CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/24**

Paper 2 AS Level Structured Questions **May/June 2026**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **23** printed pages.

[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

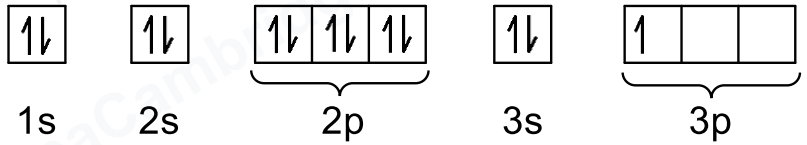
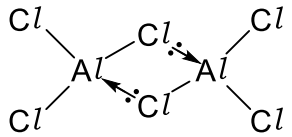
Annotations

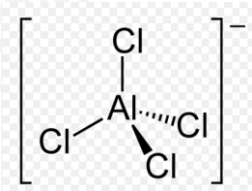
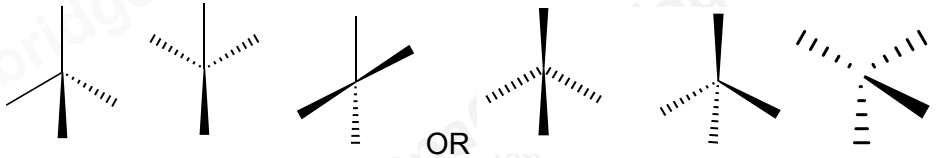
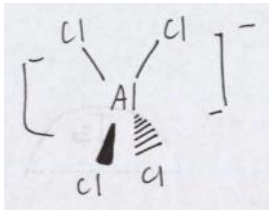
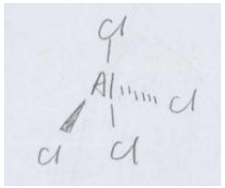
Annotation	Meaning
	Correct point **or** mark awarded
	Incorrect point **or** mark not awarded
	Unclear
	Information missing or insufficient for credit
	Benefit of the doubt given
	Contradiction in response otherwise markworthy, mark not given
	Part of the correct answer has been seen. Full credit has not been awarded.
	Error carried forward applied
	Incorrect or insufficient point ignored while marking the rest of the response
	Rounding error

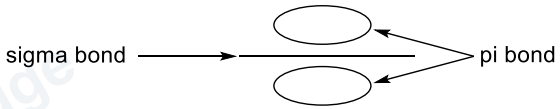
Annotation	Meaning
REP	Repetition
SEEN	Blank page **or** part of script seen
SF	Error in number of significant figures
TE	Transcription error

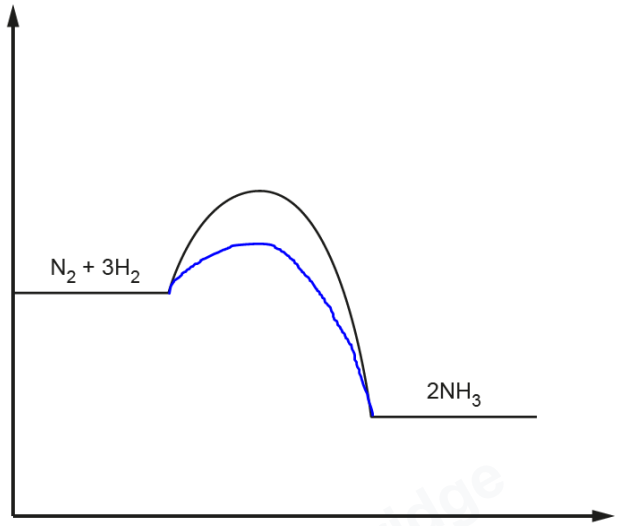
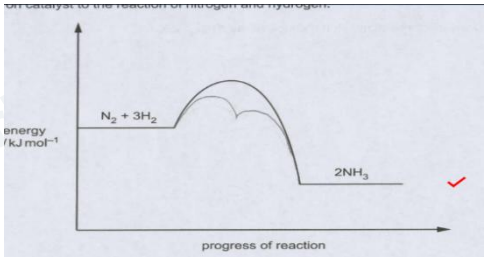
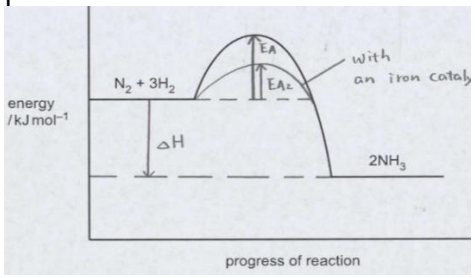
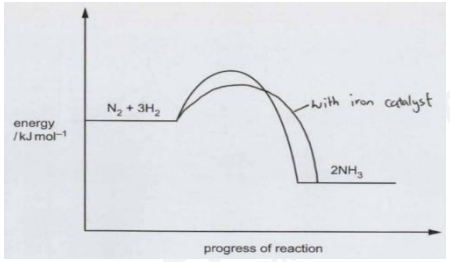
Mark scheme abbreviations

R	reject the response
A	accept the response
I	ignore the response
ecf	error carried forward
BOD	benefit of doubt given
ora	or reverse argument
owtte	or words to that extent
underline	actual word given must be used by candidate (grammatical variants excepted)
( )	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks that can be given
M	marking point

Question	Answer	Marks	Guidance
1(a)(i)	<table><tr><th>atom or ion</th><th>number of protons</th><th>number of neutrons</th></tr><tr><td>^{27}Al</td><td>13</td><td>14</td></tr><tr><td>$^{28}Al^{3+}$</td><td>13</td><td>15</td></tr></table>	2	●✓●✓
1(a)(ii)		1	**A** single or double headed arrows **A** arrows in any direction **R** lines instead of arrows
1(b)	$Al(NO_3)_3$	1	**A** $(NO_3)_3Al$
1(c)	Lone pair (of electrons) on a Cl (could be seen as : on a diagram) **AND** donated / shared with Al (could be seen by the arrow on a diagram) **OR** A fully annotated Figure 1.2: 	1	**A** full annotations on Figure 1.2 i.e. lone pair **AND** dative arrow on <u>both</u> Cl to Al bonds **R** dative bond shown from Al to Cl on diagram **R** chloride / chlorine ion **BOD** long pair **A** chlorine **A** donates / gives / shares / provides a lone pair / electron pair / both electrons <u>to Al</u>
1(d)(i)	**M1** (name of shape) tetrahedral **M2** (bond angle) 109–109.5°	2	**M1 A** tetrahedra **M1 A** phonetically spelt name of shape

Question	Answer	Marks	Guidance
1(d)(ii)	3D shape required:  Acceptable 3D descriptions of different bond types behind the plane and out of the plane are shown below  are all interchangeable  are all interchangeable Although the 3D structure shown in the syllabus is drawn as the example shown in the mark scheme it is acceptable to allow a combination of bond types shown below (3D structure has two types of wedge adjacent)  OR **A BOD** any structures which show unambiguous use of bond shapes representing bonds behind the plane and out of the plane as long as they are different.	**1**	**I** negative charge (not required) **I** bond angles **I** dative bonds **A BOD**  **R** 

Question	Answer	Marks	Guidance
2(a)(i)	**M1** sideways overlap of (adjacent) p orbitals **M2** above and below the (covalent/σ) bond	2	**M1** **A** unambiguous labelled diagram **A** 'sideways overlap of p' **A** sideways = lateral = side on = side by side = side to side = parallel **I** indirect **I** horizontal / vertical **I** shoulder-to-shoulder **M2** **A** above and below the (covalent) bond **A** labelled diagram: 
2(a)(ii)	**M1** (N_2 molecules / N_2) have a strong triple (covalent) bond **OR** N≡N (bond) is strong **M2** (N_2 molecules /N_2) are non-polar	2	**M1** **A** strong = a lot of energy to break / high activation energy / high bond energy **BOD** hard/difficult to break **I** three strong (covalent) bonds (alone) **A** three strong bonds between N atoms **R** three strong bonds **AND** triple bond (∵ = 9) **M2 A** same electronegativity / no difference in electronegativity

Question	Answer	Marks	Guidance
2(b)(i)		1	**A BOD** double hump for cat complex intermediate  **A** line that joins original line before products  **A BOD** 

Question	Answer	Marks	Guidance
2(b)(ii)	**M1** (temperature:) 400–450 °C **M2** (pressure:) 150–250 atm	2	Units required **M1** **A** alternative temperatures with appropriate units **A** 400–500 °C **A** 673–773 K **M2** **A** 15 200–25 300 kPa **A** 15 200 000–25 300 000 Pa **A** 150–250 bar

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2(c)(i)</td><td>
<table>
<tr><th></th><th>$N_2(g)$</th><th>$H_2(g)$</th><th>$NH_3(g)$</th></tr>
<tr><td>initial amount / mol</td><td>3.55</td><td>8.60</td><td>0</td></tr>
<tr><td>change in amount / mol</td><td>(−) 1.62</td><td>(−) 4.86</td><td>3.24</td></tr>
<tr><td>amount at equilibrium / mol</td><td>(+) 1.93</td><td>(+) 3.74</td><td>3.24</td></tr>
</table>
</td><td>3</td><td>
M1 (−) 1.62

M2 (−) 4.86

M3 N_2 and H_2 amount / moles at equilibrium (initial amount / moles minus change in amount / mols)

M3 A ecf from incorrect changes in amount / mols in M1 / M2
M3 R negative amounts / mols at equilibrium

Max 2:
<table>
<tr><th></th><th>$N_2(g)$</th><th>$H_2(g)$</th><th>$NH_3(g)$</th></tr>
<tr><td>initial amount /mol</td><td>3.55</td><td>8.60</td><td>0</td></tr>
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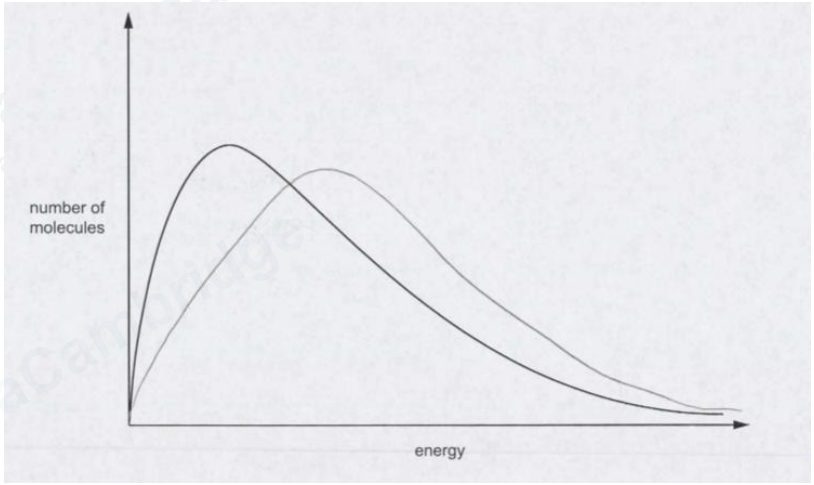
</table>
</td></tr>
</table>

Question	Answer	Marks	Guidance
2(c)(ii)	**M1** Total amount / mol = 2.561 **OR** 0.874 + 1.340 + 0.347 **M2** Mole fraction of NH_3 = 0.347 ÷ 2.561 = 0.135	**2**	**R M1 and M2** if 0.874 + 1.340 + 0.347 is not used to calculate total amount / mols e.g. total mols = 0.874 + 1.340 **M2** **A** ecf if 0.874 + 1.340 + 0.347 are used to calculate total amount / mols, but incorrectly e.g. $0.874 + 1.340 + 0.347^2$ **A** correctly rounded to minimum of 2 significant figures **A** as integer fraction e.g. 347 / 2561 **I** 13.5% **A** calculator answer 0.135494
2(c)(iii)	(partial pressure) = mole fraction (of a gas) × total pressure **OR** the pressure that would be exerted by (only) one of the gases in a mixture (of gases) (if it occupied the same volume)	**1**	**A** product of mole fraction and total pressure **A** the pressure that is exerted by one of the gases to the total pressure **A** The pressure that a gas in a mixture of gases exerts on the surroundings **A** ratio / proportion / fraction of the pressure of a gas to the total pressure (in a closed system) **A** gas = molecules = particles **R** compound / element **I** amount of pressure that a particular gas occupies compared to total pressure

Question	Answer	Marks	Guidance
2(c)(iv)	**M1** $p(NH_3)^2 = K_p \times p(N_2) \times p(H_2)^3$ OR $p(NH_3)^2 = 8.49 \times 10^{-7} \times 1590 \times (1750)^3$ **OR** $p(NH_3) = \sqrt{8.49 \times 10^{-7} \times 1590 \times (1750)^3}$ **M2** $p(NH_3)^2 = 7.23(4673906) \times 10^6$ **M3** $\sqrt{}$ **M2** = 2690 / 2689.73	**3**	**M2** ecf from.... **M1** transcription error or **M1** incorrect rearrangement for $p(NH_3)^2$ using all the terms K_p AND $p(N_2)$ AND $p(H_2)^3$ **M2 A** calculator answer 723 4673.906 **M3** ecf $\sqrt{}$ **M2** correctly calculated to minimum 3 significant figures **M3 A** calculator answer 2689.73
2(d)	**M1** (increasing temperature) increases rate **M2** increased number of particles/collisions with E_A **OR** larger proportion of particles/collisions have energy greater than or equal to E_A / $E \geqslant E_A$ **M3** increased / higher frequency of effective / successful collisions	**3**	**M1 A BOD** increases speed of reaction **M2 A** more particles with enough / sufficient energy to react **M3** **A** increased rate of effective / successful collisions **A** increase in effective / successful collisions per unit time **A** 'increased frequency of collisions' **AND** 'more effective / successful collisions' **I** increased chance / probability of effective / successful collision **I** more collisions (only) **I** references to Le Chatelier / yield **A** particles = molecules = atoms

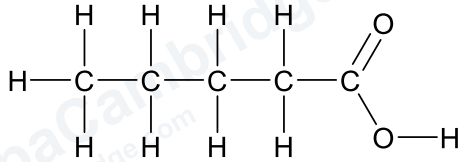
Question	Answer	Marks	Guidance
2(e)	 • start at origin and not crossing original until beyond the peak • peak to the RHS of original peak AND lower than original • line does not cross the original after the peak reached AND crosses the original once only ✓✓	2	**A BOD** slight upwards 'kick' at the end. Max 1 completely correct graphs for temperature < T_1

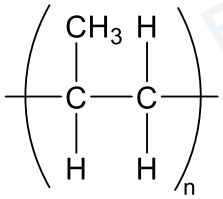
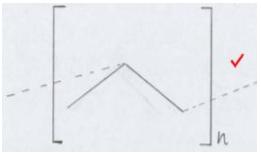
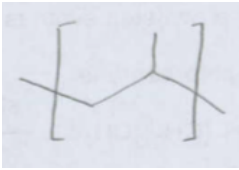
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3(a)(i)</td><td>decreases (across the period)</td><td>1</td><td>A smaller / goes down
A decreases down the period
R decreases down the group</td></tr>
<tr><td>3(a)(ii)</td><td>Na_2O</td><td>1</td><td>A Na_2O_2 and NaO_2
A equation that gives Na_2O as the only product I balancing</td></tr>
<tr><td>3(a)(iii)</td><td>$MgO + H_2O \rightarrow Mg(OH)_2$</td><td>1</td><td>A $MgO + H_2O \rightarrow Mg^{2+} + 2OH^-$
A in equation =</td></tr>
<tr><td>3(b)(i)</td><td><table><tr><th></th><th>type of bonding</th><th>type of structure</th></tr><tr><td>NaCl</td><td>I (ionic)</td><td>G (giant)</td></tr><tr><td>SiCl$_4$</td><td>C (covalent)</td><td>S (simple)</td></tr></table></td><td>2</td><td>●✓●✓
A<table><tr><th></th><th>type of bonding</th><th>type of structure</th></tr><tr><td>NaCl</td><td>GI</td><td>GI</td></tr><tr><td>SiCl$_4$</td><td>SC</td><td>SC</td></tr></table></td></tr>
<tr><td>3(b)(ii)</td><td>M1 (formula:) H_3PO_4

M2 (pH of solution:) 0–4</td><td>2</td><td>M1 A $PO(OH)_3$
M1 R H_3PO_3 (as excess water)
M1 R HCl on formula answer line
M1 R $PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$ on formula answer line</td></tr>
<tr><td>3(c)(i)</td><td>brown gas</td><td>1</td><td>gas = fumes = vapour
A red-brown gas, orange-brown gas
A shades of brown
R red gas (alone)
I white solid (formed)
I any other observations (e.g. melting, effervescence, solid disappears)</td></tr>
</table>

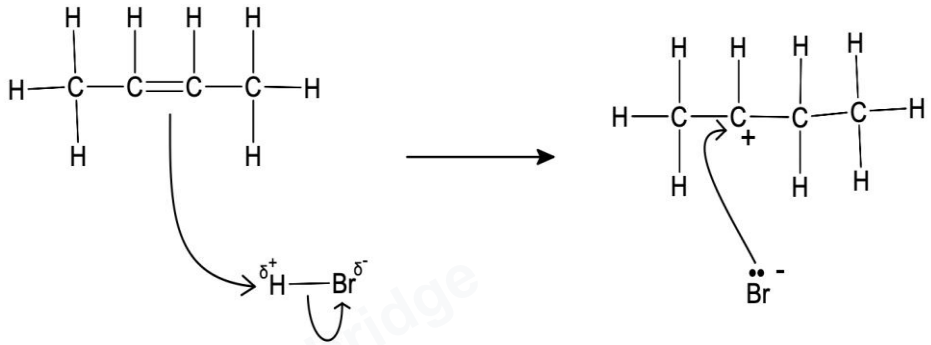
Question	Answer	Marks	Guidance
3(c)(ii)	increases	1	**A** decrease up the group. **A** more soluble

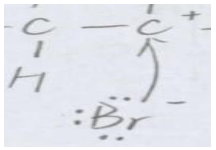
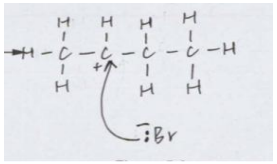
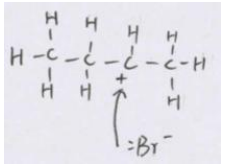
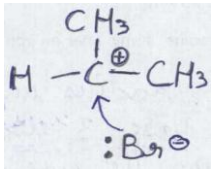
Question	Answer	Marks	Guidance
4(a)	tertiary / 3° (alcohol)	1	**I** names
4(b)	<table><tr><th>reagent</th><th>observations</th></tr><tr><td>Na</td><td>**M1** Bubbles / fizzing / effervescence</td></tr><tr><td>acidified $K_2Cr_2O_7$</td><td>**M2** (Orange to) green (solution)</td></tr><tr><td>alkaline I_2 (aq)</td><td>**M3** Yellow precipitate</td></tr></table>	3	**M1 I** Na reacts / gets smaller **M2 I** antiseptic smell **M3** precipitate = ppt = solid = powder = crystals
4(c)	**M1** bond: C=O (functional group: carboxyl / carbonyl) **AND** absorbance: 1670–1740 **M2** bond: O–H **AND** absorbance: 2500–3500 **AND** functional group: carboxyl(ic acid)	2	**M1** **I** references to C–H / C–O bonds **A** wavenumbers in the absorption range of 1670–1740 e.g. 1700 **R** functional group: amide / ester **M2** **A** wavenumbers in the absorption range of 2500–3500 e.g. 2700 **I** OH **A** C=O group / O – H group **R** – OH and – O – H

Question	Answer	Marks	Guidance
4(d)(i)	**M1** (step 1) Cl_2 **AND** ultraviolet (light) / UV (light) **M2** (step 2) KCN in ethanol **AND** heat (under reflux)	**2**	**M2** **A** ethanolic KCN AND heat alcohol = (alc) **A** NaCN in ethanol AND heat **R** HCN **R** KCN in (aq) ethanol **R** ethanoic **I** warm high temp = heat = reflux = > 60 °C
4(d)(ii)		**1**	**R** –OH

Question	Answer	Marks	Guidance
5(a)	Al_2O_3 **AND** heat / high temperature	**1**	**A** zeolite / alumina / porous pot / porcelain / ceramics **AND** heat **A** high temperature/high temp = heat **A** ⩾ 100 °C **I** catalyst **I** steam **I** pressure
5(b)(i)	 	**1**	**I** brackets **I** *n* **A** skeletal structure <u>with</u> hanging bonds / identifiable continuation bonds (i.e. dashed lines):  ✓  ✓
5(b)(ii)	non-biodegradable	**1**	**I** produces harmful products / toxic gas **I** other environmental effects **I** disposal / cost **A** non-photodegradable **A** unreactive due to strong / non-polar bonds **A** phonetical spelling **A BOD** difficult / hard to decompose / does not decompose / does not break up / down (easily)

Question	Answer	Marks	Guidance
5(b)(iii)	orange / brown (solution / liquid) to colourless	1	**I** turns clear **I** colour disappears **I** discolouration / colour discharged **A** orange / brown disappears **A** decolourises / turns colourless **A** brown / yellow / yellow-brown / orange-brown / yellow-orange **R** red / red-brown **I** 'liquid'
5(c)	positional	1	**A** regoisomerism **A** position (isomer)
5(d)(i)	electron pair acceptor	1	**I** reference to likes electrons / attracted to electrons / area of low electron density. **A** lone pair acceptor **A** gains both electrons **I** electron acceptor

Question	Answer	Marks	Guidance
5(d)(ii)	 **M1** curly arrow from = of C = C to H • **I** π or δ– label on the double bond • **R** partial charges shown on C of C = C **R** arrows from any other part of the alkene **M2** correct dipoles $H^{\delta+}$—$Br^{\delta-}$ **AND** curly arrow from bond of $H^{\delta+}$—$Br^{\delta-}$ to $Br^{\delta-}$ • **I** electrons (i.e. dots / crosses above and / or below bond **M3** correct intermediate – secondary carbocation only • **A** unambiguous structure • **I** δ+ charge on C+ • **R** lone pair on C+	**4**	Judgement of arrows: **A** curly arrows that appear straight **R** single headed arrows first time seen and then **A** **M1** judgement of arrows: π bonds **M1** starts from anywhere on π bond **AND** goes to H or close to H atom of H–Br ✓ **M1** if arrow does not start at the double bond, but when it is extrapolated back the base of the arrow hits the π bond **AND** the arrow end goes to H or close to H atom of H–Br ✓ **M2** judgement of arrows: H–Br bond **M2 A** curly arrow from bond of H–Br to just beyond the Br (if dipole correct).

Question	Answer	Marks	Guidance
5(d)(ii) ctd.	**M4** curly arrow from lone pair of $:Br^-$ to C^+ of intermediate **A** ecf from incorrect intermediate structure in **M3** when: • no positive charge on C of intermediate **OR** • $C^{\delta+}$ instead of C^+ • **I** $^{\delta-}$ on $:Br^-$		Judgement of arrows: lone pairs **M4 A** arrow starts anywhere closely associated with lone pair **A**  **A**  **A (BOD)**  **R** 
5(e)	1,2-dibromobutane	**1**	**A** 1,2 dibromobutane **A** 1,2 dibromo-butane

Question	Answer	Marks	Guidance
5f)	**M1** more stable (tertiary) intermediate **OR** more stable (tertiary) carbocation **M2** due to (greater positive) inductive effect of more alkyl/R/methyl groups **OR** due to greater (positive) inductive effect/electron donating of 3 methyl/R/alkyl groups (rather than 1 R group) **OR** due to (positive) inductive effect of 3 methyl/alkyl/R groups compared to 1 R group	**2**	**M1 I** compound **R** is more stable (than **Q**) **I** Markovnikov **A** ora **M1 A** carboncation **I** cation (alone) **A** +I = inductive effect = electron donating **A M2** '…more electron donating alkyl groups' **A** 'inducive' If 'negative inductive'….'hyperconjugation' … 'electrons increasing the stability of the carbocation'….. 'delocalisation of electrons' – is seen consult team leader. more alkylated = more alkyl / R groups **M1 A** Compound **R** is more stable tertiary intermediate/carbocation and compound **Q** is secondary intermediate/carbocation **R M2** if **Q** described as secondary carbocation/intermediate **M1 R** compound **R** is secondary (and **Q** is primary) **M2 A** (greater positive) inductive effect of more alkyl/R/methyl groups'