seen on this question where the candidate scored one mark for saying that the mass of the crisp packet coated in the nanosheet would be lower.

(c) The aluminium coating can be replaced by a very thin layer of material called a nanosheet.

The nanosheet is made from amino acids and is less than 100 nm thick.

(i) Explain why the nanosheet layer would be better than aluminium as a coating for crisp packets.

(2)

the packet would be Cheaper to make As less material is being used Perpacket. And Will Do the Same Thing And Reduce the mass

ResultsPlus
Examiner Comments

Two marks.

Two mark answers were not often seen on this question:

One mark for the packet being of lower mass.

One mark for the cost then to be lower.

Question 4(c)(ii)

About half the candidates successfully calculated the mass of water produced in the reaction described. The more successful ones started their answer by calculating the number of moles of the amino acid then used the mole ratio of amino acid: water from the equation and then found the mass of water. The weaker candidates tended to start with using the balanced equation initially to give 3 x 75 = 225 g of amino acid produced 2 x 18 g of water. But for many, they then did not know what to do following that.

There were many points within the calculation where errors could have been made but the marking mitigated those situations.

(ii) Nanosheet layers can be made from amino acids.

An equation showing a reaction of an amino acid, $C_2H_5NO_2$, is

0.46 moles

$$3C_2H_5NO_2 \rightarrow C_6H_{11}N_3O_4 + 2H_2O$$

Calculate the mass of water formed when 105 g of this amino acid reacts.

(relative formula masses: $C_2H_5NO_2 = 75$, $H_2O = 18$)

(2)

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

moles = $\frac{105\text{g}}{75 \times 3}$ $0.46 = \frac{\text{mass}}{18 \times 2}$

mass = 0.46×36

$= \frac{105}{225} = 0.46$ $= 16.8$

mass of water = 16.8 g

ResultsPlus
Examiner Comments

Two marks.

A well executed answer obtaining the correct result.

(ii) Nanosheet layers can be made from amino acids.

An equation showing a reaction of an amino acid, $C_2H_5NO_2$, is

$$3C_2H_5NO_2 \rightarrow C_6H_{11}N_3O_4 + 2H_2O$$

Calculate the mass of water formed when 105 g of this amino acid reacts.

(relative formula masses: $C_2H_5NO_2 = 75$, $H_2O = 18$)

(2)

$75 \times 3 = 225 \rightarrow 36 + 189$

$1 : 2$

$Ml = \frac{m}{mr}$ $1.4 = \frac{105}{75}$ $1.4 = \frac{50.4}{18}$ ~~25.2 g~~

2.8

25.2

mass of water = ~~50.4~~ g

ResultsPlus
Examiner Comments

One mark.

This candidate scored the one mark for showing calculating 3 x formula of the amino acid and 2 x formula mass of water.

Question 4(d)(i)

Most candidates scored the mark for naming the functional group as 'carboxylic acid' or as 'carboxyl'.

(d) Some crisps contain malic acid.

The structure of one molecule of malic acid is shown in Figure 6.

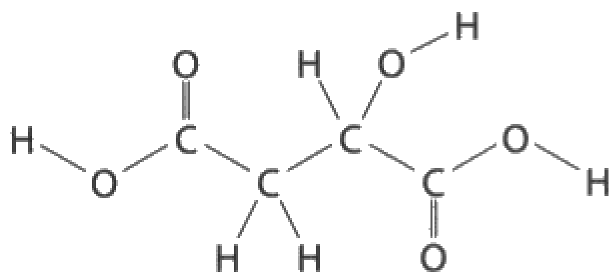


Figure 6

(i) Malic acid has two types of functional group.

One type is the –COOH functional group.

Give the name of this functional group.

Alcohol

ResultsPlus
Examiner Comments

Zero marks.

About 75% scored the mark, but not for this answer.

(d) Some crisps contain malic acid.

The structure of one molecule of malic acid is shown in Figure 6.

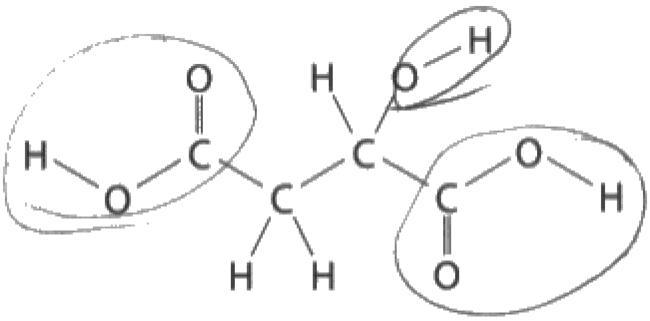


Figure 6

(i) Malic acid has two types of functional group.

One type is the –COOH functional group.

Give the name of this functional group.

Carboxylic acid

ResultsPlus
Examiner Comments

One mark.

A correct answer.

ResultsPlus
Examiner Tip

Learn the meaning of the term 'functional group' and be able to identify the functional groups as found in this specification.

Question 4(d)(ii)

Most candidates scored the mark; many used the term ‘hydroxyl’ for the name of the group. There were several candidates who thought the functional group was called 'diol', 'hydroxide' or 'ester'.

(ii) Name the other functional group.

-OH

ResultsPlus
Examiner Comments

Zero marks.

The -OH group is the functional group, but that is not its **name**.

(ii) Name the other functional group.

Alcohol, -OH

ResultsPlus
Examiner Comments

One mark.

The name and its formula were identified in this answer.

(ii) Name the other functional group.

alkene

Results Plus
Examiner Comments

Zero marks.

The alkene functional group, >C=C<, is not found within the formula of malic acid.

Question 5(b)(i)

As would be expected, most candidates could give two suitable observations for the reaction between potassium and water. The most common observations given were effervescence, a flame and the metal disappearing. In most cases the flame colour was correct. A few spoilt their answers by saying a gas was given off instead of effervescence. Only a very small number of candidates could not give a suitable observation.

(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.

• Very Vigourous bubbling

• gas emitting from the water

ResultsPlus
Examiner Comments

One mark.

This scored for 'bubbling'. The second bullet is just an interpretation of the first bullet.

(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.

• Lilac flame and sparks produced

• Potassium dissappears

ResultsPlus
Examiner Comments

Two marks.

Marks were given for lilac flame and for 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 effervescence and the potassium moving around the water.

ResultsPlus
Examiner Comments

Two marks.

Marks were given for effervescence and for the potassium moving around the water.

Question 5(b)(ii)

Mostly, this question was answered well with about half the candidates scoring all three marks. Most of the candidates wrote about both lithium and potassium comparing the number of electron shells as the first part of their argument. The middle part of their argument invariably mentioned the outer shell being further from the nucleus in potassium which then meant the attractive force between the nucleus and the outer shell was weaker. A significant number at this point included electron shielding in their answer, which was good to see as in most cases it was explained well. The end part of their argument then compared the difficulty of the atoms losing their outermost electron as a result.

The most common errors see were the attractive forces being described as intermolecular, electromagnetic or magnetic or not saying where the force was acting, usually as 'there are greater attractive forces on the electron in lithium'. Occasionally it was seen that candidates did not identify the electron being lost as the OUTER electron and some thought that potassium had more electrons to lose than lithium.

(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)

Lithiums 1 outer electron is in on electron shell closer to the nucleus of the atom so the intermolecular forces are stronger - making it harder to lose. Potassiums 1 outer electron is in an electron shell farther from the nucleus so intermolecular forces are weaker - making it easier to lose

ResultsPlus
Examiner Comments

One mark.

This scored for the electron being closer to the nucleus in Li and further away in K. The use of 'intermolecular forces' limited the mark here to just one.

(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
• Lithium atom is smaller
• Electrostatic forces of attraction between nucleus and outer most electron are stronger
• Its harder to lose this electron

ResultsPlus
Examiner Comments

Three marks.

The use of the comparative here has shown that a comparison with potassium was made. This then scored three marks.

(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)

Because potassium ~~only has 1 outer electron and will combine with others~~ has 2 more full electron shells then lithium so much more energy is released when these shells are broken.

ResultsPlus
Examiner Comments

One mark.

This just scored the mark for fewer full electron shells in lithium than 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~~ is 2,1 where as potassium is 2,8,8,1 meaning ~~the requires less energy~~ there is weaker forces of attraction between its nucleus and the outer electrons in potassium so they are lost easier.

ResultsPlus Examiner Comments

Two marks.

Marks were given for:

- the electronic configurations of both Li and K showing the difference in number of electron shells;
- the weaker forces of attraction between the nucleus and the outer electron in K.

'so they are lost easier' was not credited as it was not clear what this referred to.

Question 5(b)(iii)

Comparatively, this was quite badly answered. Although most wrote the formula of carbon dioxide on the left-hand side, relatively few identified and wrote the formula of water over on the right-hand side. Invariably, the formula of hydrogen, H_2, was given instead. In most cases, if the correct formulae were given, balancing the equation was usually correct.

The most common errors seen were the inclusion of Na in front of the OH^- on the left-hand side and charges being applied to CO_2 and 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)

2 OH^- + CO_2 → CO_3^{2-} + $2H_2O$

ResultsPlus
Examiner Comments

One mark.

This had the correct formulae, but was not balanced correctly.

O 3 H 1 C 1 O 3 H 2 C 1

(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)

$2\ OH^- + CO_2^- \rightarrow CO_3^{2-} + H_2$

ResultsPlus
Examiner Comments

Zero marks.

The inclusion of charges on the formulae was seen quite often.

ResultsPlus
Examiner Tip

Practise writing and balancing ionic equations.

(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-} + NaH

ResultsPlus
Examiner Comments

Zero marks.

Candidates writing Na in front of OH^- was seen very often in this ionic 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

Two marks.

Correct formulae and correct balancing.

Question 5(c)

This question was answered quite well with about half the candidates scoring two marks for the correctly calculated answer.

However, there were several common errors seen. Multiplying the relative atomic mass of Cs x Avogadro constant accounted for most of them – this was quite surprising in some ways since the product of that sum, 8.001×10^{25} g is such a large mass that those candidates who gave that answer did not question the magnitude of that value. The other main error that was seen concerned significant figures. Some rounded too early: using 132 or 133 instead of 132.905 as given. Some rounded incorrectly: $2.20772425249 \times 10^{-22}$ became 2.207×10^{-22}. It was also reported that several candidates missed the negative sign in front of the exponent.

(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)

$$\frac{132.905}{6.02 \times 10^{23}} = 2.143629032 \times 10^{-22}$$

mass = $2.1436219032 \times 10^{-22}$ g

ResultsPlus
Examiner Comments

One mark.

The correct mathematical process shown, but with an incorrect evaluation. The candidate here had actually divided the relative atomic mass of Cs by 6.20×10^{23} rather than 6.02×10^{23}.

ResultsPlus
Examiner Tip

Always check calculations to check for any errors.

(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)

$132.905 \times 6.02 \times 10^{23} = 8.00081 \times 10^{25}$

$132.905 \div 6.02 \times 10^{23} = 2.207724 \ldots \times 10^{25}$

mass = 8.00081×10^{25} g

ResultsPlus
Examiner Comments

One mark.

The candidate has tried two different calculations using the information provided. The candidate chose the answer to the wrong calculation but scored one mark as the evaluation was correct from an incorrect mathematical process.

(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)

$132.905 \div (6.02 \times 10^{23}) = 2.2 \times 10^{-22}$

mass = 2.2×10^{-22} g

ResultsPlus
Examiner Comments

Two marks.

A correct calculation with correct approximation to 2 significant figures.

ResultsPlus
Examiner Tip

Never approximate too early in a calculation. If no set number of significant figures or decimal places has been asked for, it is preferable to use 3 significant figures in those instances. 1 significant figure is normally not acceptable.

Question 6(a)

This question was generally very well answered with the idea of the full outer electron shell of xenon not losing, gaining or sharing electrons to account for its unreactivity.

Several candidates attempted, unsuccessfully, to write out the electronic configuration of xenon which left them saying that there were 4 electrons in the outer shell. Others did know that since xenon is in group 0 they then went on to say that Xe had 0 electrons in its outer shell.

6 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 due to its large amount of shells and stable configuration doesnt need to lose or gain an electron

ResultsPlus
Examiner Comments

One mark.

This candidate only scored the second mark for stating that xenon (atoms) would not lose or gain electrons.

6 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 has a full outer shell of electrons, making it have no need to react.

ResultsPlus
Examiner Comments

One mark.

The full outer shell scored one mark here. There was no reference to electrons being gained, lost or shared for the second mark.

6 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 has a full outer shell of electrons so doesn't need to gain or lose electrons to react with other elements to obtain a full outershell or form an ion.

Two marks.

Both marking points scored in this answer.

Question 6(b)(i)

Just over half the candidates could complete the balanced equation. There were a few who used incorrect atomic symbols: XE and Fl, but the most frequent error seen was not having diatomic fluorine in the equation.

(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.

$Xe + 2Fl_2 \rightarrow XeF_4$

ResultsPlus
Examiner Comments

Zero marks.

An example of where the incorrect atomic symbol for fluorine was used.

(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.

Xc + 4f → xef 4

ResultsPlus
Examiner Comments

Zero marks.

Fluorine as a diatomic molecule was not shown.

(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.

$Xe + 2F_2 \rightarrow XeF_4$

ResultsPlus
Examiner Comments

One mark.

Just one mark for the correct balanced equation.

Question 6(b)(ii)

Most candidates identified the correct bonding type: covalent, but many made no reference to the structure type within their answer. The reason for choosing covalent as the bonding largely came down to xenon tetrafluoride not having any delocalised electrons which could move as a way of accounting for the substance not being a conductor of electricity.

For many candidates, the melting point of 117ºC was considered to be very high, and for that reason they suggested the structure type as being 'giant'.

Only about 15% of the candidates scored full marks on this question.

(ii) Some information about xenon tetrafluoride is shown in Figure 7.

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

Figure 7

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

(3)

Xenon tetra fluoride is a covalent ~~coun~~ compound as it does not conduct electricity. It has a giant lattice structure with ~~weak~~ strong electrostatic forces which ~~explains~~ is why it has a high melting point.

ResultsPlus Examiner Comments

One mark.

This answer just scored for the bonding type – covalent.

Many candidates thought 117°C was a high temperature which meant that structure type was often incorrect as they said it had a giant structure.

ResultsPlus Examiner Tip

Melting point temperatures about 400°C are considered to be 'high'; below 200°C are generally considered as being 'low'.

(ii) Some information about xenon tetrafluoride is shown in Figure 7.

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

Figure 7

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

(3)

- A simple molecular substance with a regular lattice structure.
- atoms are bonded by covalent ~~bong~~ bonds which are strong but weak intermolecular forces of attraction between atoms which need little energy to break – ~~[illegible]~~ low melting point.
- cannot conduct electricity as it has no free electrons or ions to carry a ~~charge~~ charge.

ResultsPlus
Examiner Comments

Three marks.

The answer included the structure and bonding type of xenon tetrafluoride. After that followed two correct statements to justify the structure and bonding type, but only one was required.

Question 6(c)

Most candidates could draw a correct energy profile for an exothermic reaction. Of those most had the correct labels for the energy change and activation energy but a smaller number correctly labelled the vertical axis.

Where candidates drew an energy profile for an endothermic change, marks were still awarded for the correctly labelled vertical axis and for the activation energy and overall energy change.

Common errors included mislabelling the vertical axis such as temperature or energy change, pointing to the peak and labelling that as the activation energy and, when it was included, often the overall energy change appeared as an arrow going from the peak down to the products line.

(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 8

- 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)

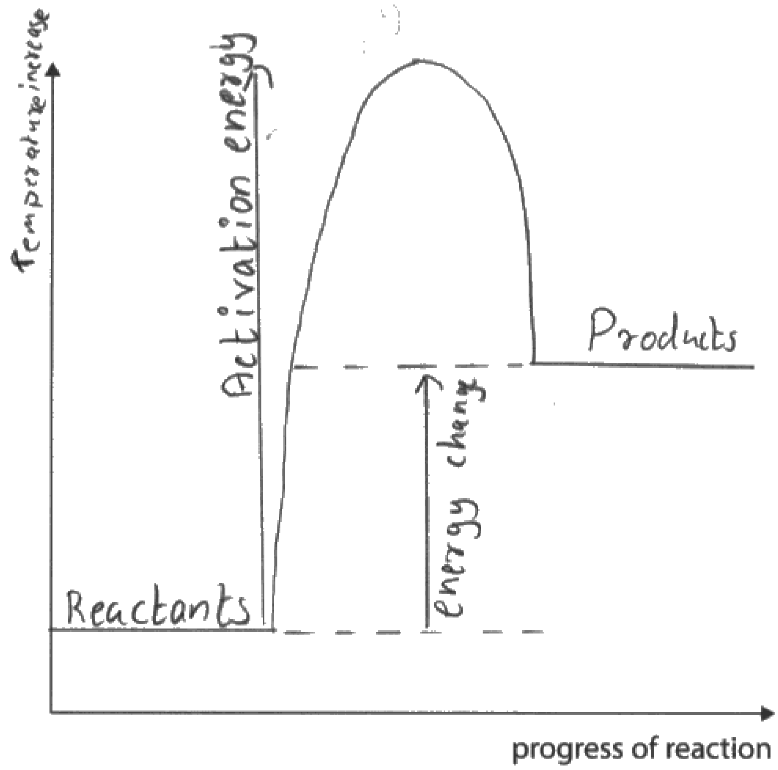


Figure 8

ResultsPlus
Examiner Comments

One mark.

This candidate had drawn the reaction profile for an endothermic reaction. That line did not score, nor did the 'temperature increase' label on the vertical axis. However, one mark was given for the correct labelling of the activation energy and the energy change for the endothermic reaction.

ResultsPlus
Examiner Tip

Learn how to draw and label reaction profiles for both exothermic and endothermic reactions.

(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 8

- 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)

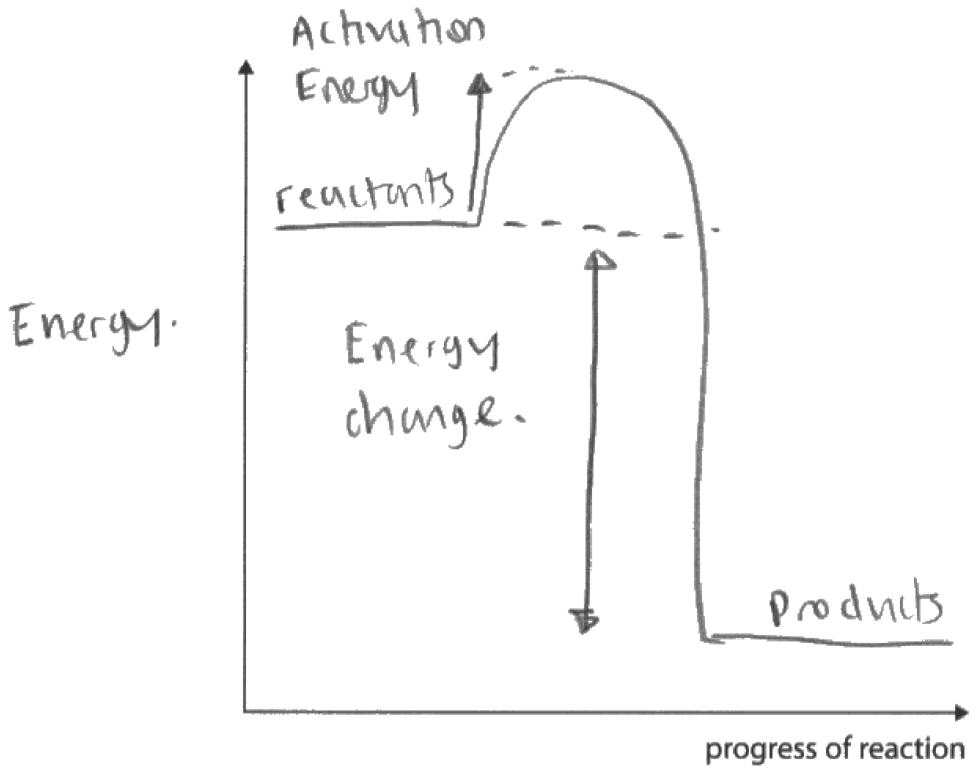


Figure 8

ResultsPlus
Examiner Comments

Three marks.

A correctly drawn profile scoring on all three marking points.

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

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

On Figure 8

- 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)

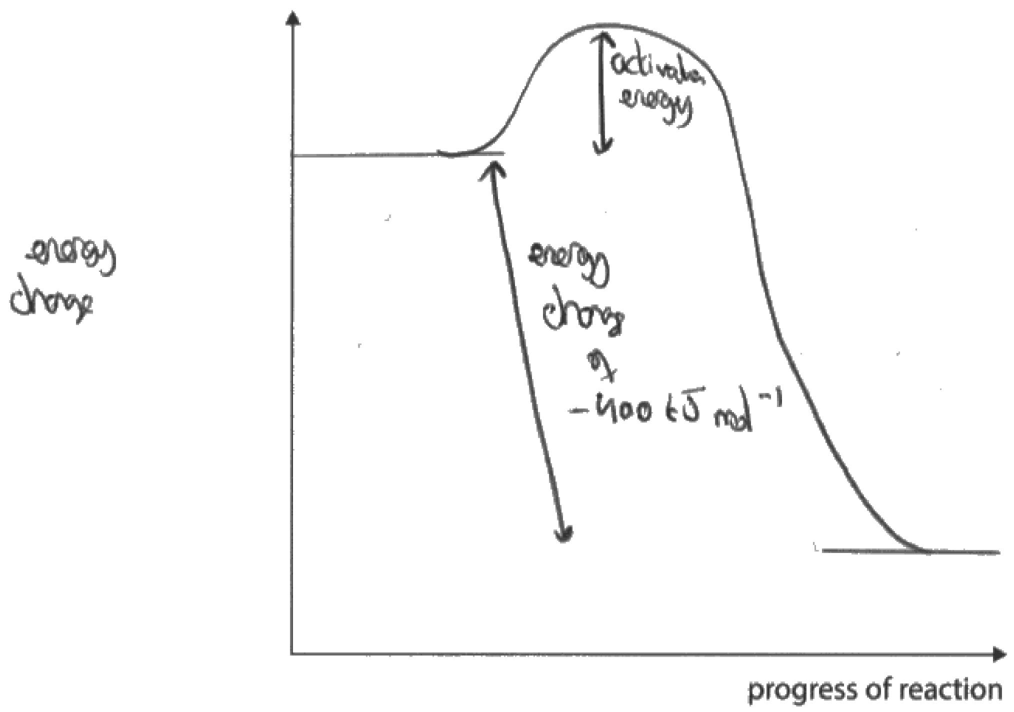


Figure 8

ResultsPlus
Examiner Comments

Two marks.

The correct profile was drawn – reactants higher than products, as well as the correct labelling of the activation energy and energy change of reaction – sometimes this was just shown as '-400 kJ mol^{-1}'. The label on the vertical axis was incorrect.

(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 8

- 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)

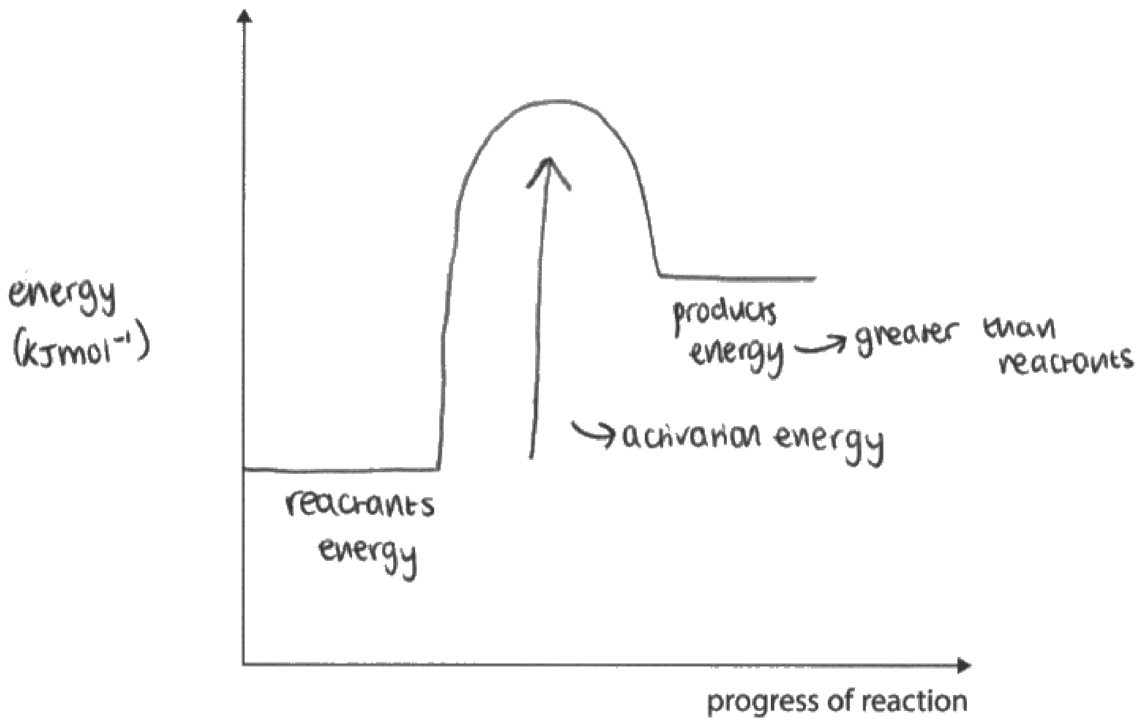


Figure 8

ResultsPlus
Examiner Comments

One mark.

This endothermic reaction profile just scored the one mark for the correct labelling of the vertical axis.

(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 8

- 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)

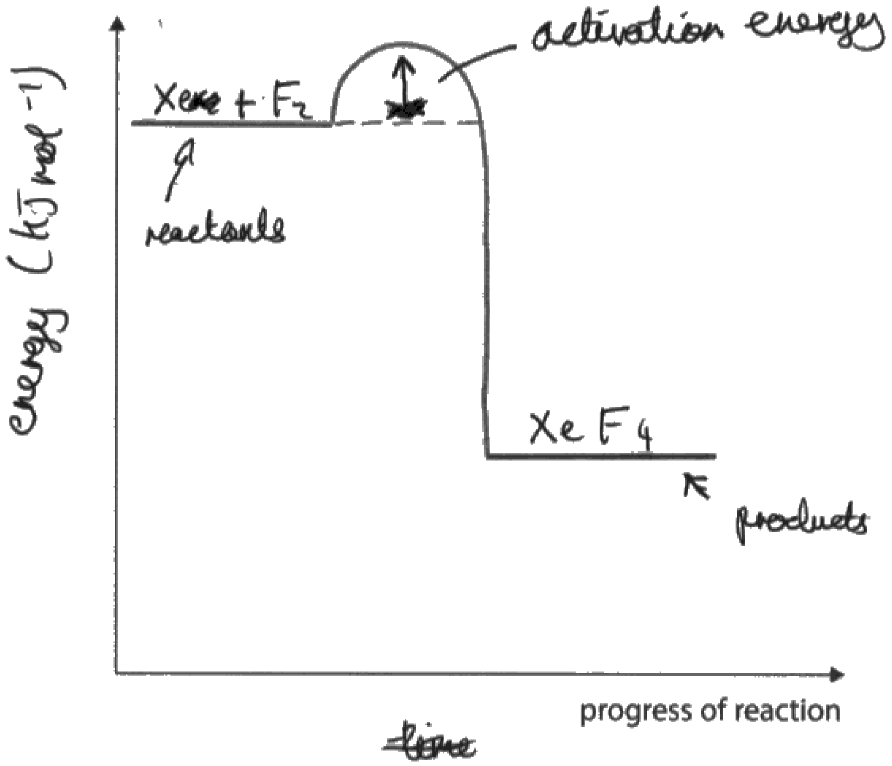


Figure 8

ResultsPlus Examiner Comments

Two marks.

Marks were given for the correct energy profile line with product being lower than reactants, and the labelling of the vertical axis. It was fairly common to see candidates not labelling the energy change for the reaction.

Question 7(a)(i)

This question was very well answered, however, many candidates often gave too much information about the arrangement of the carbon atoms and details about delocalised electrons between the layers. But eventually examiners could locate the marking points with about three-quarters of the candidates scoring two marks. Examiners reported that many candidates are referring to the structure of graphite as being made up of layers of graphene, with the layers being held together in the giant structure by weak intermolecular bonds.

A few weaker candidates just wrote about the lubricant properties often without mentioning layers of carbon atoms within the structure.

7 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)

because of the sliding layers of graphite it can be used as a lubricant. The sea of delocalised electrons allow it to move freely.

ResultsPlus
Examiner Comments

Two marks.

7 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 made from graphene which is is 1 atom thick. ~~[illegible]~~ This means that layers can be easily lost and can slide over eachother. This makes Graphite a good lubricant as it allows layers to be lost easily.

ResultsPlus
Examiner Comments

Two marks.

This scored for layers of graphene and that the layers can slide over one another.

7 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 because the Particles ~~a~~ can

easily Move ove each ~~other~~ other

ResultsPlus
Examiner Comments

Zero marks.

Even though the candidate said 'particles can easily move each other', it was not clear what was meant by particles and how these particles moved in this context.

Question 7(a)(ii)

Multiplying the number of atoms in C_{60} x the relative atomic of carbon gives the mass of 1 mole of C_{60}. Then for 5 moles of C_{60}, that is 720 x 5 = 3600 g. There was one mark for getting to this point. The second mark was for the conversion of units from g to kg as asked for in the question.

About half the candidates scored two marks, just over a quarter of the candidates made one error, the most common being:

- only working out the mass in kg for 1 mole of atoms in C_{60} (omitted the 5)
- missing that C_{60} contains 60 C atoms per molecule
- not converting the unit from g to kg.

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

(relative atomic mass: C = 12)

(2)

12x60 = 720

720x5 = 3600g → 36

mass = 36 kg

ResultsPlus
Examiner Comments

One mark.

There was an incorrect conversion from g to kg.

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

(relative atomic mass: C = 12)

(2)

$12 \times 60 = 720$

$\frac{720}{1000} = 0.72$

mass = ~~720~~ 0.72 kg

ResultsPlus
Examiner Comments

One mark.

The candidate had missed that the calculation involves 5 moles of C_{60}.

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

(relative atomic mass: C = 12)

(2)

mass = mr × moles 60g $\xrightarrow{\div 1000}$ 0.06 kg

~~= (5×12) ×~~

= 12 × 5

= 60g

mass = 0.06 kg

ResultsPlus
Examiner Comments

One mark.

This calculation had missed that C_{60} contained 60 C atoms.

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

(relative atomic mass: C = 12)

(2)

$\frac{g}{r} = 5$ $720 \times 5 = 3600g \div 1000$

3.6kg

mass = 3.6 kg

ResultsPlus
Examiner Comments

Two marks.

A correct answer for two marks.

Question 7(c)

Most candidates realised that to reduce the carbon deposit, the air hole needed to be opened and that with a sound reason gave them two marks.

However, there were a variety of errors seen which would not have solved the problem:

- using a pipe-clay triangle
- putting a lid on the beaker to present the loss of carbon dioxide
- putting a ceramic mat between the Bunsen flame and the tripod
- using a water-bath in place of the Bunsen burner.

All of which showed that these candidates did not understand the question.

A few also went on to discuss why the carbon forming was an issue and how it would affect results – again showing that they had not really understood the question.

(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 9 shows the apparatus used.

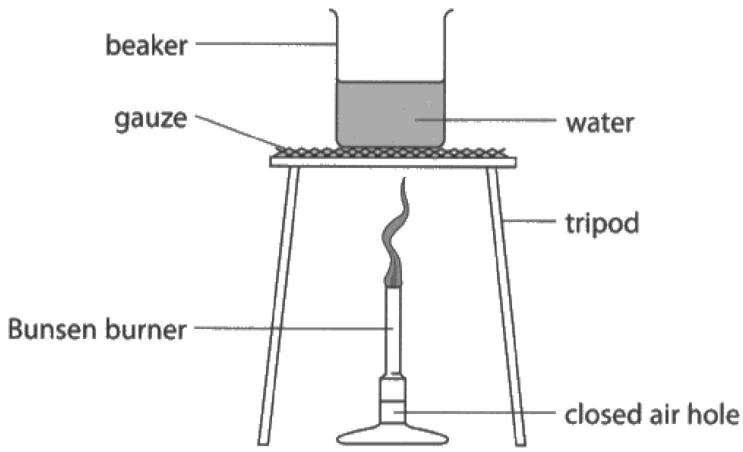


Figure 9

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)

The student should open the air hole: this will stop incomplete combustion from occuring so no carbon (soot) will form.

ResultsPlus
Examiner Comments

Two marks.

This answer included the idea of stopping incomplete 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 9 shows the apparatus used.

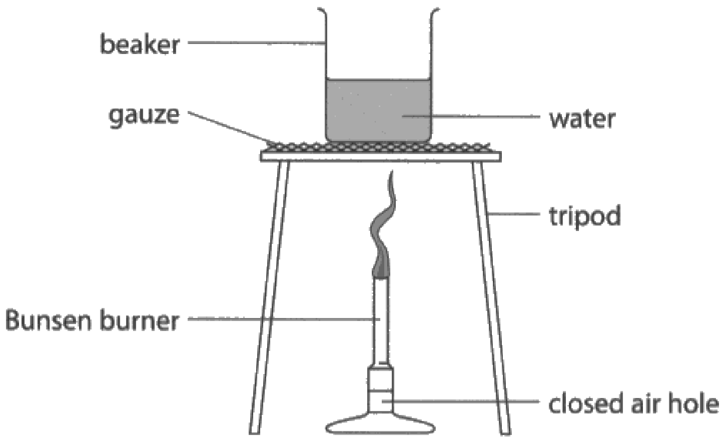


Figure 9

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)

The Student could open the air hole causing the flame to turn blue as this is then a purifide complete combustion reaction and no carbon will form as there is lots of oxygen getting to the reaction.

Examiner Comments

Two marks.

A thorough explanation of how to avoid getting the deposit 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 9 shows the apparatus used.

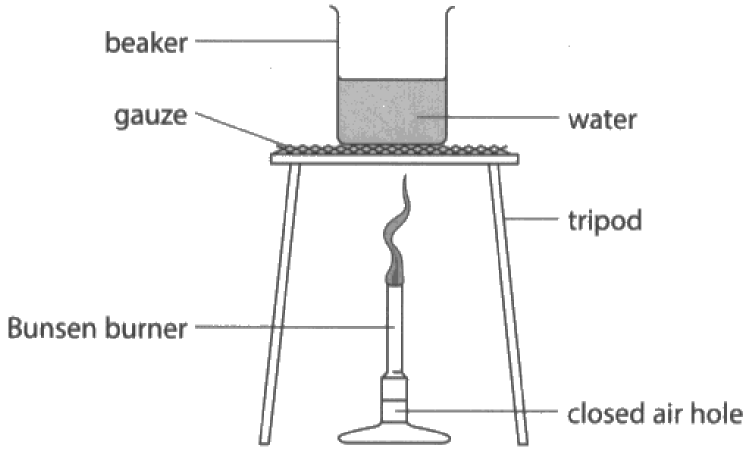


Figure 9

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 for complete combustion ~~fo~~ by letting more oxygen to come in, ~~To~~ this will form Carbon dioxide instead of carbon.
Suggest by equation ~~$CH_4 + O_2 \rightarrow CO_2 +$~~
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

ResultsPlus
Examiner Comments

Two marks.

This answer included the bonus of having a correct balanced equation for the complete combustion of methane.

(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 9 shows the apparatus used.

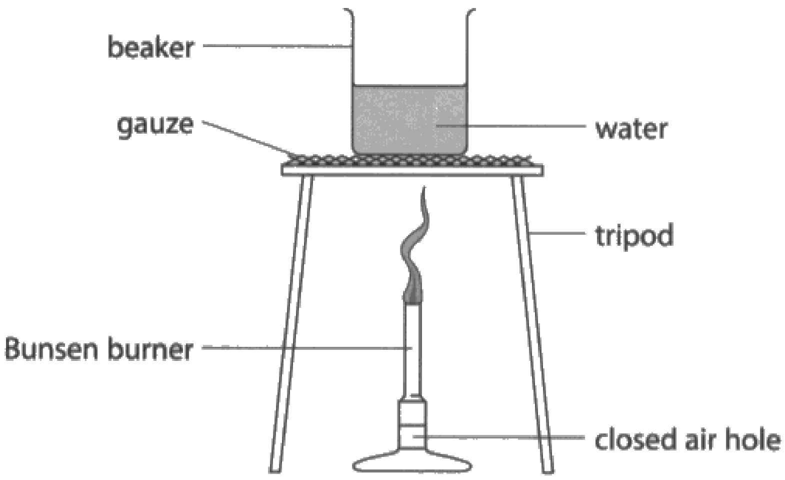


Figure 9

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 so the bunsen burner burns with a roaring blue flame which produces less carbon dioxide.

ResultsPlus
Examiner Comments

One mark.

This just scored for opening the air hole.

(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 9 shows the apparatus used.

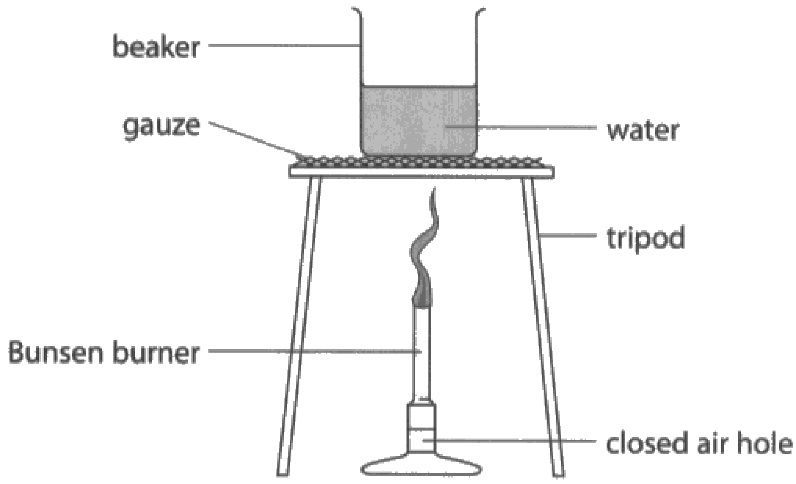


Figure 9

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)

the student can place a layer of aliminium oxide under~~neath~~ the gauze to emit carbon.

Zero marks.

Several thought about placing something bewteen the top of the flame and the gauze, without doing anything to the flame.

Question 7(d)

The majority of candidates were able to access this question well giving a correlation from the graph and several processes and as a result were able to reach level 2 and 3. Only a comparatively small group of candidates fell into level 1 and those who scored were just those who did not attempt the question.

The best answers of level 3 went on to explain how the greenhouse effect works and even went onto evaluate the graphs and how they are not necessarily a sign of causality.

There were many good explanations of the data and global warming. The quality of responses highlighted the phrases used such as 'carbon sinks'. Human and natural causes of changes in carbon dioxide levels were well known, eg decreases brought about by photosynthesis, the formation of sedimentary rocks or by the gas dissolving in the oceans and increases caused by volcanoes erupting, through respiration and the burning of fossil fuels. Mainly confined to level 3 were those candidates who illustrated their answers with equations for several processes such as photosynthesis, respiration and combustion of fuels.

The greenhouse effect was well understood by most candidates, but sometimes incorrect references to the ozone layer or UV rather than IR rays was not uncommon.

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

Figure 10 shows the concentration of carbon dioxide in the atmosphere measured in one location and the mean global temperature from 1960 to 2000.

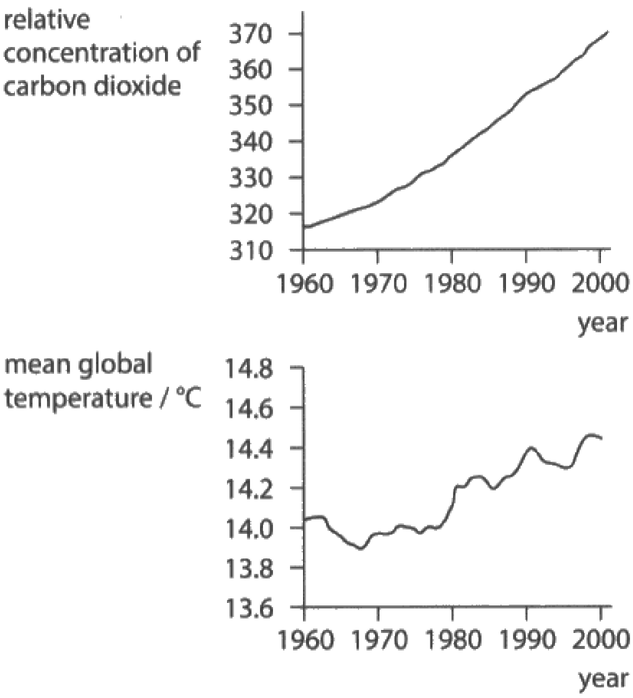


Figure 10

Evaluate whether the data in Figure 10 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 ↳ photosynthesis
- the human activities that change the amount of carbon dioxide in the atmosphere ↳ burning fossil fuels ↳ incomplete combustion
- how carbon dioxide contributes to the greenhouse effect and climate change.
  ↳ atmosphere, sunlight absorbed **(6)**

In 1960, the mean global temperature and relative concentration of carbon dioxide did not correspond to each other as much, however as 1980 onwards the concentration of co2 dramatically increases, there is a corresponding trend in the global temperature graph, showing in 1980, there was a sudden spike of an increase in the global temperature. 1980 onwards, the graphs no longer fluctuate randomly but are both ~~rapidly~~ co operatively increasing at an alarming rate. ~~This could happen~~ The CO_2 concentration being lower in 1960 could be because of relatively low consumerism compared to today so there was less deforestation allowing higher levels of photosynthesis to continue absorbing surplus CO_2. The levels of photosynthesis fluctuating could be a reason the mean global temperature is fluctuating. Arguably, the biggest impact being human activity from burning and using fossil fuels releasing lots of CO_2 in the air as a waste product which goes into the atmosphere and stays there. This can be bad because when solar radiation is emitted ~~through~~ to the Earth's atmosphere, the thicker atmosphere due to the higher CO_2 levels makes it harder for those rays to reflect back onto Earth which contributes to global warming as heat energy from solar radiation is being absorbed and staying here which increases the mean global temperature. Humans cutting down vast amounts of trees also lead to there being less CO_2 absorbed so it will stay in our atmosphere, increasing the global mean temperature. As lots of human activity has negatively impacted the atmosphere over the last decades, the CO_2 levels and global temp have reached very high.

(Total for Question 7 = 13 marks)

ResultsPlus
Examiner Comments

Six marks – level 3.

Many answers of this calibre were seen. The answer includes processes that change the level of carbon dioxide, a description of global warming and used data in the graphs to provide an evaluation.

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

Figure 10 shows the concentration of carbon dioxide in the atmosphere measured in one location and the mean global temperature from 1960 to 2000.

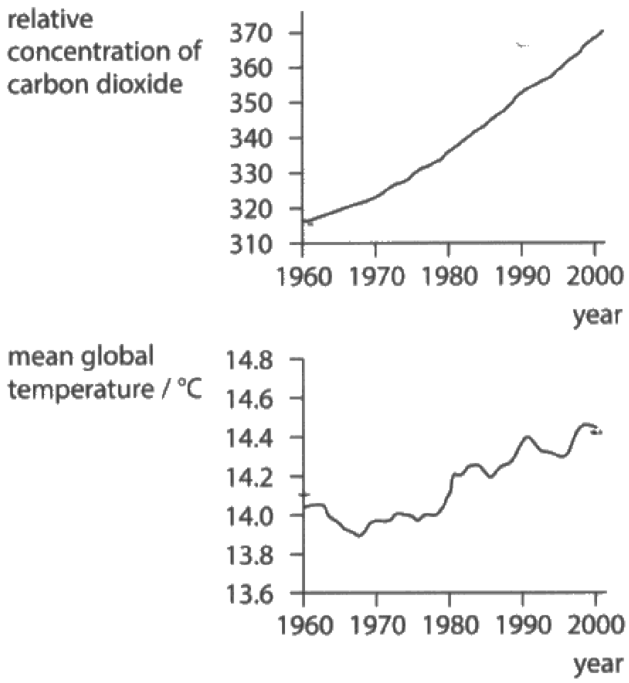


Figure 10

Evaluate whether the data in Figure 10 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)

You could say that the change in a concentration of carbon dioxide has lead to climate change because in the last 40 years the concentration of CO_2 has increased from ~~310~~ 317 to 370 and in the same time frame the global temperature has gradually increased, from ~~[illegible]~~ 14.05 to 14.45. The rise in global temperature hasn't been as dramatic as the rise in concentration of CO_2. This increase ~~can be supported~~ could be linked ~~by~~ to the increase in population over the 40 years and how the world is ~~so~~ much more industrialised and cars ~~are~~ are more in use than 40 years ago.

ResultsPlus
Examiner Comments

Two marks – level 1.

There were not many at this level. The information contained within the answer was fairly limited and largely made up of simple statements.

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

Figure 10 shows the concentration of carbon dioxide in the atmosphere measured in one location and the mean global temperature from 1960 to 2000.

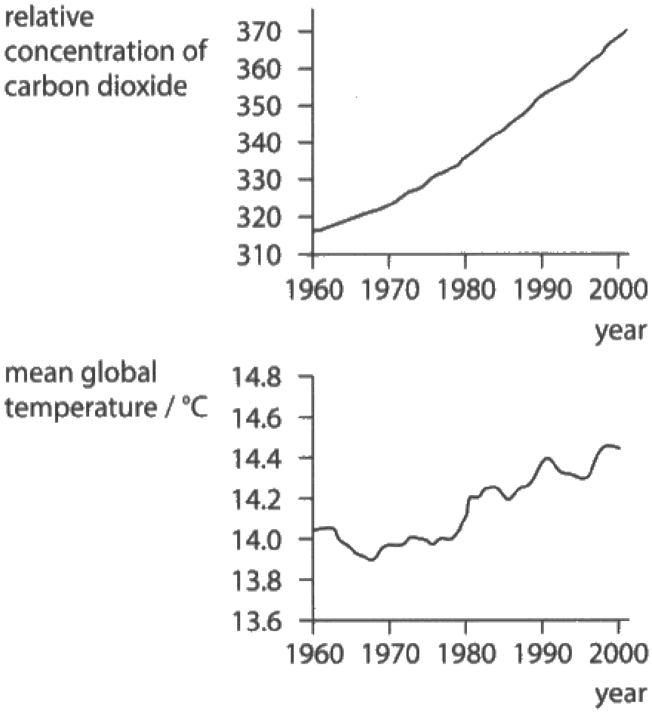


Figure 10

Evaluate whether the data in Figure 10 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)

Carbon dioxide is a greenhouse gas.
In figure 10, it is seen that as the temperature increases so does the concentration of

carbon dioxide. But ~~temper~~ temperature is not the only factor.
Human activities also affect the concentration of carbon dioxide. The amount of carbon ~~emmi~~ emission has increased through the years. This is because of the increase in the use of fuel powered cars.
Carbon dioxide is a greenhouse so the increase of the concentration can make the Earth more warmer therefore leading to climate change and increase in temperatures.

Three marks – level 2.

A process that changed carbon dioxide levels has been identified along with a limited reference to the graphs. There was also a very limited explanation of the greenhouse effect and what caused it.

Question 8(a)

Most candidates favoured using a gas syringe as a means of collecting and measuring the volume of gas.

8 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.

measuring cylinder

ResultsPlus
Examiner Comments

Zero marks.

This method alone would not work, aside from which it was already in the stem of the question.

8 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.

Using a syringe

ResultsPlus
Examiner Comments

One mark.

A correct answer.

8 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)

~~g~~ counting gas bubbles

Results Plus
Examiner Comments

Zero marks.

Counting bubbles does not answer the question about collecting the gas or even measuring its volume.

Question 8(c)

About half of the candidates wrote the balanced equation correctly.

Those who had the correct formulae of reactants and products tended to balance the equation correctly.

There were a few who wrote the balanced ionic equation and marked as if they had written the balanced equation.

Frequently seen errors included:

- monatomic halogens in the equation
- the products side written incorrectly such as 2CLBr + 2K but the reactants side written correctly.

(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 not conduct electricity at all because it is a covalent structure between two non metals meaning it can never conduct electricity.

ResultsPlus
Examiner Comments

Zero marks.

Most candidates gave answers similar to this and showed they did not know that ions were formed when hydrogen iodide dissolves in water.

(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 it would conduct electricity in water as there are free electrons that can conduct electricity (delocalised electrons). Also water is a very ~~good co~~ good conductor of electricity

Examiner Comments

Zero marks.

Several thought that when hydrogen iodide dissolves in water, it can conduct electricity because it contains delocalised electrons.

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

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

(2)

in Solution it does conduct electricity as HI is split into it's ions which can move around and carry a charge

ResultsPlus
Examiner Comments

Two marks.

Not many answered in this way where ions are present in the solution formed and so can conduct electricity as a result of the ions moving.

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

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

(2)

The solution would not conduct electricity as the compound present is covalently bonded meaning that there are no charged particles ~~of~~ or "free" electrons ~~able~~ to ~~flow~~ move or flow as charge in an electric current even in solution.

ResultsPlus
Examiner Comments

Zero marks.

The candidate has not understood that the hydrogen iodide forms ions when it dissolves in water. Answers of this type were commonly seen.

Question 8(d)(i)

About three-quarters of the candidates worked out that bromine was the substance that caused the orange colour.

Of the remainder, most opted for the incorrect answers of 'bromide' or 'potassium chloride'.

(d) Chlorine gas is bubbled through a colourless solution of potassium bromide, KBr. The mixture turns orange.

(i) Give the name of the substance that causes the orange colour.

Bromine

ResultsPlus
Examiner Comments

One mark.

A correct answer.

(d) Chlorine gas is bubbled through a colourless solution of potassium bromide, KBr. The mixture turns orange.

(i) Give the name of the substance that causes the orange colour.

bromide

ResultsPlus
Examiner Comments

Zero marks.

Bromide is the anion of bromine. Bromine is the element that is responsible for the orange colour.

ResultsPlus
Examiner Tip

Know how a halogen is different from a halide.

closetly to nucleus . Full outer shell of H I

(d) Chlorine gas is bubbled through a colourless solution of potassium bromide, KBr.
The mixture turns orange. Cl + KBr H shares electron to make full outer shell

(i) Give the name of the substance that causes the orange colour. (1)

~~KBr~~ ~~manganese~~ potassium chloride

Cl + KBr ->

Zero marks.

Potassium chloride was quite a common wrong answer to this question.

Question 8(d)(ii)

About half of the candidates wrote the balanced equation correctly.

Those who had the correct formulae of reactants and products tended to balance the equation correctly.

There were a few who wrote the balanced ionic equation and marked as if they had written the balanced equation.

Frequently seen errors included:

- monatomic halogens in the equation
- the products side written incorrectly such as 2CLBr + 2K but the reactants side written correctly.

(ii) Write the balanced equation for this reaction.

(3)

$Cl_2 + KBr \rightarrow Br + KCl_2$

ResultsPlus
Examiner Comments

One mark.

Correct reactants side, but an incorrect formula of potassium chloride on the products side.

(ii) Write the balanced equation for this reaction.

(3)

Cl + KBr → KCl + Br

ResultsPlus
Examiner Comments

Zero marks.

Examiners reported seeing several equations containing monatomic halogens.

(ii) Write the balanced equation for this reaction.

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

ResultsPlus
Examiner Comments

Three marks.

A correctly balanced equation.

(ii) Write the balanced equation for this reaction.

$KBr + Cl_2 \longrightarrow KCl + Br_2$

ResultsPlus
Examiner Comments

Two marks.

The reactants were correct as were the products. It was then unusual to see an unbalanced equation containing all the correct formulae.

Question 8(e)

Most candidates were familiar with this type of calculation and understood how to use bond energies to calculate correctly the energy change for the oxidation of hydrogen iodide.

In most cases it was clear to follow the candidate's working method as they had listed the bond energy multiplied by the number of that type of bond for the reactants and or the products.

Most knew the next step of calculating total bond energies for bonds broken – total bond energies for bonds formed = energy change for the reaction, and in for most candidates this was clearly written together with a negative sign where appropriate.

This value was then written on the answer line together with the units of kJ/mol or kJ mol^{-1}.

Inevitably there were common errors seen in the candidates' answers:

- multiplying the O=O bond by 2
- multiplying the H-O bond by 2 instead of 4
- subtracting: total bond energies for bond formed – total bond energies for bonds broken
- incorrect transfer of sign from subtraction to answer line
- missing unit on answer line
- incorrect unit: kJ/mol^{-1}.

Very few candidates scored zero marks. The largest proportion of candidates made 1 error and so scored three marks.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

H-I =299   299x4 = 1196
O=O =495   495x2 = 990
1196+990 = 2186
H-O = 464   464x2 = 928
604+1856 = 2460   928x2 1856
I-I = 151   151x2 = 302
302x2 = 604   Endothermic
2186-2460 = -274   energy change = -274

ResultsPlus Examiner Comments

One mark.

The answer will need some careful study.

The total energy for breaking bonds is incorrect – 2186 kJ/mol – 2 x bond energy of O=O was used.

The total energy for making bonds in incorrect – 2460 kJ/mol – a total of 4 x bond energy of H-I was used [151 x 2 = 302; 302 x 2 = 60].

The subtraction of total energy for breaking bonds – total energy for making bonds - 218 - 2460 is correct – one mark.

The answer from the subtraction appeared on the answer line with its sign, but the unit was incorrect.

ResultsPlus Examiner Tip

Practise calculations of this type – errors are so easy to make.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

$4 \times 299 = 1196$

$1196 + 495 = 1691$ $\quad$ $1230 - 1691 = -461$

$2 \times 464 = 928$

$2 \times 151 = 302$

$928 + 302 = 1230$

energy change = $-461\ kJ\ mol^{-1}$

ResultsPlus
Examiner Comments

Two marks.

Total energy for break bonds – 1691 kJ/mol – is correct – one mark.

Total energy for making bonds – only 2 x bond energy of O-H was used instead of 4 – this was the first error.

The subtraction was the wrong way round – the second error.

The value from the subtraction – a transferred error – appeared on the answer line with the correct unit – one mark.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

299 × 4 = 1196
+ = 2186
495 × 2 = 990

2186
2158
6028

4 × 464 = 1856
+ = 2158
2 × 151 = 302

28

energy change = 28 kJ mol^{-1}

ResultsPlus
Examiner Comments

Three marks.

There was an error in calculating the energy of the bonds broken - 2 x O=O were used. This means the energy for bonds broken was incorrect. This was the only error.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

299 x 4 = 1196 464 x 2 = 928

495 ~~x~~ x 1 = 495 151 x 2 = 302

~~464 x 2~~ 1691 = 1230

1691 − 1230

energy change = − 461 J

ResultsPlus
Examiner Comments

Two marks.

The total energy for break bonds – 1691 kJ/mol – was correct – one mark.

The first error was made by using just 2 x bond energy of O-H. This error was seen quite often.

The subtraction of total energy for breaking bonds – total energy for making bonds was correct – one mark.

The second error came on the answer line – the value from the subtraction should not be negative and the units were incorrect.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

broken : 4 X 299 + 495 = 1691

formed : 464 x 2 x 2 + 2 x 151 = 2158

broken - formed

= -467

energy change = −467 kJ mol^{-1}

(Total for Question 8 = 12 marks)

ResultsPlus
Examiner Comments

Four marks.

A clearly set out calculation with the correct 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 11.

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

Figure 11

Include a sign and unit in your answer.

(4)

4 x HI = ~~...~~ 1196 4 x H-O = 1856

1 x O=O = 495 2x ~~...~~ I-I = 302

1196 + 495 = 1691 1856 + 302 = 2158

1691 - 2158 = -467

energy change = -467

ResultsPlus
Examiner Comments

Three marks.

Unfortunately for this candidate, one mark was lost because the energy change did not include the units.

(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 11.

O=2H=O

H – O – H

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

Figure 11

Include a sign and unit in your answer.

(4)

299 x 4 = 1196
495x1 = 495
= 1691

1691 - 2460
= - 769

464 x ~~2~~ 4 = 1856
151 x ~~2~~ 4 = ~~302~~ 604

~~202~~ 2460

energy change = - 769 kJ mol^{-1}

ResultsPlus
Examiner Comments

Three marks.

This candidate made the error of using 4 I-I bonds in the calculation instead of 2. Everything else was correct.

(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 11.

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

Figure 11

Include a sign and unit in your answer.

$299 + \cancel{990}^{\,499} = \cancel{1289}^{\,794}$

$928 + 302 = 1230$

~~B~~ $1230 - 794$

$= 436$

energy change = 436

ResultsPlus
Examiner Comments

Zero marks.

Zero mark answers were not often seen.

Total bond energy for breaking bonds is incorrect – only 1 x H-I was used instead of 4.

Total bond energy for making bonds is incorrect – 2 x H-O was used instead of 4.

The subtraction was the wrong way round.

There were no units with the final answer.

Question 9(a)

The overwhelming majority of the candidates could read the graph correctly to find the concentration of the calcium ions at a reading of 175 on the photometer.

9 (a) Figure 12 shows the calibration graph of a flame photometer for the concentration of calcium ions in a solution.

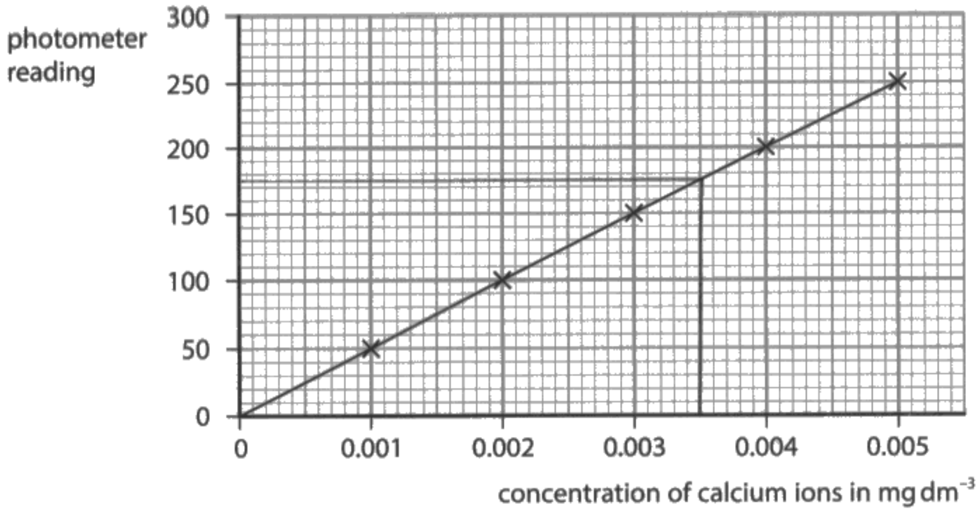


Figure 12

Use Figure 12 to find the concentration of calcium ions when the photometer reading is 175.

(1)

concentration = 0.0035 mg dm^{-3}

ResultsPlus
Examiner Comments

One mark.

The correct reading from the graph.

9 (a) Figure 12 shows the calibration graph of a flame photometer for the concentration of calcium ions in a solution.

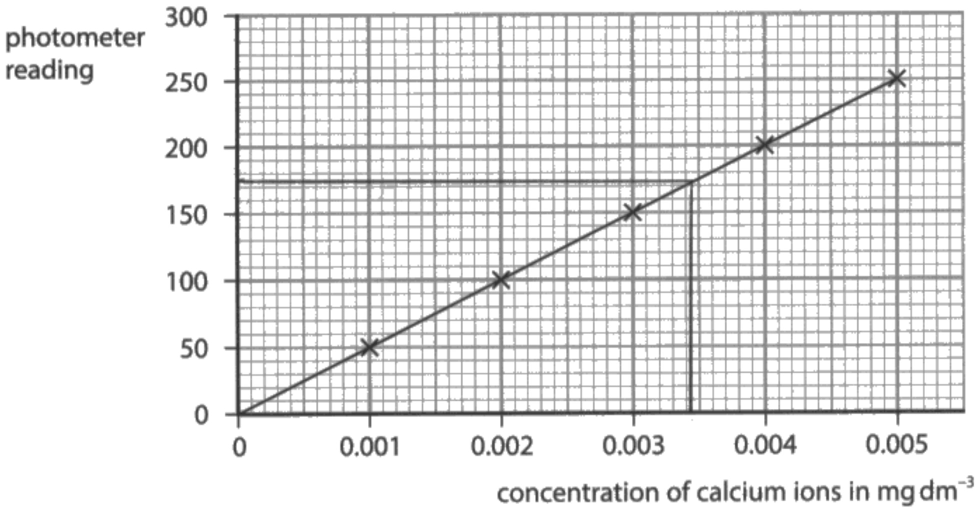


Figure 12

Use Figure 12 to find the concentration of calcium ions when the photometer reading is 175.

(1)

concentration = 0.0034 mg dm^{-3}

ResultsPlus
Examiner Comments

One mark.

This was within the tolerance allowed for reading from a graph.

9 (a) Figure 12 shows the calibration graph of a flame photometer for the concentration of calcium ions in a solution.

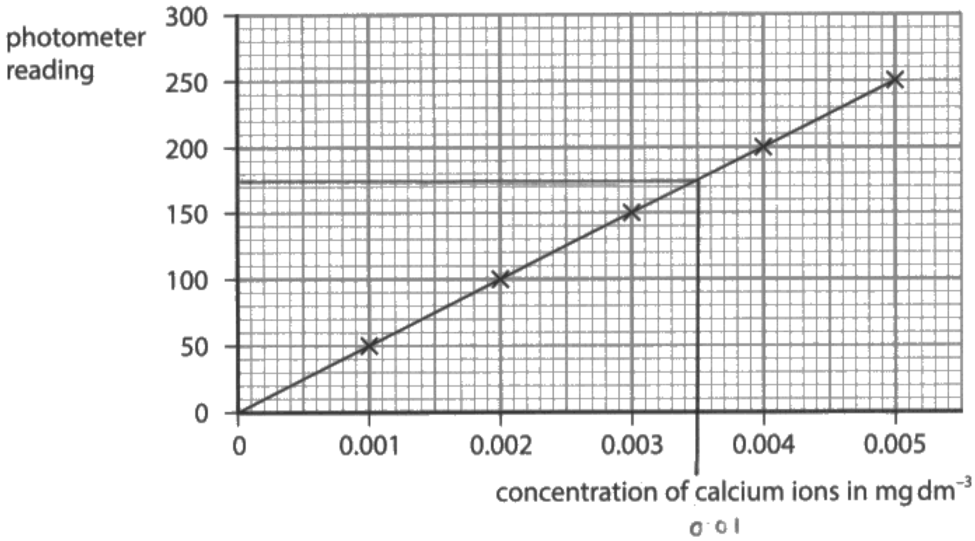


Figure 12

Use Figure 12 to find the concentration of calcium ions when the photometer reading is 175.

(1)

concentration = 0·035 mg dm^{-3}

ResultsPlus
Examiner Comments

Zero marks.

This reading is 10x too high – a careless mistake made by the candidate.

9 (a) Figure 12 shows the calibration graph of a flame photometer for the concentration of calcium ions in a solution.

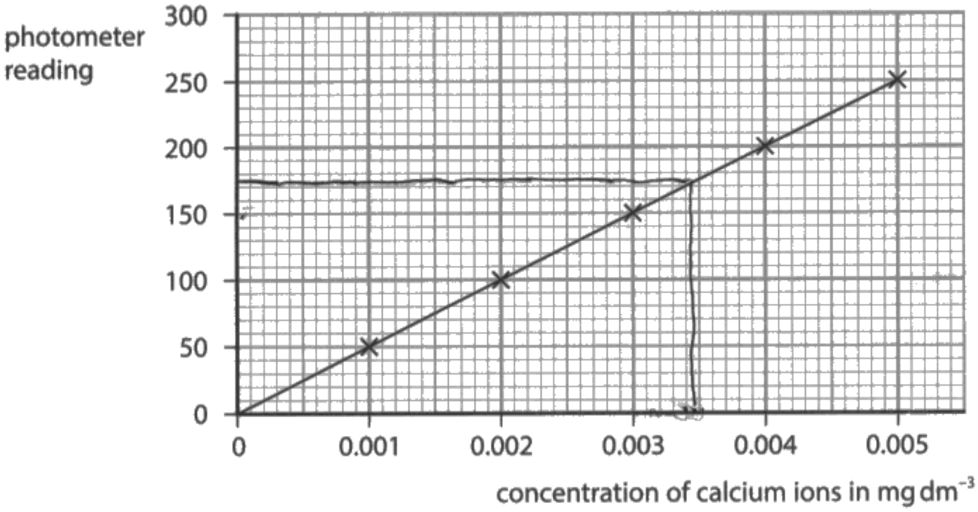


Figure 12

Use Figure 12 to find the concentration of calcium ions when the photometer reading is 175. 0.00345

(1)

concentration = 0.00345 mg dm^{-3}

ResultsPlus
Examiner Comments

One mark.

This answer was also within the tolerance for a graph reading – ±1 small square.

Question 9(b)(i)

A very straightforward question where the candiates were required to calculate the mean value of the concentration of sodium ions found in three types of bottled water. The overwhelming majority scored the mark and only a small number calculated the mean of all 4 values shown in the table of data.

(b) A flame photometer was used to measure the concentration of sodium ions in tap water and three types of bottled water.

The results are shown in Figure 13.

type of water	concentration of sodium ions in mg dm^{-3}
tap water	6.47
bottled water A	0.68
bottled water B	0.78
bottled water C	0.41

Figure 13

(i) Calculate the mean concentration of sodium ions in the three **bottled** waters.

(1)

$$\frac{6.47 + 0.68 + 0.78 + 0.41}{4} = 2.085$$

mean concentration = 2.09 mg dm^{-3}

ResultsPlus
Examiner Comments

Zero marks.

A minority of candidates had not read the question and calculated the mean of all 4 values.

(b) A flame photometer was used to measure the concentration of sodium ions in tap water and three types of bottled water.

The results are shown in Figure 13.

type of water	concentration of sodium ions in mg dm^{-3}
tap water	6.47
bottled water A	0.68
bottled water B	0.78
bottled water C	0.41

Figure 13

(i) Calculate the mean concentration of sodium ions in the three **bottled** waters.

(1)

$$\frac{0.68 + 0.78 + 0.41}{3} = 0.623\ldots$$

mean concentration = 0.623 mg dm^{-3}

One mark.

This example shows the correct answer.

Question 9(b)(ii)

This was the one calculation on the paper where there was a significant number of candidates who scored zero marks.

The most common route of scoring marks:

- conversion of mass from mg to g – dividing 6.47 mg by 1000
- working out the number of moles of sodium ions in 1 dm^3 of solution – divide the mass by the relative atomic mass of sodium
- using the concentration and the number of moles (3), calculate the volume – divide the number of moles by the concentration.

Common errorrs:

- many used their answer from part (i) for **bottled** water which resulted in a wrong calculation for the **tap** water
- not converting from mg dm^{-3} to g dm^{-3}
- having the division in the 2nd or 3rd steps the wrong way round
- incorrect rounding of numbers at some stage in the calculation.

However, most candidates were able to score at least one mark on this tricky calculation.

(ii) Calculate the volume of **tap** water, in dm^3, that contains 3 moles of sodium ions.

(relative atomic mass: Na = 23)

(3)

Mass of 3mol = 3×23 = 69g

$vol = \frac{mass}{conc} = \frac{69}{\cancel{6.47}\ 0.00647} = 10664.606\ dm^3$

volume = ~~1066~~ 10700 dm^3

ResultsPlus
Examiner Comments

Three marks.

A correct calculation leading to the answer of 10664.606 dm^3 which was then correctly approximated to 3 significant figures.

(ii) Calculate the volume of **tap** water, in dm^3, that contains 3 moles of sodium ions.

(relative atomic mass: Na = 23)

(3)

$23 \times 3 = 69$

$69 \div 6.47 = 10.66460587$

volume = ... dm^3

ResultsPlus
Examiner Comments

Two marks.

The mass was not converted from mg dm^{-3} to g dm^{-3}, so the final answer is a thousand times smaller than what it should be.

(ii) Calculate the volume of **tap** water, in dm^3, that contains 3 moles of sodium ions.

(relative atomic mass: Na = 23)

(3)

mass = moles × Mr   23 × 3 = 69

volume = ~~mass~~ mass / conc.   69 / 6.47

= 10.66460587

volume = 10.7 dm^3

→ 10.7

ResultsPlus
Examiner Comments

Two marks.

Not converting from mg dm^{-3} to g dm^{-3} proved to be a common error.

(ii) Calculate the volume of **tap** water, in dm^3, that contains 3 moles of sodium ions.

(relative atomic mass: Na = 23)

(3)

conc = volume x ~~mass~~ moles ÷ mass

÷ mass

$\frac{\text{conc}}{\cancel{\text{mass}}\ \text{moles}}$ = volume

$\frac{6.47}{3} = 2.15\dot{6} = 2.16$

volume = 2.16 dm^3

Zero marks.

For this calculation, there is just the concentration in mg dm^{-3} divided by the number of moles. So nothing to credit here.

Question 9(c)

Most candidates knew that adding sodium hydroxide solution to both salts resulted in a white precipitate, which, when adding excess NaOH, led to one precipitate dissolving. This led most candidates to identify 'aluminium' but many were not explicit about 'calcium' remaining undissolved as a white precipitate.

Errors seen here included:

- adding an incorrect solution such as dilute hydrochloric/nitric acid or even silver nitrate solution
- describing the initial observation adding sodium hydroxide as 'they turn white' rather than saying white precipitates were formed
- not being explicit about the addition of excess sodium hydroxide solution to dissolve the aluminium hydroxide
- not giving the final observation for the calcium ion compound as 'white precipitate remains' or similar
- spending half of the time erroneously testing for chloride ions.

Some candidates chose the route of using a flame test. However, in most cases a fully developed method was rarely seen. For example, the flame test wire was often not cleaned at all or was incorrectly cleaned by 'sterilising in the Bunsen flame'. The wire was often placed 'over' the flame and the flame itself was often not referred to as being blue or roaring. The flame test colour for calcium ions was fairly well known but not for aluminium.

(c) A student is given two test tubes, one containing solid aluminium chloride and the other containing solid calcium chloride.

Describe the test the student should use to show which solid is in which test tube, giving the observation for each compound.

(4)

The student should add sodium hydroxide to each test tube. ~~the~~ ~~th~~ If ~~they are both preseo~~ ~~aluminin~~ for calcium ~~is present~~. a white precipitate will form. ~~the aluminium~~ For aluminium, initially a white precipitate will form but once you add excess sodium hydroxide the aluminium will redissolve to form a colourless solution

ResultsPlus Examiner Comments

Three marks.

The basic test was correct throughout apart from not saying what happened for calcium ions.

(c) A student is given two test tubes, one containing solid aluminium chloride and the other containing solid calcium chloride.

Describe the test the student should use to show which solid is in which test tube, giving the observation for each compound.

(4)

Add dilute sodium hydroxide to each test tube. They will both form a white precipitate. Add excess sodium hydroxide to each and the solid aluminum chloride will dissolve to form a colourless solution and the calcium chloride will stay the same - won't dissolve.

ResultsPlus
Examiner Comments

Four marks.

The description of the test was correct as well as stating what happened on addition of excess sodium hydroxide solution for both aluminium and calcium ions.

(c) A student is given two test tubes, one containing solid aluminium chloride and the other containing solid calcium chloride.

Describe the test the student should use to show which solid is in which test tube, giving the observation for each compound.

(4)

add sodium hydroxide to the test tubes and wait to see what colour precipitate is formed in each.
calcium should form a blue green precipitate

ResultsPlus
Examiner Comments

One mark.

One mark was given for the addition of sodium hydroxide solution to the two test tubes containing the two compounds.

ResultsPlus
Examiner Tip

Learn the ion tests for both cations and anions.

(c) A student is given two test tubes, one containing solid aluminium chloride and the other containing solid calcium chloride.

Describe the test the student should use to show which solid is in which test tube, giving the observation for each compound.

(4)

The student should do a flame test as aluminium should look ~~purp~~ ~~greesh~~ red. and calcium ~~red brown~~ green. ~~Pu~~ Putt ~~this~~ a metal loop in a solution of hydroclonic acid so that there is no contamination and then dip in your solid and onto a roaring blue flame where you should see a different colour so you are then able to identify them.

ResultsPlus
Examiner Comments

Two marks.

Some candidates opted to carry out a flame test on the two compounds. Candidates found more success using sodium hydroxide solution to test for the metal ions.

This example was given two marks for the cleaning of the flame test wire and how to actually carry out the flame test. The flame colours did not score here.

Question 9(d)

This question was probably the least understood and the candidates found it very difficult to coherently write an explanation resulting in few candidates scoring all three marks and the majority failing to score even one mark.

Many could not decide whether the solution did or did not contain bromide ions.

Many thought that there were two separate tests – the first for bromide ions and the second for carbonate ions.

This was seen in their answers where they wrote that 'a cream-coloured precipitate formed showing that bromide ions were present' … but the question just stated 'a precipitate forms', no colour was given.

Many candidates could not grasp that the **first test without nitric acid** gave a precipitate, but the **second test with nitric acid** gave no precipitate. Many thought adding the nitric acid was just to remove impurities without stating those impurities were likely to be.

Some candidates did make comment about the fizzing that happened following the addition of nitric acid to the solid and correctly identified the gas as carbon dioxide.

Some did go on to describe the positive test for gas, but others just came to the conclusion that the solution contained carbonate ions.

(d) Silver carbonate and silver bromide are both insoluble solids.

A student tests a solution to see if it contains bromide ions.
The student adds a few drops of silver nitrate solution.
A precipitate forms.

The student repeats the test but adds some dilute nitric acid before adding the silver nitrate solution.
The mixture fizzes and no precipitate forms.

Explain what conclusion the student can draw from these results.

(3)

That it is silver carbonate as when tested before they didn't add dilute nitric acid, the reason for nitric acid is to react any unwanted carbonate so when they got a precipitate it wasn't the bromide ions it was carbonate. When they repeared it and did add dilute nitric acid it fizzed this show that CO_2 was being released to be sure however they should bubble the gas through limewater, if it turns cloudy it is CO_2.

(Total for Question 9 = 12 marks)

ResultsPlus
Examiner Comments

Three marks.

This was a very good answer. The candidate had clear understanding about what was going on.

Marks were scored for:

- identifying the compound as silver carbonate
- saying that the acid reacted with a carbonate
- the fizzing was carbon dioxide.

(d) Silver carbonate and silver bromide are both insoluble solids.

A student tests a solution to see if it contains bromide ions.
The student adds a few drops of silver nitrate solution.
A precipitate forms.

The student repeats the test but adds some dilute nitric acid before adding the silver nitrate solution.
The mixture fizzes and no precipitate forms.

Explain what conclusion the student can draw from these results.

A gas was produced
acid reacted with solution creating carbon dioxide.

ResultsPlus
Examiner Comments

One mark.

The mark was given for the formation of carbon dioxide.

(d) Silver carbonate and silver bromide are both insoluble solids.

A student tests a solution to see if it contains bromide ions.
The student adds a few drops of silver nitrate solution.
A precipitate forms.

The student repeats the test but adds some dilute nitric acid before adding the silver nitrate solution.
The mixture fizzes and no precipitate forms.

Explain what conclusion the student can draw from these results.

(3)

The student can ~~observe~~ conclude that in the first test there was some carbonates of sulfides present that caused the precipitate. The student can conclude that there is no bromide ~~a~~ present

ResultsPlus
Examiner Comments

One mark.

This was given the solution contain carbonate ions but not bromide ions.

Correct conclusion but the candidate did not give an explanation why.

Question 10(a)(ii)

About half of the candidates could remember the formula of ethanol. Of those, only about two thirds could balance the equation.

(ii) A carbohydrate has the formula $C_{12}H_{24}O_{12}$.

Complete the equation for the fermentation of this carbohydrate to make ethanol and carbon dioxide only.

$C_{12}H_{24}O_{12} \rightarrow$ $C_2H_5OH + CO_2$

ResultsPlus
Examiner Comments

One mark.

The formulae of both products were correct.

Examiners did not report seeing an incorrect formula of carbon dioxide.

(ii) A carbohydrate has the formula $C_{12}H_{24}O_{12}$.

C_2H_5OH ~~+ CO_2~~

Complete the equation for the fermentation of this carbohydrate to make ethanol and carbon dioxide only.

(2)

$C_{12}H_{24}O_{12} \rightarrow$ $4C_2H_5OH + 4CO_2$

ResultsPlus
Examiner Comments

Two marks.

A fully correct answer.

Question 10(b)

Despite an earlier question being on how monomers form polymers, it was again surprising to see that within this cohort about half the candidates could not make a reasonable attempt at formulating the repeating unit from the monomer by breaking up the >C=C< to form a single bond between those two C atoms and show continuation bonds that would lead to the adjoining repeating units. There were several who scored the first mark for breaking open the double bond but then had problems completing the rest of the repeating unit.

There were many errors seen: breaking open the >C=O was commonly seen with a continuation bond leading from the oxygen, similarly continuation bonds were sometimes seen to be attached to the CH_3 group. Examples like this led to either an incomplete bonding situation about a C atom from the original C=C group or somehow a H atom had been brought in from somewhere to complete that C atom with 4 single bonds around it.

(b) Ethanol can be oxidised to make ethanoic acid.
One use of ethanoic acid is to make a monomer.

This monomer is polymerised to make the addition polymer PVA, used as a glue.

The structure of the monomer is shown in Figure 14.

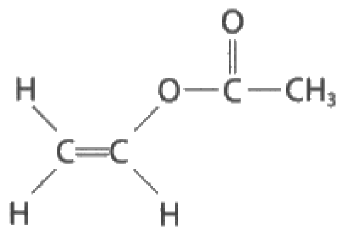
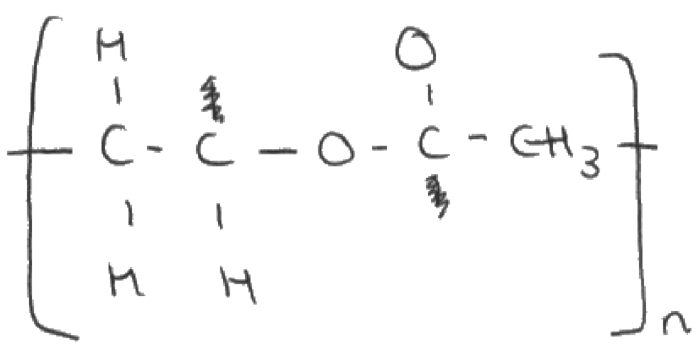


Figure 14

Draw a diagram to show the structure of the repeating unit of PVA.



ResultsPlus
Examiner Comments

Zero marks.

The >C=C< had been broken open, but it was left with 3 single bonds about the right hand C atom. A continuation bond has been shown to be coming from the CH_3 group. The [ ] and n were ignored.

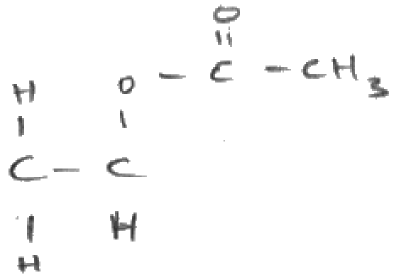
ResultsPlus
Examiner Tip

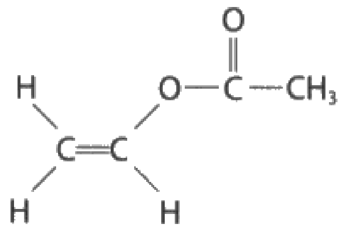
Learn how to draw monomers forming polymers (and vice versa) in addition polymerisation and how to identify the repeating unit within a polymer.

(b) Ethanol can be oxidised to make ethanoic acid.
One use of ethanoic acid is to make a monomer.

This monomer is polymerised to make the addition polymer PVA, used as a glue.

The structure of the monomer is shown in Figure 14.





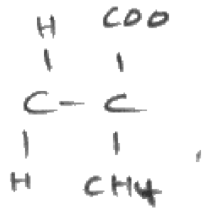
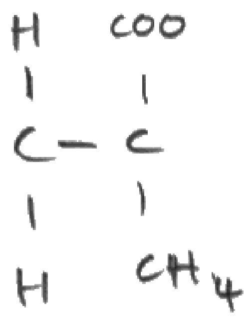


Figure 14

Draw a diagram to show the structure of the repeating unit of PVA.



![ResultsPlus Examiner Comments]

Zero marks.

Again the >C=C< has been broken open, but this time there are no continuation bonds and the side chain has been broken up to join the C atom of the original C=C.

(b) Ethanol can be oxidised to make ethanoic acid.
One use of ethanoic acid is to make a monomer.

This monomer is polymerised to make the addition polymer PVA, used as a glue.

The structure of the monomer is shown in Figure 14.

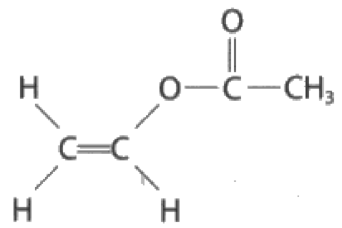
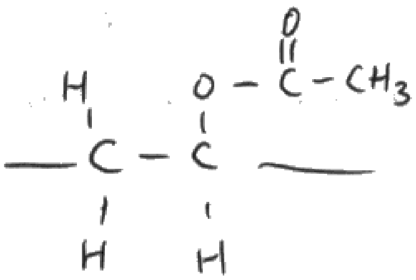


Figure 14

Draw a diagram to show the structure of the repeating unit of PVA.



ResultsPlus
Examiner Comments

Two marks.

A correct answer.

(b) Ethanol can be oxidised to make ethanoic acid.
One use of ethanoic acid is to make a monomer.

This monomer is polymerised to make the addition polymer PVA, used as a glue.

The structure of the monomer is shown in Figure 14.

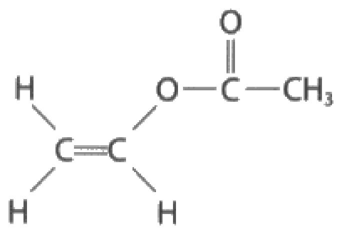
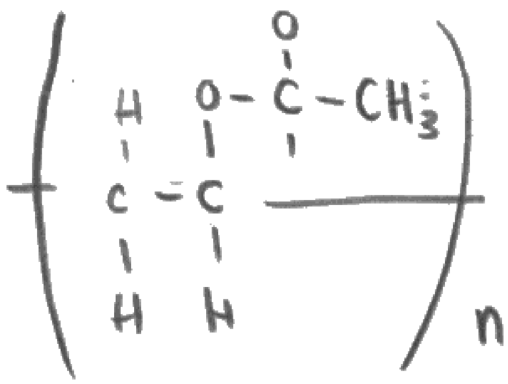


Figure 14

Draw a diagram to show the structure of the repeating unit of PVA.



ResultsPlus
Examiner Comments

One mark.

The >C=C< had been correctly broken and completed with continuation bonds, but there was a problem with the side chain.

Question 10(c)

This question enabled most candidates to make a good attempt at discussing the advantages and disadvantages of bamboo nappies and disposable nappies. Like the other six-mark question on this paper very few candidates were in level 1 and very few scored zero on this question.

Candidates fared well on this question overall with the greater majority giving a level 2 or level 3 answer, but often answers just repeated the statements in the question without explaining the advantages and disadvantages of each type of nappy.

In some of the best answers candidates emphasised the renewability or sustainability of bamboo compared to using up finite crude oil resources needed to make disposable nappies. They also brought in their own knowledge, discussing the bamboo removing carbon dioxide from the air in photosynthesis or providing a habitat. Interesting factors such as clearing crop land for bamboo trees or using crude oil for nappies rather than fuels were introduced. Some even commented on the use of bamboo nappies were depriving pandas of their primary food source.

In other responses the advantage of the bamboo nappy not taking as long to decompose and taking up landfill space was compared with disposable nappy and was countered by the much higher absorption of the latter. Successful candidates were able to explain why water absorption was important, rather than just repeating this fact. Suitable economic comparisons were made also.

The testing method was often a limiting feature as many candidates gave either a very simple method, or a sketchy explanation of their method. In measuring how much water each nappy absorbed, candidates who controlled variables such as the same original mass of nappy or using the same volume of water and submerging each nappy for the same amount of time before reweighing were often more successful. Distinct independent and dependent variables were given in the best answers.

*(c) Babies may wear bamboo nappies or disposable nappies.
Both types of nappy absorb liquid.

The bamboo in bamboo nappies comes from a fast growing plant.
A bamboo nappy can be washed and used again many times.
When a bamboo nappy is placed in landfill, it will rot away quickly.

Disposable nappies contain a polymer made using crude oil.
1 g of a typical polymer used in disposable nappies can absorb about 150 g water.
When a disposable nappy is placed in landfill, it may take over 400 years to decompose.

Discuss, using the information given, the advantages and disadvantages of bamboo nappies and disposable nappies.
Include in your answer a brief description of how a nappy could be tested to see how much water it will absorb.

(6)

Disposable nappies take longer to decompose. This means it is a pollutant. Whereas bamboo nappies are biodegradable and decompose quickly. This means bamboo nappies are less polluting.

Bamboo nappies are more sustainable because they are ~~used~~ made from fast growing plants. This means they are ~~easily~~ made quicker. On the other hand, disposable nappies made from crude oil are finite because crude oil is a finite resource.

A nappy can be tested by adding water to the nappy. Then, wait some time. If it is wet, it is less effective

ResultsPlus
Examiner Comments

Two marks – level 1.

This candidate had used some of the information supplied and then identified and commented on it as an advantage or disadvantage and the impact it would have – such as bamboo nappies being biodegradable and so would decompose quicker and would be less polluting. The testing method lacked any detail on how much water a nappy could absorb.

*(c) Babies may wear bamboo nappies or disposable nappies.
Both types of nappy absorb liquid.

The bamboo in bamboo nappies comes from a fast growing plant.
A bamboo nappy can be washed and used again many times.
When a bamboo nappy is placed in landfill, it will rot away quickly.

Disposable nappies contain a polymer made using crude oil.
1 g of a typical polymer used in disposable nappies can absorb about 150 g water.
When a disposable nappy is placed in landfill, it may take over 400 years to decompose.

Discuss, using the information given, the advantages and disadvantages of bamboo nappies and disposable nappies.
Include in your answer a brief description of how a nappy could be tested to see how much water it will absorb.

(6)

Bamboo nappies	Disposable nappies
+ easily accessable	+ can absorb lots of nappies
+ can be reused	- requires crude oil which release CO_2 into atmosphere causing the an increase in the greenhouse effect.
+ doesn't harm environment	- takes a long time to decompose, taking up space.

Can test ~~to~~ which can ~~hold~~ absorb more water by consistently adding 100 ml of water onto the inside of the ~~ea~~ nappy and ~~do~~ take note of which one starts to leak first the one which takes first can absorb the least amount of water/liquid making the ~~one~~ other one have an advantage in sales.

ResultsPlus
Examiner Comments

Three marks – level 2.

This answer was a little better than the example that scored two marks but the testing method was more detailed and some quantitative data could be obtained.

*(c) Babies may wear bamboo nappies or disposable nappies.
Both types of nappy absorb liquid.

The bamboo in bamboo nappies comes from a fast growing plant.
A bamboo nappy can be washed and used again many times.
When a bamboo nappy is placed in landfill, it will rot away quickly.

Disposable nappies contain a polymer made using crude oil.
1 g of a typical polymer used in disposable nappies can absorb about 150 g water.
When a disposable nappy is placed in landfill, it may take over 400 years to decompose.

Discuss, using the information given, the advantages and disadvantages of bamboo nappies and disposable nappies.
Include in your answer a brief description of how a nappy could be tested to see how much water it will absorb.

(6)

Bamboo nappies have advantages for the environment and economy. Since they are re-usable, less nappies will end up in landfill ~~so~~ because less nappies will be used and thrown away per baby. The nappies that do end up in landfill have little environmental damage, as they will rot away quickly meaning they do not contribute to the landfill pile. Additionally, bamboo comes from a plant, which can be easily re-grown and harvested, whereas disposable nappies require the fractional distillation of crude oil, leading to much higher energy costs and and so making disposable nappies more expensive to produce. Crude oil is also finite, whereas bamboo can be grown indefinitely, making bamboo nappies more sustainable. Bamboo nappies ~~also~~ being washable ~~it~~ means that less will be used, so less will be bought, so ~~we~~ parents ~~we~~ will spend less on bamboo nappies than disposable ones. However, bamboo nappies lose to disposable nappies in convenience and likely function. Disposable nappies will be cheaper per nappy than bamboo, so many ~~[illegible]~~ will be bought. This means disposable nappies can simply be discarded instead of washed, ~~[illegible]~~ which is much less effort ~~than~~ for the parents. Additionally, to absorb 150g of water for 1g ensures that all the liquid will be absorbed, whereas a bamboo nappy is less likely to do so because, unlike the polymer in disposable nappies, is not purpose-built to

absorb water. While disposable nappies are more convenient, though, they will remain, in high numbers due to their one-use nature, in landfill for centuries.
~~Th~~ ~~Polymers may be toxic~~ Polymers from crude oil may be toxic to any nearby wildlife, damaging the environment and making the area unusable for centuries.

To test how much water a ~~nap~~ nappy can absorb, fill a beaker with water. Measure the ~~tea~~ mass of the beaker and water with a scale.
Place a ~~ne~~ bamboo nappy inside the beaker for 10 minutes.
Then take it out, and read the new mass of the beaker + water.
New mass - starting mass will ~~ge~~ show ~~me~~ how much water the nappy absorbed.
Repeat the experiment with the same temperature and volume of water, but with a disposable nappy.
Record the change in mass, which shows how much water the disposable nappy absorbs.

Six marks – level 3.

The answer was well structured with several examples of advantages and disadvantages with their impact. The testing method was quite secure in that quantitative data about the absorbancy of the nappies could be obtained.

Paper Summary

The candidates who performed well on this paper were those who had read and understood the questions, answered the questions succinctly without repeating the question. They also answered the extended writing questions in a logical manner answering the questions as set and calculations were set out in full, so it was easy to see how the final answer was obtained.

Based on this year's performance, candidates are offered the following advice:

- Make use of the past GCSE papers that their teachers can provide – the bank of these is now large.
- Read the whole question to ensure that they know what is needed for the answer and avoid straying off topic.
- The core practicals form the basis of many of the questions covering practical work. Make sure these have been revised thoroughly.
- Practise writing and balancing equations, ionic and half equations and reactions forming polymers from their monomers.
- Inspection of the past papers will show the range of calculation types that have been set. Practise answering these types of calculations and know how to round a numerical answer to the required number of significant figures or decimal places.
- There are various patterns of reactivity of the elements of groups 1, 7 and 0. Make sure these are understood and how to explain them in terms of electrons.
- Learn how to draw reaction profiles for exo- and endothermic reactions.
- Learn the qualitative tests for identifying cations and anions as listed in the specification.

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