CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/22**

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 **24** 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	‘List rule’ guidance 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.

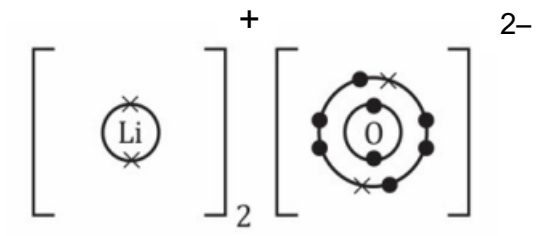
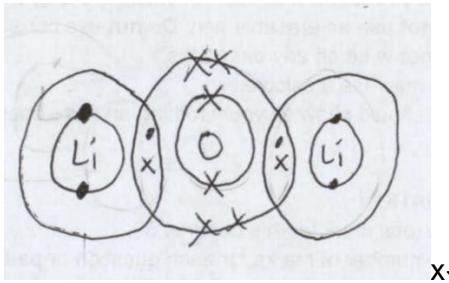
Annotations

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)	4 / four	**1**	**BOD** $(1s^2 2s^2)2p^4$
1(a)(ii)	2p **AND** 	**1**	**A** $2p^4$ for 2p **I** p alone **I** shading but it must have a node **I** axes **I** orientation **I** ignore subscripts p_x p_y p_z
1(b)	 	**2**	**M1** correct charges **M1** **A** −2 for O ion and +1 / 1+ for Li ion **M2** all else fully correct **I** symbols for Li and O **A** any symbol for electrons Max 1 for incorrect identification of type of bonding as covalent as long as all else correct  x✓ Max 1 for any ionic compound with a positively charged species and a negatively charged species

Question	Answer	Marks	Guidance
1(c)(i)	sodium oxide	**1**	**I** formulas **BOD** sodium
1(c)(ii)	$Li_2O + H_2O \rightarrow 2LiOH$	**1**	**A** $2Li^+ + 2OH^-$ for 2LiOH **BOD** LiHO **I** equations with water as both a reactant and a product
1(c)(iii)	**M1** phosphorus (V) chloride / PCl_5 **M2** aluminium chloride / $AlCl_3$	**2**	**M1 A** phosphorus pentachloride **M1 I** phosphorus chloride / phosphorus trichoride **M1 I** phosphorus alone **M2 A** Al_2Cl_6 **M2 A** aluminium alone / aluminium trichloride / aluminium(III) chloride **M2 I** incorrect aluminium chloride formula **I** $MgCl_2$ / magnesium chloride / magnesium **I** sulfur chlorides / sulfur **R** silicon chlorides / silicon **R** NaCl / Na **R** any period 3 chloride with additional elements **R** any chloride not from period 3
1(d)	nitrogen dioxide **OR** NO_2	**1**	**A** nitrogen(IV) oxide **I** nitrogen oxide alone

Question	Answer	Marks	Guidance
1(e)(i)	**M1** high pressure **OR** ⩾ 200 atm **M2** iron catalyst / Fe catalyst	**2**	**A** answers on either line **M1 BOD** equivalent pressure of ⩾ 150 atm or equivalent in alternative units with appropriate conversion **M1 A** ⩾ 15 000 **k**Pa / ⩾ 150 bar **M1 I** ATP **M1 I** numbers with no units **M2 A** alternative correct named catalysts e.g. Co (consult TL if necessary) **M2 BOD** Fe(II) catalyst / Fe^{2+} catalyst / Fe^{3+} catalyst / iron oxide catalyst **M2 BOD** magnetite catalyst **M2 I** Ni **M2 I** promoters **M2 R** Pt / platinum / vanadium oxide

Question	Answer	Marks	Guidance
1(e)(ii)	change in rate **M1** increases ……. explanation **M2** more particles have E ⩾ E_A **M3** so greater frequency of effective collisions.	**3**	**I** yield / Le Chatelier arguments **M1** might be seen in explanation if not on first answer line **M1 A** it takes less time to reach equilibrium **M2 A** more particles have energy greater than / equal to the activation energy / E_A **M2 R** particles have more activation energy **M2 I** particles have more energy **M2 I** atoms / reactants **M3 A** more effective collisions per unit time /increased rate of effective collisions **M3 I** higher chance / probability of more successful collisions **M3 I** more collisions / more effective collisions alone effective = successful particles = molecules activation energy = sufficient / enough energy to react

Question	Answer	Marks	Guidance
2(a)(i)	curve x = electron **AND** curve y = proton	**1**	

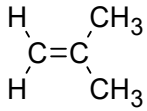
Question	Answer	Marks	Guidance
2(a)(ii)	particles in y are deflected less because they have larger mass	**1**	ecf name given for particles in curve y have the heavier mass. Assume 'they' = y = particles of y unless explicitly refer to 'x' in answer **A** they are heavier **A** higher mass / charge ratio **A** greater weight **A** they have greater momentum **A** (particles in) x are lighter **I** 'electrons have negligible mass' (comparison required) **I** lower charge density **I** density **I** protons are larger **I** kinetic energy **R** protons have greater charge density
2(b)(i)	(atom) **A** and (atom) **B** **OR** (atom) **A** and (atom) **C**	**1**	**A** 6 and 17 **OR** 6 and 14 **A** carbon and chlorine **OR** carbon and silicon
2(b)(ii)	(atom) **B** and (atom) **C**	**1**	**A** 17 and 14 **A** chlorine and silicon

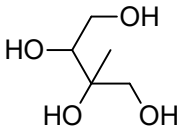
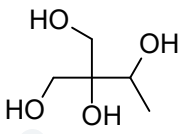
Question	Answer	Marks	Guidance
2(b)(iii)	**M1** atom **A** has (one) fewer (electron) shell(s) (so decreased shielding effect) **M2** (so) more attraction of nucleus for outer/valence electrons / outer or valent shell **OR** In atom **C** the effect of more protons / increased nuclear charge is less significant than / outweighed by the (increased shielding) effect of the additional shell ora = ✓✓	**2**	Subject of question is **A**, so 'it' = **A** **A** reverse argument for atom **C** **I** subshells / orbitals **I** incorrect identities of atoms **A**, **B** and **C** **M1 A** more shells down group shell = energy level = quantum level If number of shells is given, it must be correct (atom **A**=2 and atom **C**=3) **M1 A** atom **A** has outer electrons in a lower energy shell **M1 I** distance from the nucleus **M1 I** reference to one fewer outer/valence shell **M2 A** more attraction of protons to the outer/valence electrons **M2 BOD** pull for attraction

Question	Answer	Marks	Guidance
3(a)(i)	$H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ **OR** $H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + 2HCl$	**1**	**A** $Cl^- + H_2SO_4 \rightarrow HCl + HSO_4^-$ **A** $2Cl^- + H_2SO_4 \rightarrow 2HCl + SO_4^{2-}$

Question	Answer	Marks	Guidance
3(a)(ii)	**M1** H_2SO_4 acid **AND** Cl^- base **M2** H_2SO_4 donates proton(s) **AND** Cl^- accepts protons **OR** H_2SO_4 gives / transfers protons <u>to Cl^-</u>	**2**	proton = hydrogen ion **I** general definition of BL acids and bases. Cl^- = Cl in $NaCl$ **I** HC*l* is base/protons given to HCl Alternative if neither **M1** nor **M2** can be awarded: • H_2SO_4 acid • Cl^- base • H_2SO_4 donates proton(s) • Cl^- accepts proton(s) •✓•✓
3(b)	**M1** (steamy fumes) HBr **M2** (brown vapour) Br_2 **M3** (pungent gas) SO_2	**3**	If formula given, **I** name. If no formula given, **I** name <u>once only</u> and then **A** correct name. **I** state symbols **M1 I** HCl **M2 I** Br **M3 I** Br_2 and / or HBr
3(c)	(brown vapour is made when) HBr / bromide (anions) are oxidised (by H_2SO_4)	**1**	**A** H_2SO_4 / S (in H_2SO_4) is reduced by HBr / Br^- / Br in NaBr / Br in HBr **A** bromide / Br^- loses electrons **A** Br^- oxidised by S (VI) (in H_2SO_4) **A** Br^- /HBr / Br in NaBr reduces S(VI) (to S(IV)) **I** displacement **I** oxidation products **I** oxidation numbers unless they are specifying the S(VI) in H_2SO_4 **R** bromine is oxidised by sulfuric acid For VI allow 6+ / 6 / +6

Question	Answer	Marks	Guidance
3(d)	H_2SO_4 is not (a) strong enough (oxidising agent) to oxidise Cl^- / NaCl / HCl **OR** Cl^- is not (a) strong enough (reducing agent) to reduce H_2SO_4 / S (in sulfuric acid)	**1**	**A** HBr / Br^- is a stronger reducing agent than HCl/ Cl^- **A** reducing ability of halides increases down the group Cl^- = HCl / NaCl / Cl in NaCl / Cl in HCl / chloride Strong enough = good enough Not strong enough oxidising agent = can't oxidise **I** bond energy arguments **I** reactivity arguments if not linked to redox **I** electronegativity arguments **I** reduction product e.g. H_2S **A** H_2SO_4 is (a) strong enough (oxidising agent) to oxidise Br^- **A** Br^- is (a) strong enough (reducing agent) to reduce H_2SO_4 / S (in sulfuric acid) / sulfate ions Br^- = HBr / NaBr / Br in NaBr / Br in HBr / bromide **R** HCl is a stronger oxidising agent than H_2SO_4 **R** Cl^- is a stronger oxidising agent than H_2SO_4 **R** NaCl is a stronger oxidising agent than H_2SO_4

Question	Answer	Marks	Guidance
4(a)(i)	PCl_5 **OR** $SOCl_2$ **OR** HCl **OR** PCl_3 **OR** equivalent names	**1**	**A** thionyl chloride or sulfur oxide dichloride for $SOCl_2$ **A** phosphorus pentachloride or phosphorus trichloride **BOD** $SOCl_2$ (aq) **A** conc. HCl **/** concentrated hydrochloric acid **A** hydrogen chloride / HCl (g) **I** hydrochloric acid alone / HCl (aq) / dilute HCl **I** $NaCl$/KCl and conc. H_2SO_4 /conc. H_3PO_4 **R** PCl_5 (aq)
4(a)(ii)	catalyst **OR** dehydrating agent	**1**	**A** causes dehydration **A** speeds up / increases rate of reaction and remains unchanged owtte **A** lowers activation energy / E_A **I** heterogenous / homogenous **I** acid **R** redox
4(a)(iii)	$H_2C=C(CH_3)_2$ **OR**  **OR** 	**1**	**A** any unambiguous structure **I** C_4H_8
4(b)(i)	colour of mixture at start of reaction ……orange **AND** colour of mixture after the reaction ……green	**1**	**A** any shade of orange **A** any shade of green **BOD** blue / grey for green **BOD** brown for green (as dichromate is in excess)
4(b)(ii)	0.005 **OR** 5×10^{-3}	**1**	**I** 1 / 200

Question	Answer	Marks	Guidance
4(b)(iii)	1.875×10^{-3}	**1**	**A** 1.88×10^{-3} **OR** 1.9×10^{-3} **A** 2×10^{-3} with appropriate working **R** 1.880×10^{-3} **OR** 1.90×10^{-3} **OR** 2.0×10^{-3} **OR** 1.87×10^{-3}
4(c)(i)	$3C_5H_{12}O_4 + \mathbf{5}Cr_2O_7^{2-} + \mathbf{40}H^+ \rightarrow 3C_5H_6O_6 + \mathbf{10}Cr^{3+} + \mathbf{29}H_2O$ **M1** $5Cr_2O_7^{2-}$ **M2** fully correct equation	**2**	
4(c)(ii)	$HOCH_2CH(OH)C(OH)(CH_3)CH_2OH$ **OR** $(HOCH_2)_2C(OH)(CHOHCH_3)$  **OR**  • molecular formula $C_5H_{12}O_4$ • 2 primary alcohol groups • 1 secondary alcohol group • 1 tertiary alcohol group •✓•✓	**2**	**A** unambiguous structure **I** any name attempted Max 1 all correct but 1 or more connectivity issue e.g. C−H−O

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>structure of product</th><th>systematic name of product</th></tr>
<tr><td>$CH_3(CH_2)_5Cl$</td><td>1-chlorohexane</td></tr>
<tr><td>$CH_3(CH_2)_3CHClCH_3$</td><td>2-chlorohexane</td></tr>
<tr><td>$CH_3(CH_2)_3CH_2ClCH_2Cl$</td><td>1,2 dichlorohexane</td></tr>
<tr><td>$CH_3(CH_2)_{10}CH_3$</td><td>dodecane</td></tr>
<tr><td>$CH_3(CH_2)_3CH(CH_3)CH(CH_3)(CH_2)_3CH_3$</td><td>5,6-dimethyldecane</td></tr>
</table>
</td><td>2</td><td>Max 1 for consistently incorrect alkane stem that has correct idea of 1-chloro and 2-chloro.

Max 1 6-chlorohexane and 5-chlorohexane.

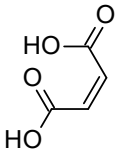
Max 1 for consistent errors e.g. 1-chlorhexane and 2-chlorhexane OR 1-clorohexane and 2-clorohexane OR chloro-1-hexane and chloro-2-hexane

A missing hyphen</td></tr>
<tr><td>5(b)(i)</td><td>(species) with one or more unpaired electrons</td><td>1</td><td>BOD species with (an) unpaired electron(s)
I lone / single / free / odd number of electrons (in valence shell)
I species with specified number (except 1) unpaired electrons
BOD species with one or two unpaired electrons
R it is an unpaired electron

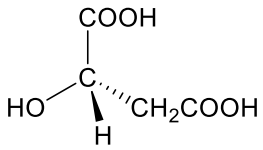
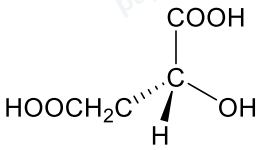
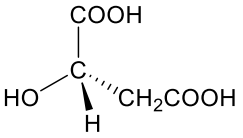
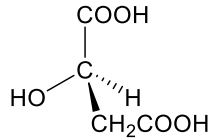
BOD species = atom, ion, particle, molecule, substance, element, compound</td></tr>
<tr><td>5(b)(ii)</td><td>homolytic (fission)</td><td>1</td><td>BOD homolytical
A homolysis
I covalent
I photolytic</td></tr>
</table>

Question	Answer	Marks	Guidance
5(b)(iii)	**M1** $CH_3(CH_2)_4CH_3 + Cl\bullet \rightarrow CH_3(CH_2)_3\bullet CHCH_3 + HCl$ **M2** $CH_3(CH_2)_3\bullet CHCH_3 + Cl_2 \rightarrow CH_3(CH_2)_3CHClCH_3 + Cl\bullet$	**2**	Independent marks **A** radicals with or without • **M1 I** alkyl radical as $\bullet C_6H_{13}$ **OR** $CH_3(CH_2)_5\bullet$ **I** position of the dot **BOD** $CH_3(CH_2)_3CH_3CH\bullet$ **OR** $CH_3(CH_2)_3CCH_3H\bullet$ **M2 A** ecf on their alkyl structure from **M1** (even if **M2** does not balance) **M2 A** alkyl radical as $\bullet C_6H_{13}$ **OR** $CH_3(CH_2)_5\bullet$ **M2** ecf use of anion/cation
5(b)(iv)	**M1** $CH_3(CH_2)_4CH_3 + \bullet Cl \rightarrow CH_3(CH_2)_4\bullet CH_2 + HCl$ **M2** $CH_3(CH_2)_4\bullet CH_2 + CH_3(CH_2)_4\bullet CH_2 \rightarrow CH_3(CH_2)_{10}CH_3$ **OR** $2CH_3(CH_2)_4\bullet CH_2 \rightarrow CH_3(CH_2)_{10}CH_3$	**2**	Independent marks **A** radicals with or without • **M1 A** $CH_3(CH_2)_5\bullet$ **M1 I** alkyl radical as $\bullet C_6H_{13}$ **I** position of the dot **M2 A** alkyl radical as $\bullet C_6H_{13}$ **OR** $CH_3(CH_2)_5\bullet$ **M2** ecf use of anion/cation

Question	Answer	Marks	Guidance
5(c)	number of alkyl / methyl groups	**1**	**A** number of C atoms bonded to the central carbon / branches / R groups **BOD** number of alkyl groups bonded to the carbocation **I** number of C atoms bonded to the carbocation **I** number of C atoms **I** number of ethyl/propyl groups **I** number of hydrogens **I** inductive effect **I** tertiary>secondary>primary stability **I** carbocation stability

Question	Answer	Marks	Guidance
6(a)(i)		**1**	**A** any unambiguous cis / Z structure of **P** **I** connectivity **I** trans structure

Question	Answer	Marks	Guidance
6(a)(ii)	**M1** limited / restricted / lack of / no rotation about the pi bond / π bond of C=C **M2** (two) different groups attached to each C of the C=C / each end of the C=C	**2**	**M1** **A** limited / restricted / lack of / no rotation about the C=C reference to C=C needs to be made once only **BOD** C−C double bond **I** double bond (there is a C=O also in the molecule) **I** movement rotate = twist = spin **R** (compound) **P** has a chiral carbon **M2** each = both **A** different atoms / functional groups / H <u>and</u> COOH / species **I** each side (of the C=C) **R** different compounds / molecules
6(b)(i)	**M1** steam / H_2O (g) **M2** H_3PO_4 (catalyst) / phosphoric (V) acid (catalyst)	**2**	**M1 A** water <u>and</u> then temperature ⩾100 °C (temperature might be seen on conditions line) **M2** **A** H_3PO_4 (catalyst) / phosphoric (V) acid (catalyst) / sulfuric acid (catalyst) / H_2SO_4 (catalyst) on reagent line **A** orthophosphoric acid / phosphoric acid / sulfuric acid **I** heat under reflux / heat alone **I** pressure **I** state symbols

Question	Answer	Marks	Guidance
6(b)(ii)	**M1**  **M2** 	2	COOH = CO_2H **A** $C_2H_3O_2$ **M1** 4 correct groups around central C in any orientation (might be seen on 'isomer 2') **M2** enantiomer of their **M1** structure (does not have to be shown as its mirror image).   **M2 R** bonds in the plane that are opposite to each other **I** bond shapes that are not associated with the chiral carbon. **I** bond angles **I** connectivity

Question	Answer	Marks	Guidance
6(c)(i)	**M1** (molecular ion peak at) 116 **M2** has the same (116) molecular mass (as **P**)	**2**	**M1** **A** the peak to be identified on the spectrum **A** the peak furthest to the right / the peak with the highest m/e value **I** an unquantified peak between 110 and 120 **I** 99 for $HOOCCH=CHCO^+$ **I** 71 for $C_3H_3O_2^+$ **R** any other peak except 99 and 71 **M2** look at structures at the top of the page for evidence of the Mr of P = 116 **I** AMU M^+ ion peak = molecular ion peak = M peak Molecular mass = M_r = RFM = molar mass **A** The molecular mass (of **P**) is 116 ✓✓ unless contradicted **R** relative atomic mass / Ar
6(c)(ii)	**M1** (m / e = 45) $COOH^+$ **M2** (m / e = 99) $HOOCCHCHCO^+$ / $HOOCCH=CHCO^+$	**2**	Max 1 for both correct structures with no + charge **OR** – charge **OR** • **OR** no charges **OR** dots **BOD** sticks on fragment e.g. $–COOH^+$ **A** CO_2H^+ / CHO_2^+ **I** $C_4H_3O_3$

Question	Answer	Marks	Guidance
6(c)(iii)	**M1** Br_2 (aq) / bromine water **M2** orange / brown to colourless in **S** (not **R**) **OR** **M1** Na_2CO_3 / sodium carbonate / $NaHCO_3$ / sodium hydrogencarbonate **M2** fizzing / effervescence in **R** (not **S**)	**2**	**R** capitalisation once e.g. $KMNO_4$ **M2** observation dependent on unambiguous attempt at **M1** reagent *e.g.* **M1** Br × **M2** decolourises **S** ✓ **OR M1** $K_2Cr_2O_7$ / $Cr_2O_7^{2-}$ (no acid) ^ **M2** (orange) to green ✓ **OR M1** $NaCO_3$ × **M2** bubbles in **R** ✓ etc **M2 I** alkene for **S** / carboxylic acid for **R** but **A** alcohol for **S** **M1 A** bromine / Br_2 **M1 A** aqueous iodine / aqueous I_2 / iodine water NOT iodine alone **M1 R** iodoform **M2 A** decolourises **M2 A** yellow to colourless **M2 R** red **M2 A** bubbles **M2 I** limewater (turns milky)

Question	Answer	Marks	Guidance
6(c)(iii)			Alternatives: **M1** acidified potassium dichromate / H^+ **AND** $K_2Cr_2O_7$ **M1 BOD** H^+ / $Cr_2O_7^{2-}$ **M2** (orange) to green with **S** (not **R**) **M1** potassium permanganate / $KMnO_4$ **M1 BOD** potassium manganate **M1 BOD** MnO_4^- **M2** decolorises / (purple) to colourless (solution) / brown ppt with **S** (not **R**) **M2 A** green solution formed if alkaline $KMnO_4$ used **M1** addition of named alcohol and (conc) sulfuric acid **OR** named alcohol and catalyst **M2** sweet smell with **R** (not **S**) **M1** addition of named carboxylic acid and (conc) sulfuric acid **OR** named carboxylic acid **AND** catalyst **M2** sweet smell with **S** (and not **R**) **M1** named acid-base indicator **M2** appropriate colour change with **R** (and not **S**) **M1 A** Mg / magnesium **M2 A** faster bubbles with **R** (comparison required)