Pearson
Edexcel

Examiners' Report
June 2024

IAL Chemistry WCH11 01

ResultsPlus

Introduction

The paper was accessible to the majority of candidates and produced a full range of marks. Candidates with a sound knowledge of the chemistry covered in this unit were able to score high marks. There were two questions where it was necessary for candidates to balance equations and include state symbols (15(a) and 15(b)(ii)) in general these questions were poorly answered with an average of 1.4 being scored out of the 4 marks available. The mean mark for the paper was nearly 43 and section A scored an average of nearly 14. Candidates of all abilities gained marks on Question 4 (a definition), Question 6(a) (electronic configuration) and Question 10 (second ionisation). The graphical question was answered better than other calculation questions, with the majority scoring the mark for the average titration volume. Some questions were more challenging, and these were where the candidates had to apply their chemistry knowledge to 'real life' situations and Question 18(a)(ii) (application of how acids behave). It was also notable that in some questions the scientific terms had been used incorrectly.

Question 15 (a)

This question was about the photo decomposition of solid silver chloride.

15 This question is about silver.

(a) Silver chloride decomposes in light. This reaction was used in the first photographic plates.

Write an equation for this decomposition.
Include state symbols.

(2)

$2AgCl(s) \xrightarrow{UV} 2Ag(s) + Cl_2(g)$

ResultsPlus
Examiner Comments

Here both marks were scored.

15 This question is about silver.

(a) Silver chloride decomposes in light. This reaction was used in the first photographic plates.

Write an equation for this decomposition.
Include state symbols.

(2)

$AgCl_2(s) \rightarrow Ag(s) + Cl_2(g)$

ResultsPlus
Examiner Comments

This candidate was able to get the state symbol mark for a 'near miss' on the formula of silver chloride.

15 This question is about silver.

(a) Silver chloride decomposes in light. This reaction was used in the first photographic plates.

Write an equation for this decomposition.
Include state symbols.

(2)

$AgCl_2 (s) \longrightarrow Ag(s) + 2Cl (g)$

ResultsPlus
Examiner Comments

In this case, the candidate does not know the formula of silver chloride or chlorine and so did not gain any marks.

ResultsPlus
Examiner Tip

Learn the charges on ions. Be aware that all halogens exist as diatomic molecules.

Question 15 (b)(i)

This question is about the observations made when a displacement reaction occurs.

(b) Silver can form in displacement reactions.

(i) State **two** observations that are made when copper metal is added to silver nitrate solution.

(2)

solution turns from colourless to blue, shiny silver solids are formed on the surface of the copper metal.

ResultsPlus
Examiner Comments

A perfect response.

(b) Silver can form in displacement reactions.

(i) State **two** observations that are made when copper metal is added to silver nitrate solution.

(2)

Fizzing

a colour changing ~~from~~ to blue

ResultsPlus
Examiner Comments

'Fizzing' was a popular incorrect observation.

They did, however, score 1 mark for the colour change to blue.

(b) Silver can form in displacement reactions.

(i) State **two** observations that are made when copper metal is added to silver nitrate solution.

(2)

- No reaction is occured because because Silver is higher copper so Can't copper can't displace Silver nitrate

ResultsPlus
Examiner Comments

This candidate has erroneously thought that silver is more easily oxidised than copper.

ResultsPlus
Examiner Tip

Ensure that the reactivity series is learned.

Question 15 (b)(ii)

A balancing equation with state symbols question, based on the observations in Question 15(b)(i).

(ii) Write an equation for this displacement reaction.
Include state symbols.

(2)

$$Cu(s) + 2AgNO_3(aq) \longrightarrow Cu(NO_3)_2(aq) + 2Ag(s)$$

ResultsPlus
Examiner Comments

A perfect response.

(ii) Write an equation for this displacement reaction.
Include state symbols.

(2)

$$Cu_{(s)} + 2AgNO_{3(aq)} \longrightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

NO_3^- Ag^+ Cu^{2+} NO_3

$$Cu_{(s)} + 2Ag^+_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$$

ResultsPlus
Examiner Comments

A perfect response given as a fully correct ionic equation.

(ii) Write an equation for this displacement reaction.
Include state symbols.

(2)

$AgNO_3(aq) + Cu(s) \longrightarrow CuNO_3(aq) + Ag(s)$

ResultsPlus
Examiner Comments

Here the candidate does not know the charges on copper ions in aqueous media. They were able to score the state symbol mark as the error on the formula of copper(II) nitrate was taken as a 'near miss'.

ResultsPlus
Examiner Tip

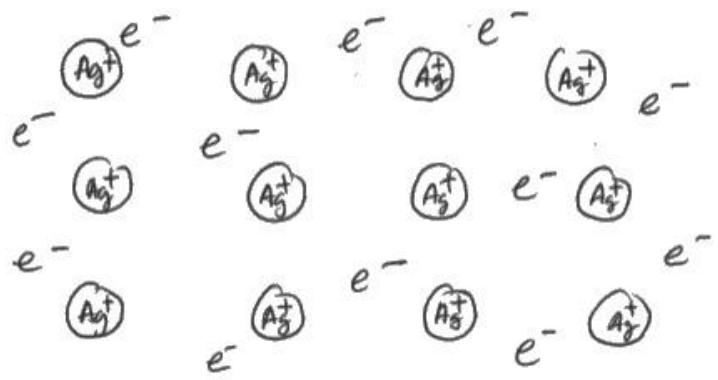
Learn the charges on ions.

Question 15 (c)(i)

This question was about drawing metallic bonding.

(c) (i) Describe the bonding in pure silver metal.
Include a 2D diagram to show the arrangement of 12 of the silver particles involved.

(3)



Strong Electrostatic force of attraction between the sea of delocalised electrons and positive cation. & So ~~meth~~ metallic bonding. Large amount of energy required to break the bonds. Due to delocalised electrons, it can conduct electricity in both solid and ~~liq~~ liquid state.

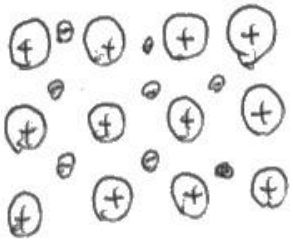
ResultsPlus
Examiner Comments

All three marks scored.

The candidate has included many extra details, which do not contradict the required answer.

(c) (i) Describe the bonding in pure silver metal.
Include a 2D diagram to show the arrangement of 12 of the silver particles involved.

(3)



The bonding is metallic which is the strong attraction between positive ions and the sea of delocalized electrons

ResultsPlus
Examiner Comments

The diagram is heading in the correct direction, but the question clearly states 12 silver particles – which there are and so there should also be 12 electrons, but the MS actually only required 10 to be shown. The candidate also omitted 'electrostatic' when describing the attraction.

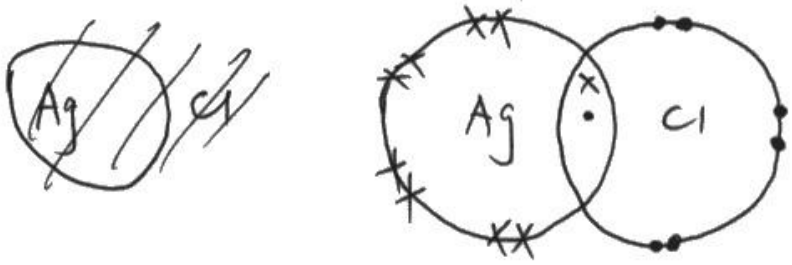
So only 1 mark scored.

ResultsPlus
Examiner Tip

Ensure the question has been fully read and include all the details.

(c) (i) Describe the bonding in pure silver metal.
Include a 2D diagram to show the arrangement of 12 of the silver particles involved.

(3)



Share electrons, covlant bond.

ResultsPlus
Examiner Comments

This candidate appears to think that this question is about bonding in silver chloride, even then thinking that it would be covalent, not silver.

ResultsPlus
Examiner Tip

Ensure that the question has been read carefully.

Question 15 (c)(ii)

This question was about the application of metallic bonding relating to metallic properties.

(ii) Pure silver cups are too soft so small amounts of copper are added to make an alloy.

Explain why copper makes the silver less malleable.

(2)

an alloy has different size of cations, which makes them harder to slide over each other, ~~and~~ hence increase strength, which requires higher energy to break.

ResultsPlus
Examiner Comments

The candidate has given an excellent response covering the ideas that the copper and silver ions are of different sizes and that this would cause them not to slide so easily over each other.

ResultsPlus
Examiner Tip

Learn how structure and bonding affects properties.

(ii) Pure silver cups are too soft so small amounts of copper are added to make an alloy.

Explain why copper makes the silver less malleable.

(2)

the size of copper is different thang silver. So the ~~&~~ copper ion atoms stay between the layers of silver, to avoid ~~bec~~ the layers from sliding pass eachothe~~r~~r.

ResultsPlus
Examiner Comments

In the fourth line "to avoid the layers from sliding pass each other" is not acceptable for this mark, as this makes it sound as though there is no sliding at all.

In the first line "The size of copper is different than silver" alone would not be good enough, but the candidate has then referred to "the copper ion," which makes it clear enough that they are writing about metallic particles and not just lumps of the two metals.

ResultsPlus
Examiner Tip

Ensure you use precise scientific language when answering questions.

Question 16 (a)(i)

A definition of relative atomic mass, which was a repeat of a question from 2023, but both marks were only scored by 39% of candidates.

16 This question is about silicon.

(a) (i) Define relative atomic mass.

(2)

It's the average mass of an atom compared to ~~it~~ carbon mass of atom of ~~~~ ^{12}C

ResultsPlus Examiner Comments

A perfect response.

ResultsPlus Examiner Tip

Ensure that definitions have been correctly learned.

16 This question is about silicon.

(a) (i) Define relative atomic mass.

(2)

mass of an atom compared to $\frac{1}{12}$ mass of carbon (12) atom.

ResultsPlus Examiner Comments

Here the candidate has not mentioned the mean or average mass of an atom, so can only score the relative to 1/12th of the mass of carbon-12 mark.

16 This question is about silicon.

(a) (i) Define relative atomic mass.

(2)

Mass of an atom ~~relative~~ measured relative to 1/12 of carbon atom.

ResultsPlus
Examiner Comments

Here the candidate is close to both marking points, but has failed to mention mean or average mass and has also not mentioned carbon-12.

Question 16 (a)(ii)

This calculation of relative atomic mass using isotopic abundance data was well answered with over 75% of the candidates scoring both marks.

(ii) **Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.**
Give your answer to 3 significant figures.

Isotope	Abundance (%)
^{28}Si	91.07
^{29}Si	4.62
^{30}Si	3.00
^{32}Si	1.31

$$\frac{(91.07 \times 28) + (29 \times 4.62) + (30 \times 3) + (1.31 \times 32)}{100}$$

$$= \frac{2549.96 + 133.98 + 90 + 41.92}{100}$$

$$= \frac{2815.86}{100} = 28.15$$

28.2

ResultsPlus
Examiner Comments

A perfect response.

(ii) Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.
Give your answer to 3 significant figures.

Isotope	Abundance (%)
^{28}Si	91.07
^{29}Si	4.62
^{30}Si	3.00
^{32}Si	1.31

(2)

$A_r = 28 \times 91.07\% + 29 \times 4.62\% + 30 \times 3\% \times 32 \times 1.31\%$

$\approx 28.158 \ (g \cdot mol^{-1})$

ResultsPlus
Examiner Comments

Only the calculation mark can be awarded as, unfortunately, the candidate did not round to three significant figures as requested in the question.

The unit (not required) given is the only allowed unit.

ResultsPlus
Examiner Tip

Ensure that the question has been read carefully.

Question 16 (a)(iii)

This question was about the formation of a doubly charged ion in a mass spectrometer. Only about a third of candidates answered this correctly.

(iii) In the mass spectrum of silicon, there is also a small peak at $m/z = 14$. Deduce the formula of this particle.

(1)

$^{28}Si^{2+}$

ResultsPlus
Examiner Comments

A fully correct response.

(iii) In the mass spectrum of silicon, there is also a small peak at $m/z = 14$. Deduce the formula of this particle.

(1)

^{28}Si

Al Si P S

[1] [1] 4V

ResultsPlus
Examiner Comments

In this response the 2+ charge has been omitted.

Question 16 (b)(i)

An explanation of the general trend in first ionisation energies. Only 36% of the candidates scored all 3 marks.

(b) Consider the elements Al, Si, P and S.

(i) Explain the trend in the first ionisation energies of Al, Si and P.

(3)

The Ionisation energy increases from Al → P as the nuclear charge increases, but the shielding effect is constant, so more force of attraction between the nuclei and valence electrons, so more energy required to remove 1 electron.

ResultsPlus
Examiner Comments

A fully correct response.

(b) Consider the elements Al, Si, P and S.

$1s^2 2s^2 2p^6 3s^2 3p^{1,2,3,4}$

(i) Explain the trend in the first ionisation energies of Al, Si and P.

(3)

The first ionisation energies increase, proton number increase, the electrongative attraction increase

ResultsPlus
Examiner Comments

A brief response that only missed the point about the electrons being removed from the same sub-shell.

ResultsPlus
Examiner Tip

Ensure that chemical ideas are not confused.

(b) Consider the elements Al, Si, P and S.

(i) Explain the trend in the first ionisation energies of Al, Si and P.

(3)

- Al ion reacts Al^{+1} ion to get an electron.
- Which is the first ionisation energy.
- When one mole of atom takes another mole from a gaseous atom to form a mole for another gaseous atom.

ResultsPlus
Examiner Comments

This candidate has confused the idea of trend with a poor attempt at explaining first ionisation.

ResultsPlus
Examiner Tip

Ensure that the question has been read carefully.

Question 16 (b)(ii)

A question about how the first ionisation energies of successive elements provides evidence for electron sub-shells. Nearly 43% of the candidates scored no marks.

(ii) Explain why sulfur does **not** follow this trend.

(2)

S : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

Sulfur has a paired electron in its outer shell which experiences electron – electron repulsion therefore requires less energy to be removed.

ResultsPlus
Examiner Comments

The candidate has given the electron configuration showing four electrons in the 3p sub-shell. They have gone on to state there are paired electrons, and that there is electron-electron repulsion.

(ii) Explain why sulfur does **not** follow this trend.

(2)

Because only Sulfur has one full 3p orbit. S is $1s^2 2s^2 2p^6 3s^2 3p^4$.

ResultsPlus
Examiner Comments

The candidate has given the correct electron configuration, but has not mentioned that one 3p orbital contains two electrons. They have not mentioned that there would be repulsion between the two electrons in the one 3p orbital.

ResultsPlus
Examiner Tip

Questions of this sort appear frequently and it is therefore important that candidates learn the reasons for elements not following the general first ionisation trend across a period.

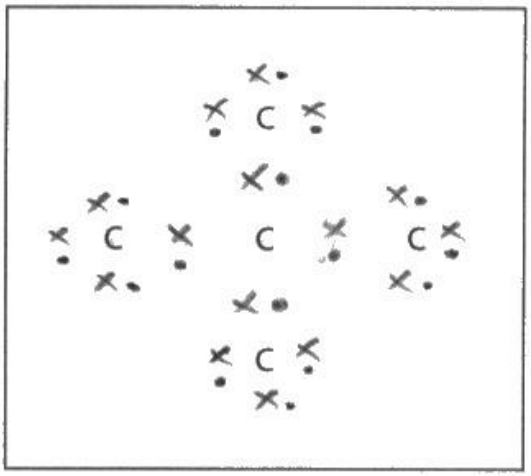
Question 17 (a)

This question was about the electrons in the diamond giant covalent lattice. The majority of candidates scored 1 of the 2 marks available.

17 Carbon exists as several different structures called allotropes.

(a) Complete the dot-and-cross diagram by adding all the electrons in the outer shells of the five carbon atoms in a diamond tetrahedral unit.

(2)



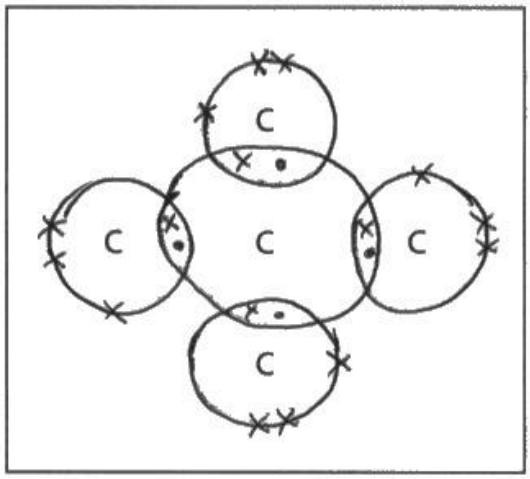
ResultsPlus
Examiner Comments

A perfect response. In this case the candidate has used a combination of dots and crosses for all the covalent bonds, in a Lewis structure.

17 Carbon exists as several different structures called allotropes.

(a) Complete the dot-and-cross diagram by adding all the electrons in the outer shells of the five carbon atoms in a diamond tetrahedral unit.

(2)



ResultsPlus
Examiner Comments

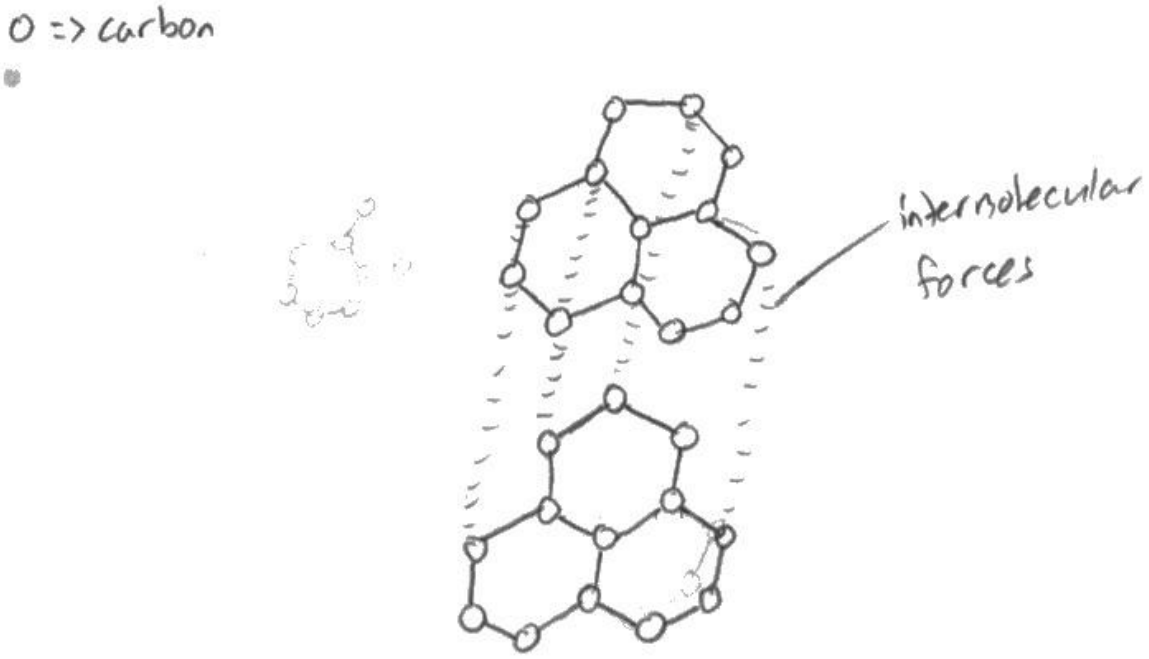
This was a common response for 1 mark as the candidate had only included the pairs of electrons around the central carbon atom and not all the electron pairs around the outer carbon atoms.

Question 17 (b)

In this question, candidates were asked to draw a 3D structure of graphite, showing 2 layers with at least 13 carbon atoms in each. In reality, this meant each layer needed to show 3 hexagons.

(b) Draw a labelled 3D structure of graphite, showing two layers of at least 13 carbon atoms each and the forces between the layers.

(2)

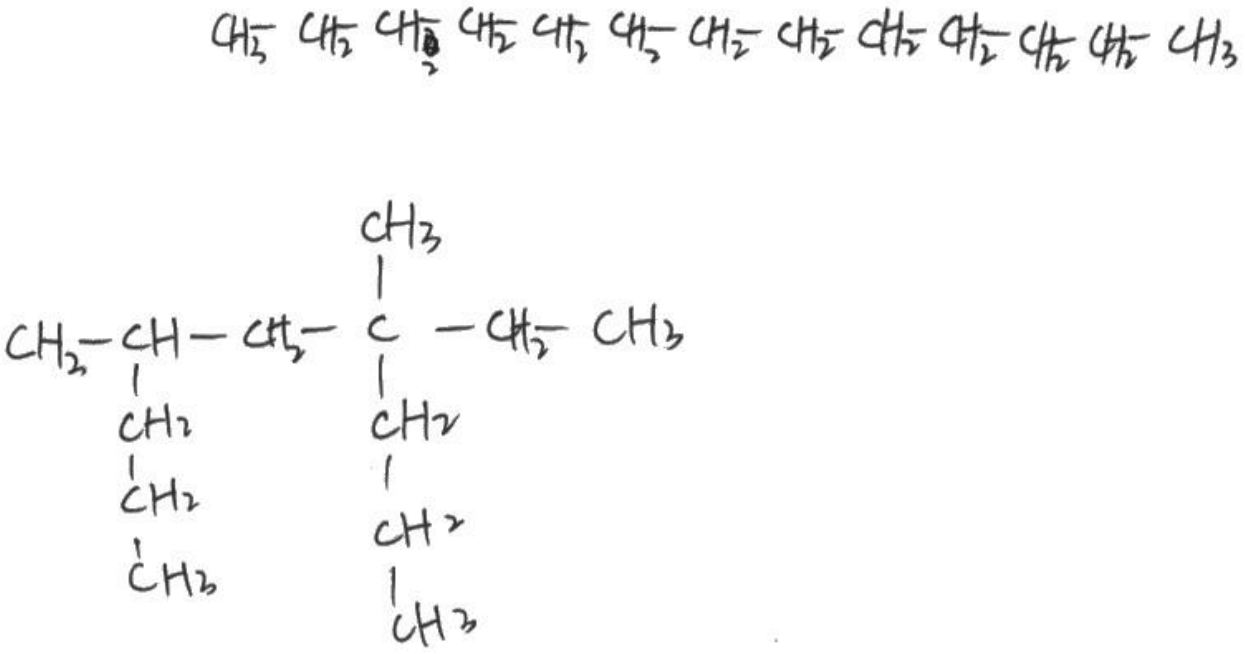


ResultsPlus
Examiner Comments

A perfect response, showing 3 hexagons per layer and forces between the layers labelled.

(b) Draw a labelled 3D structure of graphite, showing two layers of at least 13 carbon atoms each and the forces between the layers.

(2)



ResultsPlus
Examiner Comments

Here the candidate has not recalled the stem of Question 17, where it mentions different structures of carbon.

ResultsPlus
Examiner Tip

Ensure that you remember that the entire question has be read carefully.

Question 17 (c)

An application of the ideas behind the different structure and bonding found in two different structures of carbon and how this affects the physical properties.

(c) Suggest why diamond has a greater density than graphite.

(2)

diamond is giant covalent structure, which each C bonded with ~~four~~ 4 other C.

graphite is giant covalent structure, but it has ~~layers~~ large distance between each layer.

so diamond has greater density than graphite.

ResultsPlus
Examiner Comments

A perfect response where the candidate has correctly stated that in diamond, each carbon atom is covalently bonded to four others but in graphite, there are gaps between the layers.

(c) Suggest why diamond has a greater density than graphite.

(2)

This is because Carbon atoms in diamond is bonded to 4 other Carbon atoms, whereas graphite is only bonded to 3 other carbon atoms.

This means that more molecules are bonded to ~~no one~~ molecules in the same ~~am~~ amount of space and diamond is more tightly packed together, and hence a higher density than graphite.

ResultsPlus
Examiner Comments

In this response, the candidate has correctly stated that each carbon atom is bonded to four others in diamond, but they have then mentioned molecules and this has negated one mark.

ResultsPlus
Examiner Tip

Make sure that precise scientific language is used.

Question 18 (a)(i)

In this question, candidates were asked to name a reaction type.

18 Baking powder is added to cake mixtures to make cakes 'rise' by releasing a gas during cooking.

Baking powder contains an acidic derivative of tartaric acid and about 30% by mass of sodium hydrogencarbonate.

Baking powder releases the gas in two types of reaction during cooking, one of which is neutralisation.

(a) (i) Give the name of the second type of reaction.

(1)

Thermal decomposition

ResultsPlus
Examiner Comments

A perfect response.

Question 18 (a)(ii)

An application of how and why acids react.

(ii) Suggest why neutralisation does not occur in an unopened container of baking powder.

(1)

The reaction requires water in atmosphere to take place because it takes place in solution.

ResultsPlus
Examiner Comments

The candidate has mentioned that water is required for neutralisation to take place.

(ii) Suggest why neutralisation does not occur in an unopened container of baking powder.

(1)

there is no oxygen for baking soda to react with

ResultsPlus
Examiner Comments

This was a common incorrect answer.

Question 18 (b)(i)

This empirical formula calculation was correctly completed by over half of the candidates. Many lost a mark for not first calculating the amount of oxygen present.

(b) (i) The acidic derivative of tartaric acid contains 20.8% potassium, 25.5% carbon, 2.66% hydrogen by mass and the rest is oxygen.

Calculate the empirical formula.

(2)

$K: \frac{20.8}{39.1} = 0.532 \text{ mol}$ 1

$C: \frac{25.5}{12} = 2.13 \text{ mol}$ 4

$H: \frac{2.66}{1} = 2.66 \text{ mol}$ 5

$O: \frac{51.04}{16} = 3.19 \text{ mol}$ 6

$C_4H_5O_6K$

ResultsPlus
Examiner Comments

A fully correct response.

(b) (i) The acidic derivative of tartaric acid contains 20.8% potassium, 25.5% carbon, 2.66% hydrogen by mass and the rest is oxygen.

Calculate the empirical formula.

(2)

K : C : H

$\frac{0.1208}{19}$ $\frac{0.255}{12}$ $\frac{0.266}{1}$

~~0.00629~~ ~~0.02125~~

0.0011 : 0.021 : 0.266

1 : 18.3 24.2

∴ ~~KC18H24~~ $H_{24}KC_{18}$

ResultsPlus
Examiner Comments

In this response, the candidate has omitted to calculate the percentage of oxygen and they have then used the atomic number of potassium rather than the atomic mass of potassium.

ResultsPlus
Examiner Tip

Take care looking up data and ensure that the question has been read carefully.

Question 18 (b)(ii-iv)

The first part of this question – 18(b)(ii) – was a balanced equation for a neutralisation where the candidates had been given the formula of one of the reagents and in the next part, they were told the name of one of the products. A surprising number did not score both marks available. In the second part – 18(b)(iii) – candidates were asked to use the ideal gas equation to calculate the volume of carbon dioxide gas and, in the third part – 18(b)(iv), the decrease in volume of carbon dioxide.

(ii) The acidic derivative of tartaric acid can be represented by the formula $H^+K^+A^{2-}$.

Write the equation for the neutralisation of sodium hydrogencarbonate by $H^+K^+A^{2-}$.

State symbols are not required.

(2)

$NaHCO_3 + H^+K^+A^{2-} \rightarrow$

$Na^+ H^+CO_3^{2-} + H^+K^+A^{2-} \rightarrow H_2O + CO_2$

(iii) Calculate the maximum volume, in **cm³**, of carbon dioxide gas released by the neutralisation reaction in (b)(ii) from 5.00 g of baking powder, in an oven at 190°C at 101 000 Pa.

Baking powder contains 30% sodium hydrogencarbonate by mass.
[$pV = nRT$]

(5)

$PV = nRT \rightarrow$ [redacted] $\frac{30}{100} \times 5 = 1.5\,g$

$\rightarrow n = \frac{1.5}{84} = \frac{1}{56}$ { $190 + 273 = 463\,K$

$V = \frac{\frac{1}{56} \times 8.31 \times 463}{101{,}000} = 6.8025\ldots \times 10^{-4}\ m^3$

$\rightarrow cm^3 = x(100)^3 = 680\,cm^3$ (to 3 sf)

(iv) Calculate the decrease in volume when the carbon dioxide gas is cooled to 20°C.

(2)

$V = \frac{\frac{1}{56} \times 8.31 \times 293}{101,000}$

$V = 430\ cm^3$ (to 3 sf)

$680 - 430 = 250\ cm^3$

So volume has decreased by $250\ cm^3$

ResultsPlus
Examiner Comments

18(b)(ii): The candidate has omitted the salt formed in the neutralisation.

18(b)(iii): A fully correct calculation

18(b)(iv): A fully correct calculation

(ii) The acidic derivative of tartaric acid can be represented by the formula $H^+K^+A^{2-}$.

Write the equation for the neutralisation of sodium hydrogencarbonate by $H^+K^+A^{2-}$.

State symbols are not required.

(2)

$NaHCO_3 + HKA^- \rightarrow NaKA + H_2O + CO_2$

(iii) Calculate the maximum volume, in **cm^3**, of carbon dioxide gas released by the neutralisation reaction in (b)(ii) from 5.00 g of baking powder, in an oven at 190°C at 101 000 Pa.

Baking powder contains 30% sodium hydrogencarbonate by mass.

[$pV = nRT$]

(5)

$V = \frac{nRT}{P}$

$n = \frac{m}{mr}$

$n = \frac{1.5}{23 + 1 + 12}$

$n = 0.0178$

$V = \frac{8.31 \times 463 \times 0.0178}{101000}$

$V = 6.8 \times 10^{-4}\ m^3$

$V = 680.3\ cm^3$

ResultsPlus
Examiner Comments

In 18(b)(ii), the candidate lost a mark for incorrectly copying the formula of the tartaric acid formula.

The candidate scored all five marks for 18(b)(iii).

Question 19 (a)

A definition question that was answered correctly by over 60% of the candidates.

19 Both butter and margarine are fats used in cooking.

(a) Margarines are sold as unsaturated fats.

State the meaning of the term unsaturated.

(1)

has carbon - carbon double bond.

ResultsPlus
Examiner Comments

An acceptable answer.

19 Both butter and margarine are fats used in cooking.

(a) Margarines are sold as unsaturated fats.

State the meaning of the term unsaturated.

(1)

~~can~~ ~~Mov~~ Move solute can be dilolved.

ResultsPlus
Examiner Comments

This candidate has confused the two meanings of saturated and not read the question carefully.

ResultsPlus
Examiner Tip

Ensure that you read the question carefully.

Question 19 (b)(i)

This question focused on naming an organic reaction. This was answered correctly by just over half the candidates.

(b) (i) The degree of unsaturation can be determined by the reaction with bromine water.

Name the type of reaction.

(1)

addition

ResultsPlus
Examiner Comments

Enough for the answer.

(b) (i) The degree of unsaturation can be determined by the reaction with bromine water.

Name the type of reaction.

(1)

~~substitution~~ Addition (nucleophilic)

ResultsPlus
Examiner Comments

Here the candidate has lost the mark due to over embellishment.

Question 19 (b)(ii-iv)

The question was split in the following way:

19(b)(ii) – graph plotting (3 marks)

19(b)(iii) – mean volume calculation – nearly always answered correctly (1mark)

19(b((iv) – interpolation from the graph (1 mark)

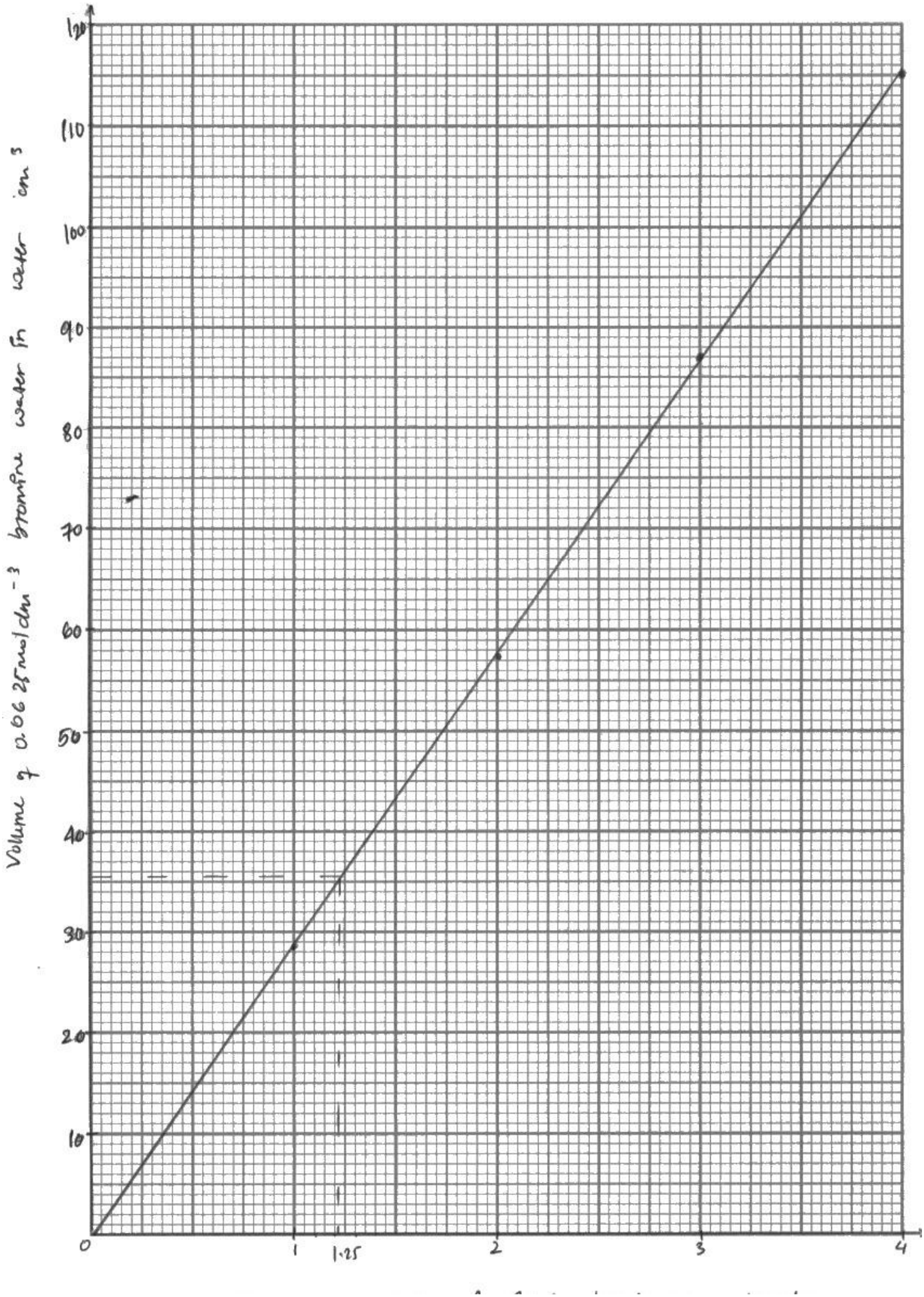
A third of the candidates scored 4 of the 5 available marks.

Data using 0.5 g of some unsaturated fat in this bromination is given in the table.

Average number of C=C bonds per molecule	Volume of 0.0625 mol dm^{-3} bromine water / cm^3
1	28.3
2	57.3
3	86.9
4	115

(ii) Plot a graph of the data. Include a line of best fit.

(3)


Volume of 0.0625 mol dm⁻³ bromine water in cm³
120
110
100
90
80
70
60
50
40
30
20
10
0
1
1.25
2
3
4

(iii) Data for the bromination of 0.5 g samples of a margarine are shown.

Trial	Volume of 0.0625 mol dm^{-3} bromine water / cm^3
1	36.9
2	34.1
3	39.3
4	32.5

Calculate the mean volume of bromine water using all results in the table.

(1)

mean volume = $\frac{36.9 + 34.1 + 39.3 + 32.5}{4}$

= 35.7 cm^3

(iv) Determine the average number of C=C bonds per molecule of the unknown sample to 2 significant figures, using your graph.

(1)

~~1.25 C=C~~

~~1.25~~ 1.3 C=C bonds per molecule

ResultsPlus
Examiner Comments

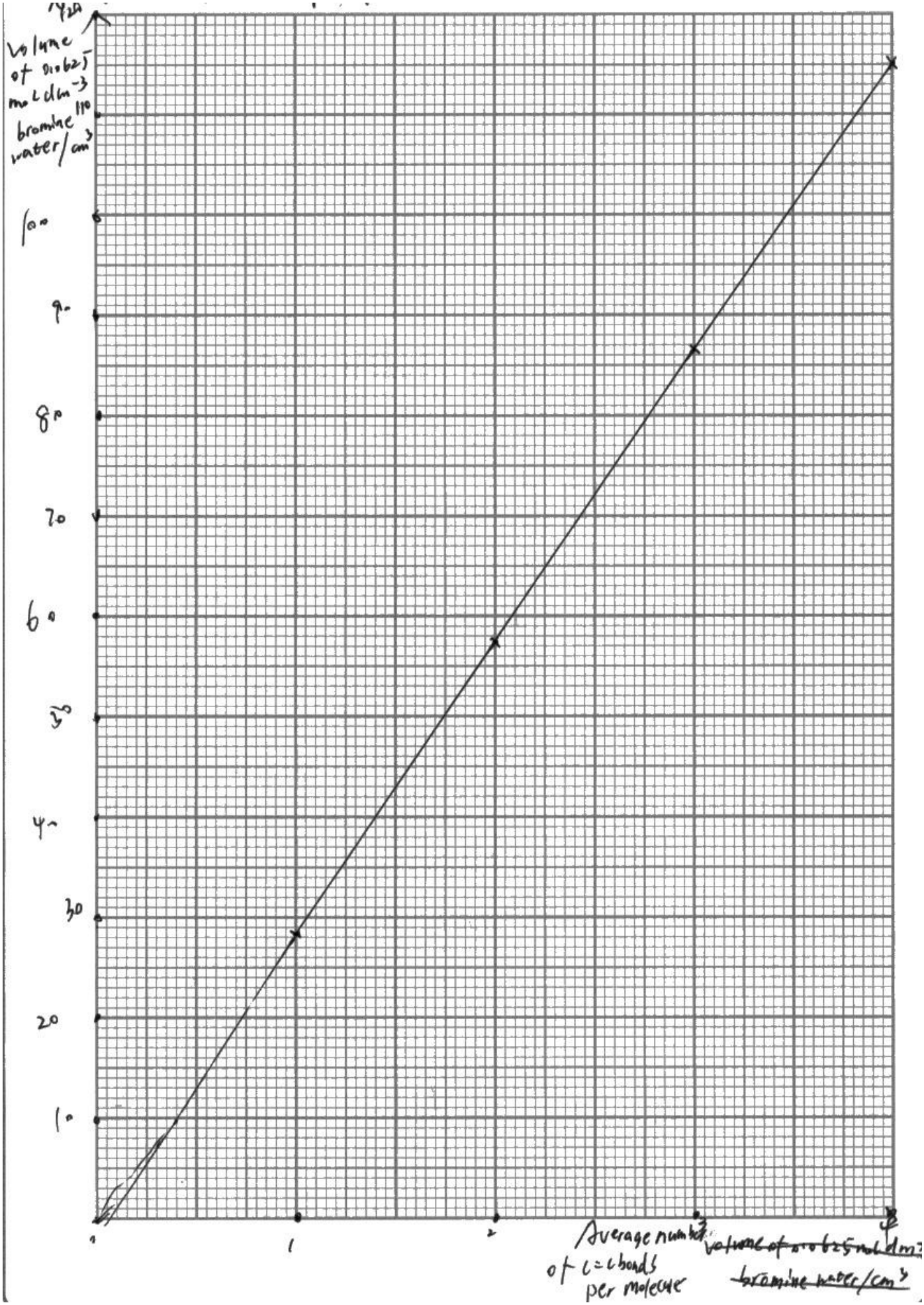
A fully correct response.

Data using 0.5 g of some unsaturated fat in this bromination is given in the table.

Average number of C=C bonds per molecule	Volume of 0.0625 mol dm^{-3} bromine water / cm^3
1	28.3
2	57.3
3	86.9
4	115

(ii) Plot a graph of the data. Include a line of best fit.

(3)


Volume of 0.025 mol dm⁻³ bromine water/cm³
110
100
90
80
70
60
50
40
30
20
10
0
1
2
Average number of C=C bonds per molecule

(iii) Data for the bromination of 0.5 g samples of a margarine are shown.

Trial	Volume of 0.0625 mol dm^{-3} bromine water / cm^3
1	36.9
2	34.1
3	39.3
4	32.5

Calculate the mean volume of bromine water using all results in the table.

(1)

$\frac{36.9 + 34.1 + 39.3 + 32.5}{4} = 35.7$

(iv) Determine the average number of C=C bonds per molecule of the unknown sample to 2 significant figures, using your graph.

(1)

ResultsPlus
Examiner Comments

19(b)(ii): A perfect graph drawn with labels and units on the axes, appropriate scale and plotting and straight line of best fit drawn.

19(b)(iii): Mean titre volume calculated correctly

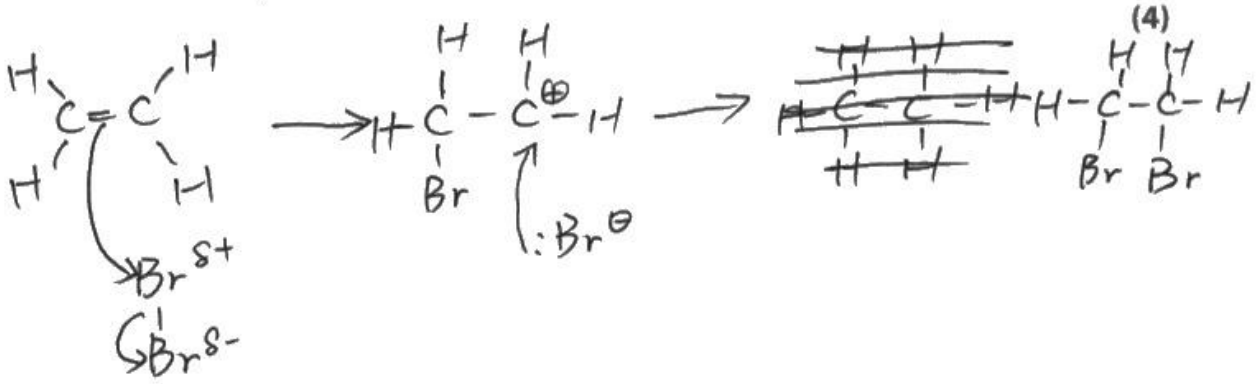
19(b)(iv): Not attempted.

Question 19 (c)(i)

A similar mechanism question was on this paper in 2023. This year nearly 40% of the candidates scored all 4 marks.

(c) (i) **Using the simplest alkene as an example, draw the mechanism to show the reaction with liquid bromine.**

(4)

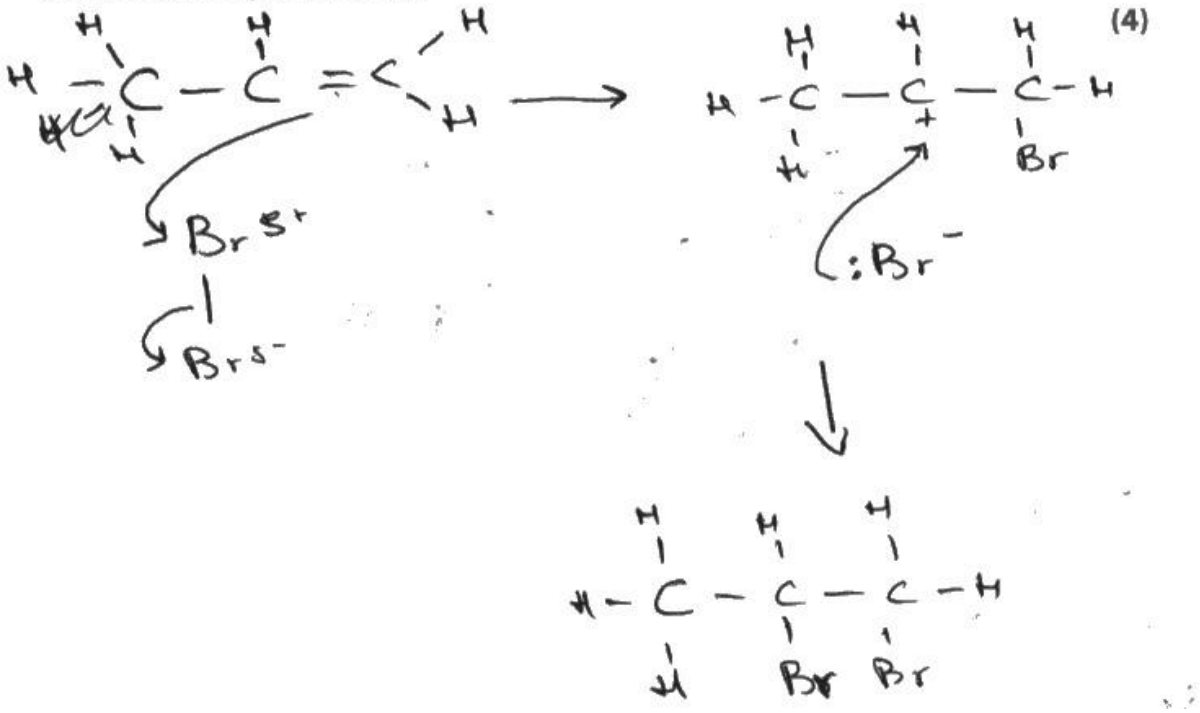


ResultsPlus
Examiner Comments

A fully correct response.

(c) (i) Using the simplest alkene as an example, draw the mechanism to show the reaction with liquid bromine.

(4)

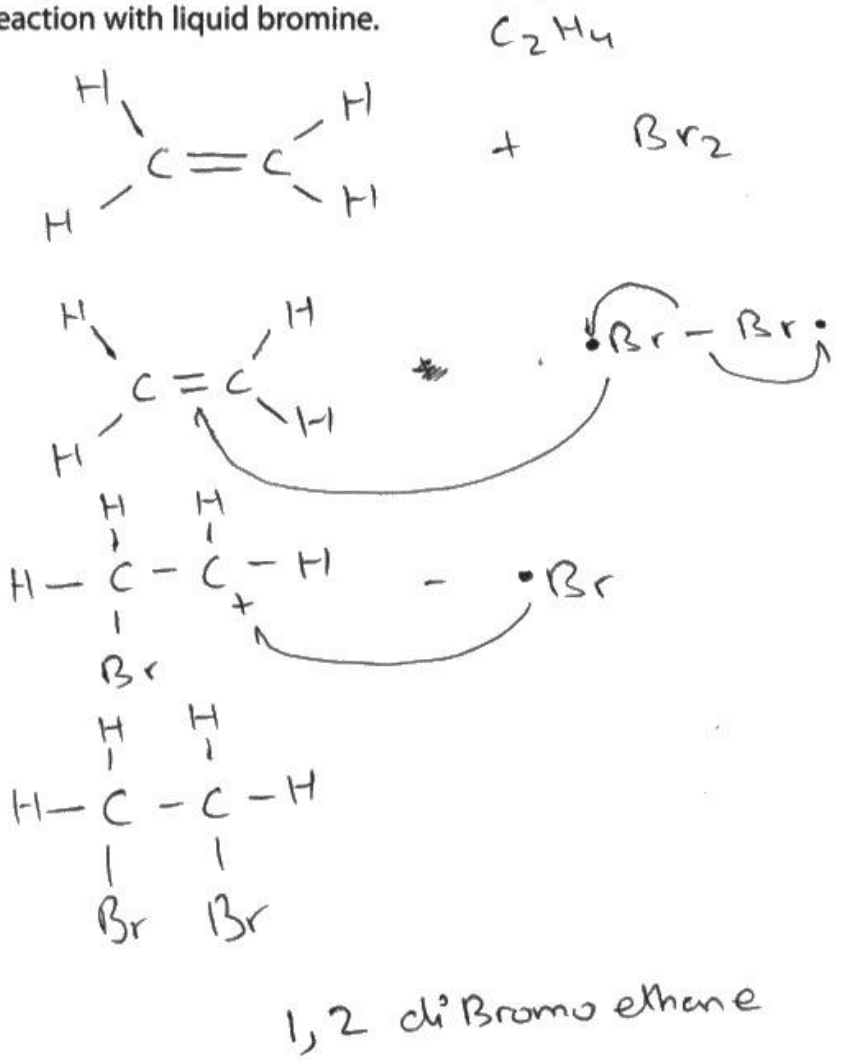


ResultsPlus
Examiner Comments

In this response, the only error is that the candidate has not selected the simplest alkene as the organic starting material.

(c) (i) Using the simplest alkene as an example, draw the mechanism to show the reaction with liquid bromine.

(4)



ResultsPlus
Examiner Comments

In this response, the candidate has correctly given the carbocation intermediate and correct final product.

So overall 1 mark scored.

ResultsPlus
Examiner Tip

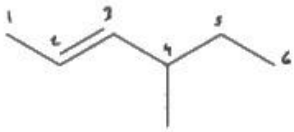
Make sure that all organic mechanisms have been thoroughly learned.

Question 19 (c)(ii)

This question concerned organic nomenclature and was answered correctly by over 60% of the candidates.

(ii) Name this compound by applying IUPAC rules.

(1)



4-methylhex-2-ene

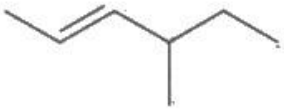
ResultsPlus
Examiner Comments

A perfect response.

(ii) Name this compound by applying IUPAC rules.

(1)

C_7H_{14}



Oct-2-ene

ResultsPlus
Examiner Comments

The candidate has counted all the carbons as the longest chain, but has then given the name as "oct".

ResultsPlus
Examiner Tip

Learn the IUPAC nomenclature rules and apply them correctly.

Question 19 (d)

In this question, candidates needed to draw a skeletal diagram of trans but-2-ene and then explain the meaning of trans.

(d) Explain the meaning of "trans" in "trans" fats, using a **skeletal** formula showing four carbon atoms in your answer.

(2)

← trans- but-2-ene

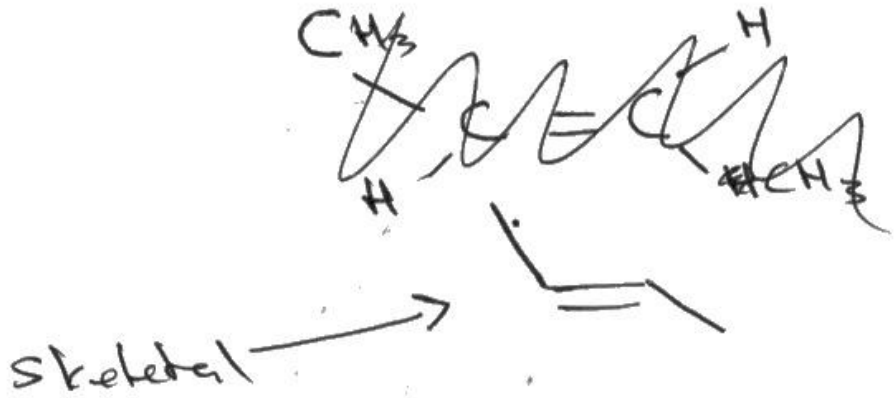
• trans - is a geometric isomerism where the group with the highest priority number (Ar value) is on opposite sides of the carbon carbon double bond due to limited rotation around the central carbon. CH_3 group is on the bottom left, CH_3 on the other carbon is in the top right

ResultsPlus
Examiner Comments

A fully correct response.

(d) Explain the meaning of "trans" in "trans" fats, using a **skeletal** formula showing four carbon atoms in your answer.

(2)



~~the molecule with higher Mr~~ ~~is~~

The molecule with higher mass is at the opposite side of the double bond.

ResultsPlus
Examiner Comments

The candidate has drawn a correct diagram.

The use of 'molecule' for the alkyl group does not score the second mark.

ResultsPlus
Examiner Tip

Be more precise with scientific language.

Question 20 (a)

Candidates were asked to draw the displayed formula for chloroethene and tetrafluoroethene. Just over 46% of the candidates scored both marks.

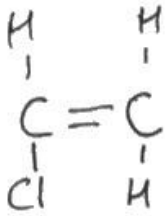
20 Many synthetic polymers are used in the home.
Some are used as containers and others as coatings.

PVC and PTFE are two such examples.

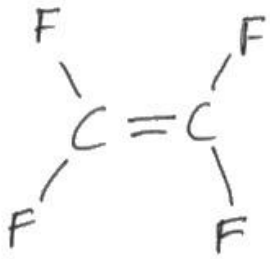
(a) Draw the **displayed** formula of each of the monomers for these polymers.

(2)

chloroethene



tetrafluoroethene



ResultsPlus
Examiner Comments

A fully correct response.

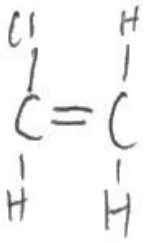
20 Many synthetic polymers are used in the home.
Some are used as containers and others as coatings.

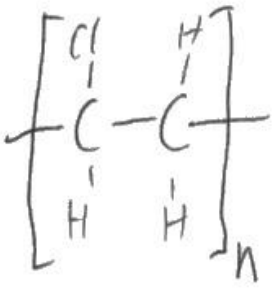
PVC and PTFE are two such examples.

(a) Draw the **displayed** formula of each of the monomers for these polymers.

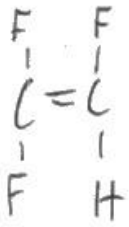
(2)

chloroethene





tetrafluoroethene



ResultsPlus
Examiner Comments

This clip shows a common error – drawing trifluoroethene. The drawings of the polymeric structures were ignored.

Question 20 (b)

This question was about dealing with polymer waste.

(b) Incineration and recycling are two methods of disposing of polymer waste. Give **one** advantage and **one** disadvantage for each method.

(4)

Incineration

advantage The rubbish is burnt and the energy produced is used to generate electricity. It can reduce large volume of polymers.

disadvantage Incineration releases toxic gases such as HCl and also green house gases which cause global warming.

Recycling

advantage Save raw materials.

disadvantage Requires people for carefully sorting, since one each kind of polymers can only be recycled in one way.

ResultsPlus
Examiner Comments

A fully correct response.

(b) Incineration and recycling are two methods of disposing of polymer waste.
Give **one** advantage and **one** disadvantage for each method.

(4)

Incineration

advantage ~~en~~ ① generate electricity
② reduce pollutant in the land fill
③ reduce Methane emission.

disadvantage ① emission of toxic gas such as HCl
② emission of carbon dioxide which causes ~~envi~~ global warming.

Recycling

advantage ① save raw material.
② ~~one~~ resourses are conserved.
③ use less energy.

disadvantage ① yield is low ② useful part is small.
③ transportation cause carbondioxide emission.

ResultsPlus
Examiner Comments

A near perfect response.

For the incineration advantage, 'reduce methane emission' is ignored.

For the incineration disadvantage, both of the answers are correct.

For the recycling advantage, 'use less energy' is ignored.

For the Recycling disadvantage, comments about transportation are ignored and 'yield' is not required.

Paper Summary

Based on their performance on this paper, candidates should:

- Read the questions carefully, particularly noting any words in bold.
- Use the correct scientific terminology.
- Ensure they can balance equations especially interpreting state symbols from the information in the question.
- Applying IUPAC nomenclature.
- Application of chemical ideas in real life situations.
- Application of methods of polymer disposal.