CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/43**

Paper 4 A Level Structured Questions **May/June 2026**

MARK SCHEME

Maximum Mark: 100

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 **21** 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
BOD	Benefit of the doubt given
CON	Contradiction in response otherwise markworthy, mark not given
	Part of the correct answer has been seen. Full credit has not been awarded.
ECF	Error carried forward applied
I	Incorrect or insufficient point ignored while marking the rest of the response
RE	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

/	alternative responses for the same marking point
R	reject the response
A	accept the response
I	ignore the response
ecf	error carried forward
AVP	any valid point
ora	or reverse argument
AW	alternative wording
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)	$Ca^{2+}(g) + S^{2-}(g) \rightarrow CaS(s)$ **M1** all species **M2** all state symbols	**2**	If reverse lattice energy equation is given $CaS(s) \rightarrow Ca^{2+}(g) + S^{2-}(g)$ award [1] if all species and state symbols are correct.
1(b)	(ionic) bonds are formed / the ions bond	**1**	**A** attractive force × distance. **A** electrostatic attraction × distance. **I** electrostatic attraction alone. **I** exothermic / energy released. **I** ions come together. **I** formation of the lattice / solid / CaS. **I** reference to energy required to break bonds. **CON** energy required to form bonds. **CON** bond formed is clearly covalent, e.g. Ca–S.
1(c)	**M1** MgO CaS KC*l* **M2** CaS (and MgO) the ion**s** / particle**s** are more highly charged than KC*l* **or** KC*l* has ion**s** with the small**est** charge **ora** **M3** MgO the ion**s**/particle**s** are smaller than CaS **or** MgO has the smallest ion**s** **ora**	**3**	**A** for all four charges **I** nuclear charge **I** charge density for **M2** and **M3**
1(d)(i)	(enthalpy of) atomisation (of C*l*) **or** bond energy (C*l*–C*l*) **and** **(first)** electron affinity (of chlorine)	**1**	If this is given in symbols we will accept ΔH_{at} , ΔH_{atom} or $\Delta H_{atomisation}$. If symbols and words are given, **I** the symbols. If this is given in symbols we will accept ΔH_{EA}, ΔH_{EA1}, $\Delta H_{electron\ affinity}$ or $\Delta H_{first\ electron\ affinity}$. If symbols and words are given, **I** the symbols. **CON** electron affinity of chloride / Cl^- / Cl_2

Question	Answer	Marks	Guidance
1(d)(ii)	**M1** chlorine value doubled / –486 seen / 2x – 243 seen **M2** answer –643 2336 +(2x – 243) –2493 = –643	**2**	ecf use of 1x – 243 for ans = –400 (**working needed**). –643 scores [2]
1(e)	**M1** Correct $\Delta G = \Delta H - T\Delta S$ and use of T = 873 **M2** ΔG = –36 / –35.8 / –35.78 / –35.775 ecf T only **M3** it is (feasible) **and** **ΔG** is negative / **ΔG** is less than zero **UNC** (**Note: ΔG** now in bold) **M3** is **UNC**onditional on the basis it is a correct answer on the answer line. If the calculation has not been worked through to an answer, or has given a negative value for ΔG, there is no **M3** for 'not feasible because ΔG is positive'.	**3**	**CON** G for ΔG. **A** Δ_{Gibbs}. If T = 600 then [1] ecf for +12. **CON** G for ΔG but do not penalise twice If in words we need 'change'. **I** ΔG is exothermic. **A** ΔG in words 'Gibbs Free Energy **change**'
1(f)	• higher • Ca^{2+} larger (than Mg^{2+}) **ora** • (In $CaCO_3$) less distortion / polarisation of anion / CO_x^{y-} ora all standalone **ora** for $MgCO_3$ but must be stated	**2**	●✓✓ any two for one mark. All three for two marks. **or ionic** radius / size **I** atomic **or** group 2 trend but up / down the group must be clear. **I** references to ionic bond strength. **or** Ca^{2+} less polarising **on** anion / CO_x^{y-} **I** 'depolarisation'. **or** C-O / C=O bond (must be identified, e.g. C–O) is less weakened by Ca^{2+}.

Question	Answer	Marks	Guidance
2(a)(i)	$-\log[H^+]$	**1**	[ ] essential. **CON** $-\log(H^+)$, $-\log_e[H^+]$, $-\ln[H^+]$.
2(a)(ii)	$[H^+][OH^-]$ / K_axK_b	**1**	[ ] essential but do not penalise in **(i)** and **(ii)**. **I** 1×10^{-14}.
2(b)(i)	$(10^{-2.9})$ 0.0013/0.00126/1.3x10^{-3}/1.26x10^{-3}	**1**	
2(b)(ii)	2bi^2 / 0.105 0.00126^2 / 0.105 ecf bi 1.5×10^{-5} / 1.51×10^{-5} / 1.53×10^{-5} ecf	**1**	
2(c)(i)	**M1** $[CH_3CH_2CH_2COOH]$ = 0.15 **M2** $[CH_3CH_2CH_2COO^-Na^+]$ in solution **D** = 0.036 / 0.0359 **M3** $[CH_3CH_2CH_2COO^-Na^+]$ in solution **C** = 0.054 / 0.0538 / 0.0539 / 0.0540 Another possible approach goes via moles of acid to get moles of salt, **M1** moles acid = 0.045 mol **M2** moles salt = 0.0108 / 0.0107 mol **M3** original [salt] = 0.0538 / 0.0539 / 0.0540	**3**	If $[CH_3CH_2CH_2COOH]$ = 0.45 [0] but then [salt] in mixture = 0.108 [1] ecf [salt] in solution C = 0.162 [1] ecf **VERIFY** with working.
2(c)(ii)	$CH_3CH_2CH_2COO^-Na^+ + H^+ \rightarrow CH_3CH_2CH_2COOH + Na^+$ **or** $CH_3CH_2CH_2COO^- + H^+ \rightarrow CH_3CH_2CH_2COOH$ **or** $CH_3CH_2CH_2COO^- + H_2SO_4 \rightarrow CH_3CH_2CH_2COOH + HSO_4^-$ **or** $2CH_3CH_2CH_2COO^-Na^+ + H_2SO_4 \rightarrow 2CH_3CH_2CH_2COOH + Na_2SO_4$	**1**	
2(c)(iii)	$CH_3CH_2CH_2COOH + OH^- \rightarrow CH_3CH_2CH_2COO^- + H_2O$ **or** $CH_3CH_2CH_2COOH + KOH \rightarrow CH_3CH_2CH_2COOK + H_2O$ **or** $CH_3CH_2CH_2COOH + K^+OH^- \rightarrow CH_3CH_2CH_2COO^-K^+ + H_2O$	**1**	

Question	Answer	Marks	Guidance
2(d)	**M1** 2,2-dichlorobutanoic **and** chlorine is electron withdrawing / negative inductive effect / electronegative **M2** weakens O–H bond / stabilises anion / stabilises conjugate base / stabilises carboxylate ion	**2**	**I** references to C=O, O, alkyl groups. **A** –O–H bond and OH bond but **CON** – OH bond, C–O–H bond.

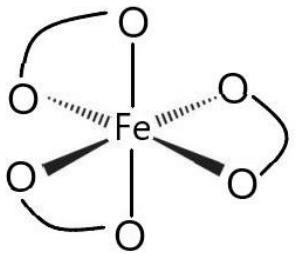
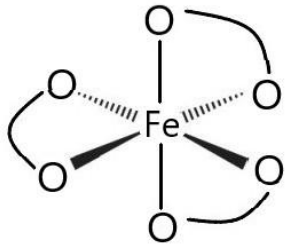
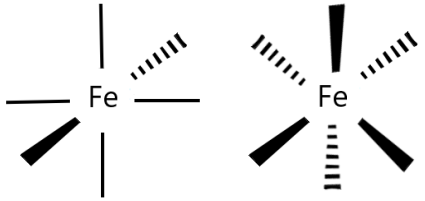
Question	Answer	Marks	Guidance
3(a)	2 1 3	**1**	
3(b)	**M1** 1.4×10^{-6} **M2** $mol^{-2}dm^{6}s^{-1}$	**2**	**I** $mol^{-2}dm^{6}s^{-}$
3(c)(i)	(overall) first order **and** [NO] is (almost) constant	**1**	**I** '$[H_2]$ first order'. **I** [NO] zero order. **I** [NO] not a limiting factor. **I** $[H_2]$ is a limiting factor. **A** [NO] pseudo zero order.
3(c)(ii)	**M1** 33 000 / 32 500 / 32 542 / 32 540 / 32 535 / 3.25×10^{4}, etc. **M2** 130 000 / 130 141 / 1.3×10^{5} / 1.32×10^{5}, etc. ecf $t_{\frac{1}{2}}$	**2**	32 542 if ln2 used. answer = $t_{\frac{1}{2}} \times 4$
3(d)(i)	**M1** one N_2O_2 and one H_2 on L **or** one N_2O and one H_2O on R **M2** $N_2O_2 + H_2 \rightarrow N_2O + H_2O$	**2**	(**M1** is for either correct LHS or RHS).

Question	Answer	Marks	Guidance
3(d)(ii)	no H_2 involved in step one (and H_2 in rate equation) **or** only one species from rate equation **or** does not contain species in the same molar proportion as rate equation **or** if step 1 is RDS then order wrt $[H_2] = 0$ **or** step 1 does not include **all** species in rate equation **or** rate would be second order wrt NO only **or** reaction would be overall second order	**1**	**I** 'does not agree with rate equation'. **I** reference to NO without reference to order of reaction. **I** N_2O_2 not in the rate equation.

Question	Answer	Marks	Guidance
4(a)	$\Delta G^{\ominus} = -nF\,E^{\ominus}_{cell}$	**1**	**A** $\Delta G^{\ominus} = -\,nF\,E_{cell}$.
4(b)	$Cu^{2+} + 2V^{2+} \rightarrow Cu + 2V^{3+}$ (+) 0.60	**2**	**CON** cancellable species / electrons If ⇌ read forwards **I** 0.6 + not needed but – is **CON**.
4(c)	**M1** Cu **M2** V^{2+}	**2**	**or** in words if unambiguous.
4(d)	**M1** Cl_2 / chlorine **M2** V / vanadium	**2**	**CON** if both oxidised and reduced form given. **CON** if both oxidised and reduced form given.
4(e)	**All candidates get three marks**	**3**	

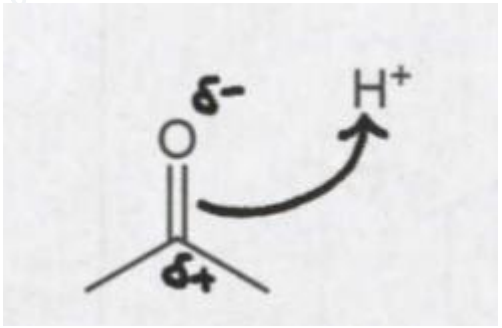
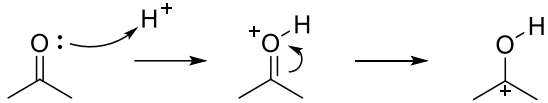
Question	Answer	Marks	Guidance
5(a)	similarity in energy of (3)d and (4)s (subshells / orbitals) **A** same	**1**	this is a syllabus statement – do not allow much variation of meaning, **I** statements that can be understood to refer to 3d only.
5(b)	$3d^7\ 4s^2$ / $4s^2\ 3d^7$ $3d^7$ / $3d^7\ 4s^0$	**1**	**A** full configurations with no errors.
5(c)	**M1** the **d** orbitals are split / become non-degenerate / reference to ΔE within d-subshell or ΔE between d orbitals **M2** electrons are promoted / excited / jump to **higher** level owtte **M3** absorbing (energy of) light / photon / frequency / wavelength / $h\nu$ **and** complementary colour is seen / reflected / transmitted	**3**	'complementary' may be described but 'different colour' is not enough. **M3 CON** emits / energy released.
5(d)	**M1** blue to red / blue to pink **M2** $CoCl_2 + 6H_2O \rightarrow [Co(H_2O)_6]^{2+} + 2Cl^-$ **or** $CoCl_4^{2-} + 6H_2O \rightarrow [Co(H_2O)_6]^{2+} + 4Cl^-$	**2**	**A** named shades of blue and pink. **I** $CoCl_2 + 6H_2O \rightarrow CoCl_2 \bullet 6H_2O$. **I** $Co^{2+} + 6H_2O \rightarrow [Co(H_2O)_6]^{2+}$.
5(e)(i)	(white / brown / off white) precipitate / ppt / solid **and** brown (solution)	**1**	**CON** clearly wrong colours, e.g. black / blue / green / purple or wrong observations, e.g. fizzing.
5(e)(ii)	starch **and** blue / black to colourless / white / off-white	**1**	colourless / white to blue / black is **CON.**
5(e)(iii)	redox	**1**	**A** oxidation-reduction (both needed).

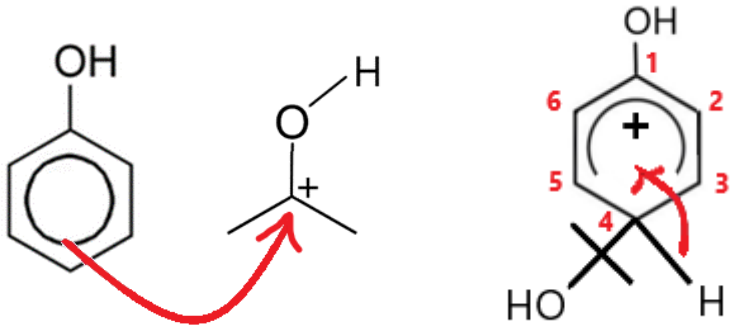
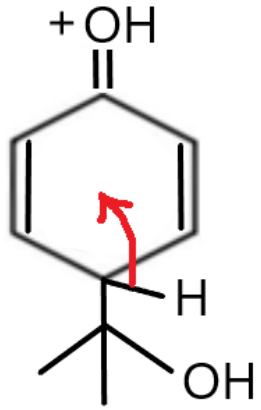
Question	Answer	Marks	Guidance
5(e)(iv)	• moles of $S_2O_3^{2-}$ = 0.2 × 37.6 / 1000 = 7.52 × 10^{-3} • moles of I_2 = 3.76 × 10^{-3} ecf • moles of Cu = 7.52 × 10^{-3} ecf • mass of Cu = 0.48 / 0.478 / 0.4775 / 0.47752 g ecf 0.239 g, 0.955 g or 1.41 g on the answer line, without any correct, understandable working, scores [0]	3	●✓✓✓ two points for one mark correct answer scores [3].

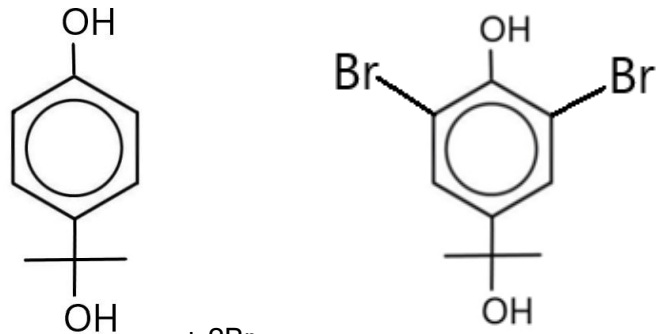
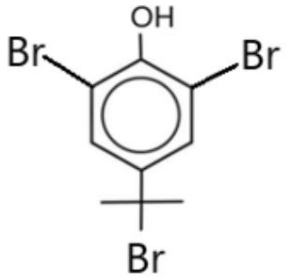
Question	Answer	Marks	Guidance
6(a)	**M1 two lone** pairs / LP **M2** donated / form dative bond(s) / coordinate bond(s) to (central) metal / TM / TE atom / ion	2	**CON** '2 or more dative bonds'.
6(b)(i)	$[Fe(C_2O_4)_3]^{3-}$ **or** $Fe(C_2O_4)_3^{3-}$	1	
6(b)(ii)	**M1** One correct isomer of $[Fe(C_2O_4)_3]^{3-}$ drawn with 3D and oct **M2** Two optical isomers drawn with 3D and octahedral **only**   	2	Correct 3D. octahedral, different These two renditions of octahedral are acceptable.  **I** charges.
6(b)(iii)	optical **only**	1	

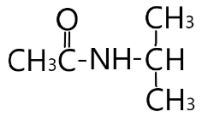
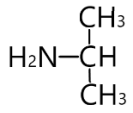
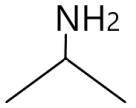
Question	Answer	Marks	Guidance
6(c)	$\frac{\left[[HgI_4]^{2-}\right]}{\left[Hg^{2+}\right]\left[I^-\right]^4}$ **M1** **M2** $mol^{-4}\ dm^{12}$ unc	**2**	**A** $[HgI_4^{2-}]$. **A** $[Hg^{2+}]$ with complexing H_2O. The charges shown here are essential. Final set of brackets must be square ×3. Penalise two or more round outer brackets. ecf only after K_{stab} with 4th power.

Question	Answer	Marks	Guidance
7(a)(i)	HNO_3 **and** H_2SO_4 **and** conc once **and** 25° ⩽ T ⩽ 60°	**1**	Acids may be named. Any dilute or aq is **CON**. Temperature must be numerical and within range. **I** heat or warm. **CON** boil or reflux.
7(a)(ii)	0° ⩽ T ⩽ 10° **and** HNO_2 **or** $NaNO_2$ + HC*l*	**1**	**A** '*T* below 10°' etc. **CON** heat or warm. **I** sodium nitrate. **A** nitrous acid.
7(a)(iii)	benzenediazonium chloride / phenyl diazonium chloride	**1**	**A** very minor errors, e.g. word order. **CON** benzyl'benzoyl. **I** diazo.
7(b)(i)	0 1 2 0 6 3	**1**	**A** blank for zero.
7(b)(ii)	6	**1**	

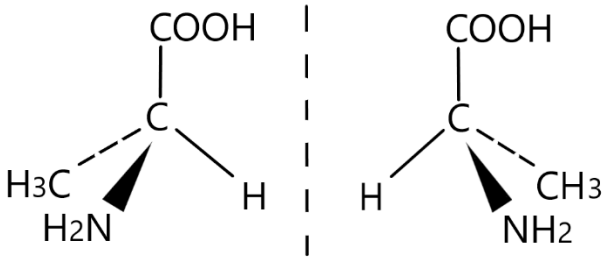
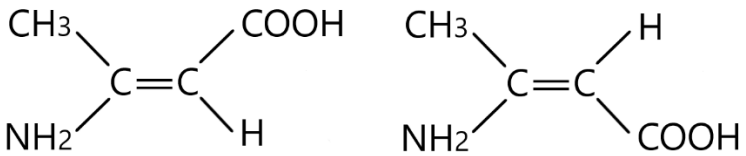
Question	Answer	Marks	Guidance
7(b)(iii)	 dipole Curly arrow from C=O to H^+ **or** 	**1**	**I** δ+ on the H^+. Curly arrow must start on C=O. Any incorrect curly arrow is **CON**. **A** in two steps, e.g.  with dipole. Additional charges are **CON**.

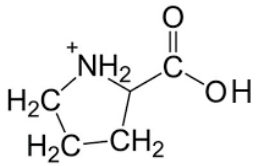
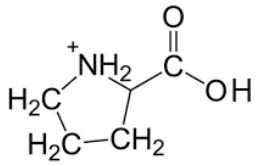
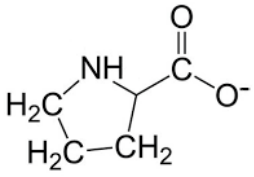
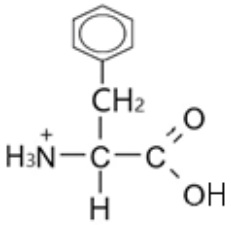
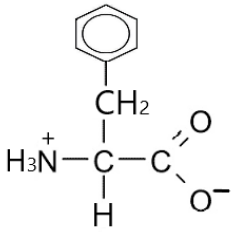
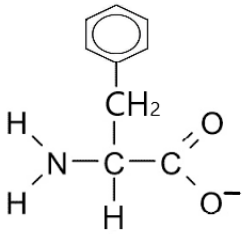
Question	Answer	Marks	Guidance
7(b)(iv)	 **M1** CA on leftmost diagram **M2** **K**, showing horseshoe, + charge and H **M3** curly arrow on C–H bond in **K** back into ring Use of quinoid intermediate: **M1** as above – curly arrow on leftmost diagram **M2** for the intermediate shown at the bottom of guidance. The curly arrow for M3 is shown on this diagram but is not necessary for **M2**. **M3** as above – curly arrow on C–H bond in **K** back into ring	**3**	'Usual rules' for K. Centre of + charge must be above a line joining C3 and C5. 'Horseshoe' must include C6, C1 and C2, may include one or both of C3 and C5, must not include C4. **I** curly arrow showing delocalisation of phenolic LP (LP on oxygen of phenol). **CON** additional curly arrows Curly arrow must start on or within hexagon and may cross hexagon anywhere. Curly arrow must touch hexagon. 

Question	Answer	Marks	Guidance
7(b)(v)	• less readily • lone pair (LP) on O (of phenol) / p-orbital on O • is delocalised into the ring / overlaps with delocalised ring / π-system • activates ring / more attractive to electrophile / electron (charge) density increased ('electron' inferred if 'LP donated to ring') / becomes more electron rich	**2**	●✓●✓ two points for one mark, four points for two marks. **A** LP on OH **I** LP in phenol. 'Delocalised' or 'joins π system' needed may be awarded without LP if linked to O. **I** references to polarisation of electrophile (it has a full + charge, stated in the Q) **I** makes ring more reactive / more susceptible to electrophiles / more negative. **I** 'O is electron donating'. **I** 'attracts nucleophile more'.
7(c)(i)	 **M1** structure of product (compound **H**) **M2** equation balanced, must have HBr	**2**	**A** OH of tertiary alcohol group substituted to bromide as well as ring substitutions and equation with HBr **and** H_2O on the right.  → product above + H_2O + HBr
7(c)(ii)	electrophilic substitution **scroll and SEEN**	**1**	**CON** nucleophilic substitution unless –OH on sidechain substituted with Br when it becomes **I**.

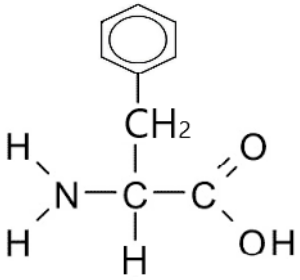
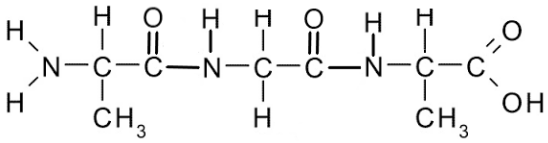
Question	Answer	Marks	Guidance
8(a)(i)	$CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$	**1**	**CON** aq.
8(a)(ii)	PCl_3 or PCl_5	**1**	**A** names, phosphorus(III) chloride, phosphorus trichloride, phosphorus(V) chloride, phosphorus pentachloride. **CON** aq, but not in both **8(a)(i)** and **8(a)(ii)**.
8(a)(iii)	 **or** $CH_3CONHCH(CH_3)_2$	**1**	Or any unambiguous structural or skeletal formula.
8(a)(iv)	 **or** $CH_3CHNH_2CH_3$	**1**	No ecf from **8(a)(iii)** – Q specifies **L** is an amide and gives the structure of M. or skeletal 
8(a)(v)	(nucleophilic) addition-elimination	**1**	No ecf from **8(a)(iii)** – Q specifies **L** is an amide. **I** 'condensation' – correct but not a mechanism.
8(a)(vi)	$LiAlH_4$	**1**	No ecf from **8(a)(iii)** – Q specifies **L** is an amide. **CON** aq.
8(b)(i)	• r – triplet • s – quartet/quadruplet • t – doublet • u – multiplet	**2**	●✓●✓ two points for one mark, four points for two marks. **A** septet, heptet, septuplet.

Question	Answer	Marks	Guidance
8(b)(ii)	**M1** one more peak **and** reference to N-H Subject of Q is 'in $CDCl_3$' so assume this if no solvent specified. See first two ALLOWs in guidance. **M2** H (of NH) is exchanged with D (in D_2O) / NH + D → ND + H / H (of NH) is not exchanged with D (in $CDCl_3$) the bits in brackets for **M2** are not essential but if clearly wrong it is **CON**	**2**	**A** 'NH peak is present'. **A** 'NH peak is not present in D_2O'. **A** reference to five peaks or five proton environments **and** reference to N-H. **A** 'it is exchanged with D' if NH peak already referred to and you are confident they refer to 'in D_2O'. **A** 'it is not exchanged with D' if NH peak already referred to and you are confident they refer to 'in $CDCl_3$'. **I** 'D_2O replaces the H'.

Question	Answer	Marks	Guidance
9(a)	**M1** One pair of diagrams of **P** with correct use of 3D showing mirror images of two optical isomers  **M2** One pair of diagrams showing correct E and Z of **Q**  **M3** Optical **or** enantiomerism in the right place **and** Geometric(al) **or** E / Z **or A** cis/trans in the right place	**3**	**Q** may be given above, and **P** may be given below. Mirror plane not essential. **M3** conditional on optical linked to an attempt on **P** and geometrical / cistrans / EZ linked to an attempt on **Q** in M1 and M2.
9(b)(i)	the **pH** at which (the amino acid is) a zwitterion / no **net** charge / no **overall** charge / no total charge electrically neutral / charge is neutral	**1**	**A** clear and correct description of zwitterion for second component.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>9(b)(ii)</td><td>
<table>
<tr><th></th><th>pH 4.0</th><th>pH 5.5</th><th>pH 8.0</th></tr>
<tr><td>T</td><td>  </td><td>  </td><td>  </td></tr>
<tr><td>U</td><td>  </td><td>  </td><td>  </td></tr>
</table>
</td><td>3</td><td>●✓●✓ ●✓

two structures for one mark,
four structures for two marks,
six structures for three mark.

Phe at 5.5 can be
 
Table left is repeated larger after 9(c)(iii).</td></tr>
<tr><td>9(c)(i)</td><td> 

M1 – amide links correct

M2 – remainder is fully correct, e.g.
terminal groups not trailing bonds
neutral, zwitterion, 1+ or 1–
side/R groups CH_3 – H – CH_3
all H atoms on α-carbons</td><td>2</td><td>Fully correct [2].</td></tr>
<tr><td>9(c)(ii)</td><td>hydrolysis</td><td>1</td><td>I acid / alkaline / enzymatic / NS.</td></tr>
<tr><td>9(c)(iii)</td><td>condensation</td><td>1</td><td>I addition-elimination.</td></tr>
</table>