EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
70 Minutes

Score /58

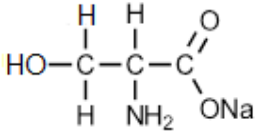
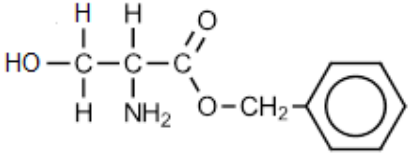
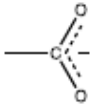
Percentage %

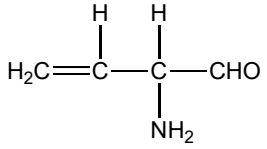
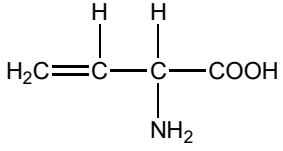
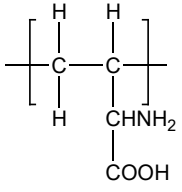
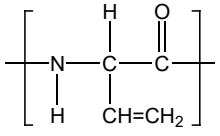
CHEMISTRY

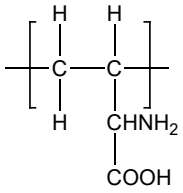
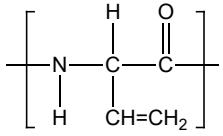
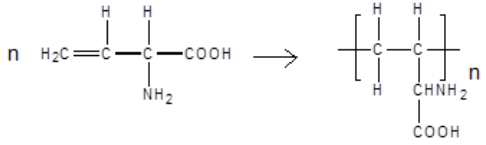
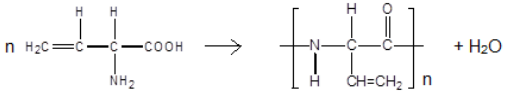
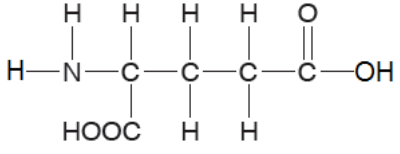
OCR AS & A LEVEL

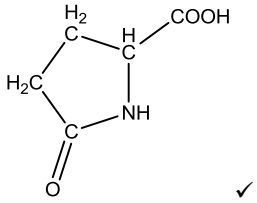
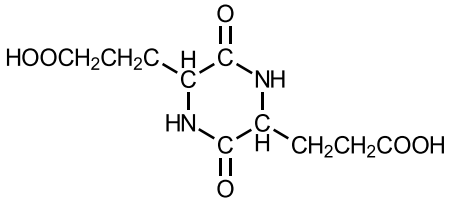
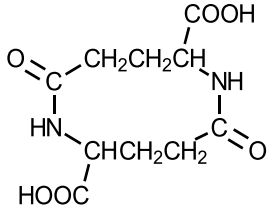
Mark Scheme

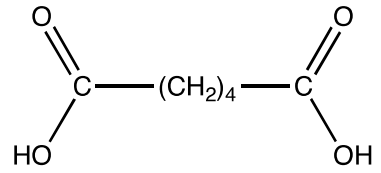
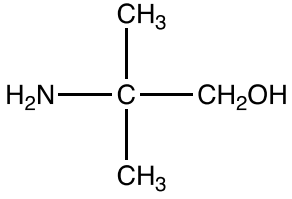
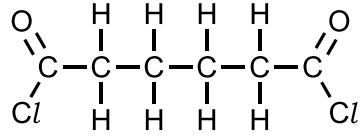
Module 6: Organic chemistry and analysis

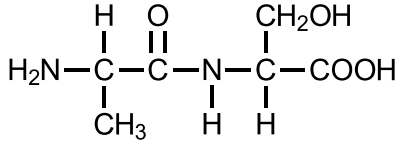
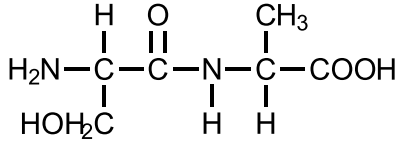
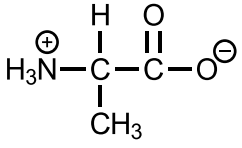
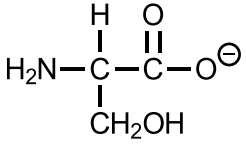
Question			Answer	Mark	Guidance
1	(a)	(i)	 ✓  ✓ —NH_3^+ in second product ✓	3	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW** —O^-Na^+ **OR** —O^- (cation not required) **DO NOT ALLOW** —O—Na (covalent bond) **DO NOT ALLOW** –O (without the sodium) **ALLOW** delocalised carboxylate 
		(ii)	perfume/fragrance/flavouring ✓	1	**IGNORE** solvent **OR** food additive
		(iii)	Reaction 3: (hot) ethanolic ammonia ✓ Reaction 4: oxidation ✓ Reaction 5: hydrolysis ✓	3	**ALLOW** NH_3 (dissolved) in ethanol **IGNORE** other conditions **ALLOW** oxidisation/oxidised **DO NOT ALLOW** redox **ALLOW** nucleophilic addition-elimination **DO NOT ALLOW** nucleophilic substitution **IGNORE** acid/base

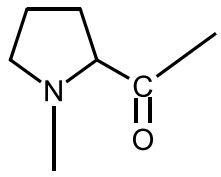
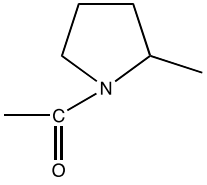
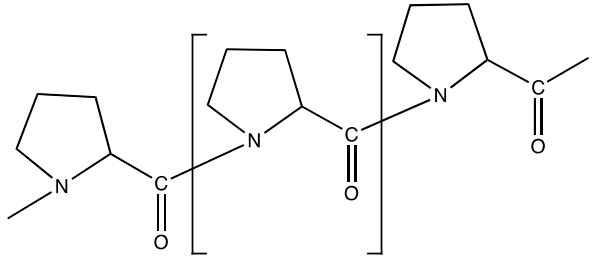
Question	Answer	Mark	Guidance
(b)	**M1** Compound **E**  ✓ **M2** Compound **F**  ✓ **M3** Compound **G**  ✓ **M4** Compound **H**  ✓	6	**ANNOTATE ANSWER WITH TICKS AND CROSSES ETC** **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous Labels are not required for compound E, F, G or H **IGNORE** labels for **M1**, **M2**, **M3** and **M4** CH_2=CH must be shown in **E** **ALLOW** C_2H_3 **OR** $CHCH_2$ for $CH=CH_2$ in **F** **ALLOW ECF** from error in structure of aldehyde E **ALLOW** multiple repeat units but must be full repeat units **ALLOW** end bonds shown as ..... **DO NOT ALLOW** if structures have no end bonds **IGNORE** brackets unless they are used to pick out the repeat unit from a polymer chain **IGNORE** n **ALLOW** $C_2H_4NO_2$ for $CH(NH_2)COOH$ in polymer **G** **ALLOW** C_2H_3 **OR** $CHCH_2$ for $CH=CH_2$ in polymer **H** **ALLOW ECF** from $NH_2CH_2CH=CHCOOH$ for the formation of compound G or compound H

Question			Answer	Mark	Guidance
			M5 Compound **G** **OR**  Is an addition polymer ✓ **M6** Compound **H** **OR**  is a condensation polymer ✓		**ALLOW** alkene forms addition polymer/polymer with same empirical formula as monomer **ALLOW** equation for reaction  **ALLOW** amino acid forms condensation polymer **OR** (molecules of) compound **F** join/bond/add/react/form polymer and water/small molecule **ALLOW** equation for reaction 
	(c)	**(i)**	 ✓	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous

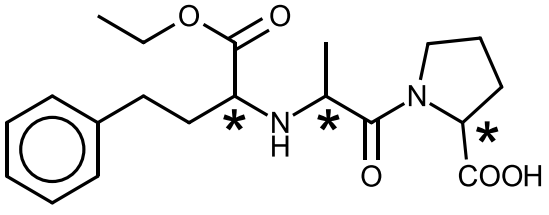
Question	Answer	Mark	Guidance
(ii)	 ✓  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW** a cyclic amide with a 3 membered ring **ALLOW**  **OR** a structure obtained by condensation of a glutamic acid molecule with the first cyclic amide

Question			Answer	Mark	Guidance
	(d)	(i)	Ester **AND** amide ✓	1	**ALLOW** peptide for amide
		(ii)	 ✓  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous Functional groups do not need to be fully displayed **ALLOW** structures as shown; the O-H bond and the N-H bonds in the functional groups **do not** need to be displayed **DO NOT ALLOW** -COOH **ALLOW**  Penalise incorrect connectivity to OH once in this question
		(iii)	(The molecule/amide/ester) can be <u>hydrolysed</u> ✓	1	**ALLOW** (the molecule/amide/ester) can form hydrogen/H-bonds <u>with water</u> **IGNORE** acid/base
			Total	**20**	

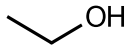
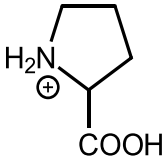
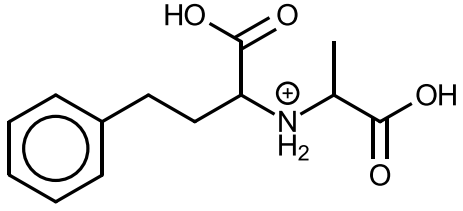
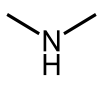
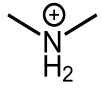
Question			Answer	Mark	Guidance
2	(a)	(i)	 ✓  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **DO NOT ALLOW** peptide chains
	(a)	(ii)	alanine at pH 6.0  ✓ serine at pH 10.0  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **ALLOW** + charge on N or H: *i.e.* $^{+}NH_3$ or NH_3^{+} **DO NOT ALLOW** '–' charge on C *i.e.* ^{-}COO **DO NOT ALLOW** if structure is incomplete

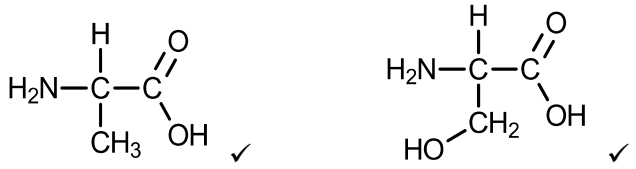
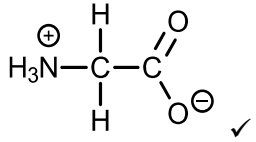
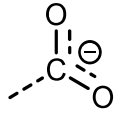
Question			Answer	Mark	Guidance
	(a)	(iii)	 ✓ **OR** 	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **IGNORE** bond angles **DO NOT ALLOW** more than one repeat unit **ALLOW** end bonds shown as - - - - - **DO NOT ALLOW** if structure has no end bonds **IGNORE** brackets unless they are used to pick out the repeat unit from a polymer chain **IGNORE** *n* 

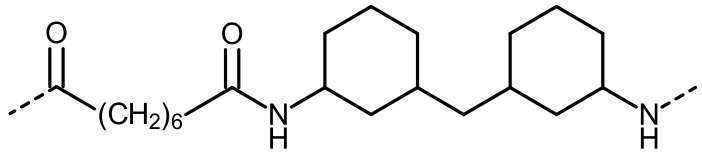
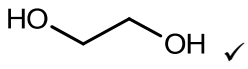
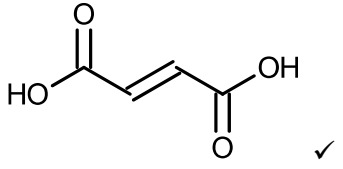
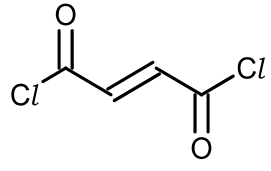
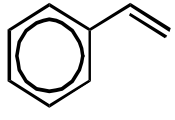
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><td colspan="3">^{1}H NMR spectrum for serine</td></tr>
<tr><th>chemical shift, δ /ppm</th><th>relative peak area</th><th>splitting pattern</th></tr>
<tr><td>2.0 to 3.0</td><td>1</td><td>triplet</td></tr>
<tr><td>3.3 to 4.2</td><td>2</td><td>doublet</td></tr>
</table>
One mark for each correct row ✓✓
</td><td>2</td><td>ALLOW δ values ± 0.2 ppm, as a range or a value within the range

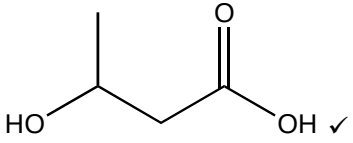
ALLOW a response that implies a splitting into three for a triplet/into two for a doublet</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td> 

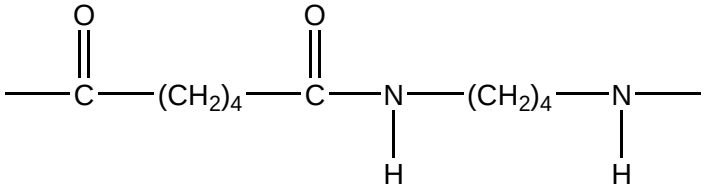
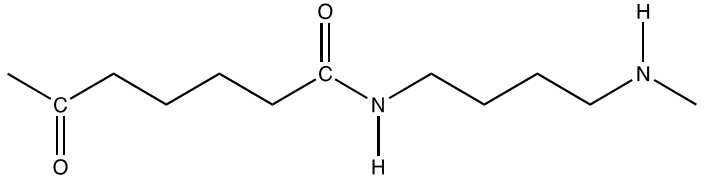
✓</td><td>1</td><td>ALL correct for one mark</td></tr>
<tr><td></td><td>(c)</td><td>(ii)</td><td>any two from:
no/fewer side effects
increases the (pharmacological) activity/effectiveness
Reduces/stops the need for/cost/difficulty in separating stereoisomers/optical isomers
✓✓</td><td>2</td><td>IGNORE toxic/harmful
IGNORE a response that implies a reduced dose
IGNORE “it takes (less) time to separate”</td></tr>
</table>

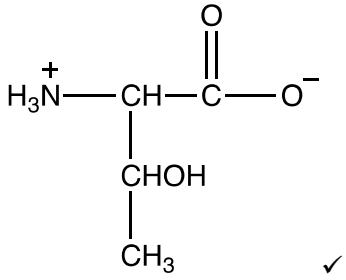
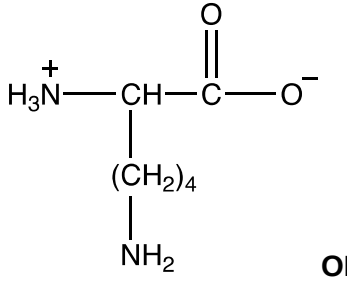
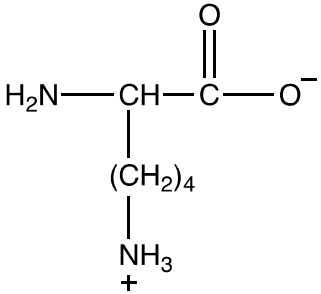
Question			Answer	Mark	Guidance
	(c)	(iii)	 ✓ one mark for ethanol  ✓ one mark for proline with NH **OR** NH_2^+  ✓ one mark for remaining fragment with  or  ✓ **Fourth** mark for structure of **both** ions shown correctly with NH_2^+	4	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **ALLOW** + charge on H of NH_2 groups, *i.e.* NH_2^+ **IGNORE** negative (counter) ions
	(c)	(iv)	idea of separating (the components/compounds) **AND** idea of (identifying compounds by) comparison with a (spectral) database ✓	1	**ALLOW** (identifies compounds) using fragmentation (patterns)/fragment ions (but **IGNORE** molecular ions) **IGNORE** retention times
			Total	15	

Question			Answer	Marks	Guidance
3	(a)	(i)	**monomers** join/bond/add/react/form polymer/form chain **AND** another product/small molecule *e.g.* H_2O/HC*l* ✓	1	**IGNORE** 'two' when referring to monomers, *i.e.* (two) monomers…
		(ii)	 ✓ ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **ALLOW** zwitterions
		(iii)	The pH at which the zwitterion exists ✓  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **ALLOW** pH at which there is no **overall**/**net** charge **IGNORE** pH at which there is no charge/ neutral charge *ie overall/net is required* **ALLOW** pH at which contains COO^- **AND** NH_3^+  **ALLOW** delocalized carboxylate **ALLOW** + on N or H; - must be on O
	(b)	(i)	Adsorption ✓	1	**DO NOT ALLOW** absorption **ALLOW** partition **ALLOW** adsorbtion
		(ii)	R_f = 0.53 to 0.62 ✓ Amino acid is methionine ✓	2	Values vary if distance measured to middle or top of spot Independent marks. No need to show working as question asks for estimate of R_f

Question			Answer	Marks	Guidance
	(c)		 amide link ✓ correct structure ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **ALLOW** 'terminal' —NH— at other end 'End bonds' **MUST** be shown (solid or dotted) **IGNORE** brackets and/or *n* **DO NOT ALLOW** aromatic rings in amine residue **ALLOW** CONH for amide link
	(d)	(i)	 ✓  Penalise connectivity once (i.e. not –HO)	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous For dicarboxylic acid: **ALLOW** dioyl chloride  **DO NOT ALLOW** the CIS monomer
		(ii)	 ✓	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous
			Total	**13**	

Question			er	Marks	Guidance
4	(a)	(	photodegradable **OR** light/sunlight/UV ✓	1	**IGNORE** IR/heat **IGNORE** bacteria **DO NOT ALLOW** burn/combustion
		(ii)	 ✓	1	**DO NOT ALLOW** structure with any C shown (especially as part of C=O) **DO NOT ALLOW** OH—
	(b)	(	ammonia/NH_3 **AND** ethanol **OR** ethanolic ammonia ✓	1	**ALLOW** ammonia in a sealed tube **IGNORE** heat **ALLOW** dilute ethanolic ammonia /NH_3 **DO NOT ALLOW** any reference to water or hydroxide ions, e.g. **DO NOT ALLOW** dilute ethanolic NH_3(**aq**) e.g. **DO NOT ALLOW** ethanolic NH_3 + NaOH
		(ii)	**Nitrogen** electron pair/lone pair accepts a proton/H^+ ✓ *Requires position of electron pair on N* $Cl^-H_3N^+(CH_2)_4N^+H_3\,Cl^-$ **OR** $ClH_3N(CH_2)_4NH_3Cl$ ✓	2	**DO NOT ALLOW** Nitrogen/N lone pair accepts hydrogen *proton/H^+ required* **ALLOW nitrogen** donates an electron pair **IGNORE** NH_2 group donates electron pair **ALLOW** + charge (if shown) on N or H of NH_3 e.g. $Cl^-H_3N^+(CH_2)_4NH_3^+Cl^-$ **DO NOT ALLOW** just $H_3N^+(CH_2)_4NH_3^+$ i.e. **2 x** Cl^- **MUST** be included

Question			er	Marks	Guidance
		(iii)	1 mark for amide/peptide link correctly displayed within an attempted repeat unit ✓ 1 mark for rest of structure correct including side links ✓ 	2	Minimum requirement is each end of a displayed amide group attached to a carbon atom (could be skeletal) Brackets **not** required **IF** more than one repeat unit has been drawn a single repeat unit **MUST** be identified by brackets or clear label **DO NOT ALLOW 2nd** mark if amide/peptide link wrong *1st mark requires amide group fully displayed* *For 2nd mark, **ALLOW** –CONH– in correct structure* **ALLOW** correct structural **OR** displayed **OR** skeletal formula **ALLOW** combination of formulae as long as unambiguous e. 

Question			er	Marks	Guidance
	(c)	(i)	One mark for each correct structure  ✓  **OR**  ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formula **ALLOW** combination of formulae as long as unambiguous **ALLOW** COO^- '–' charge must be on O of COO^- but **ALLOW** + sign shown as $^+NH_3$ **OR** NH_3^+ **BUT** only one NH_2 can be protonated in zwitterion
		(ii)	Zwitterion at pH 9.60/higher pH has **one** NH_2 group **OR** Zwitterion **OR** amino acid at pH 9.60/higher pH has a side chain with an NH_2 group ✓ **Note:** **ASSUME** that 'it' refers to zwitterion	1	**ALLOW** amino acid at 9.60/higher pH has **two** NH_2 groups **ALLOW** amino acid at 9.60/higher pH has more NH_2 groups **ALLOW** amine **OR** amino for NH_2 **IGNORE** CHOH slightly acidic
			Total	**10**	