M1.(a) Secondary

1

(b) Nitrogen and oxygen are very electronegative

1

Therefore, C=O and N–H are polar

1

Which results in the formation of a hydrogen bond between O and H

1

In which a lone pair of electrons on an oxygen atom is strongly attracted to the δ+H

1

[5]

M2. (a) (i) hydrolysis

not hydration

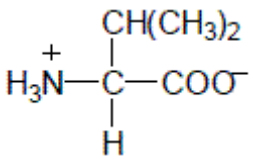
1

(ii) 2-aminopropanoic acid

ignore alanine
QoL

1

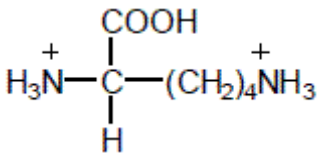
(iii)



allow $-CO_2^-$
allow $^+NH_3-$
don't penalize position of + on NH_3

1

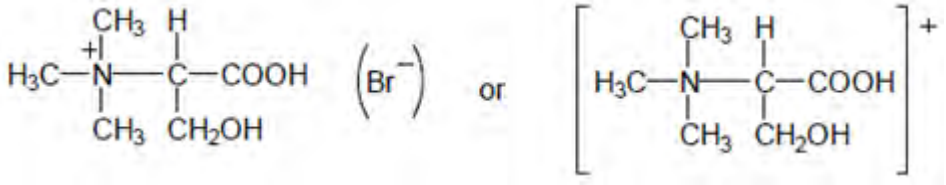
(iv)



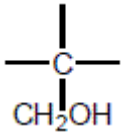
allow $-CO_2^-$
allow $^+NH_3-$
don't penalize position of + on NH_3

1

(b) (i)



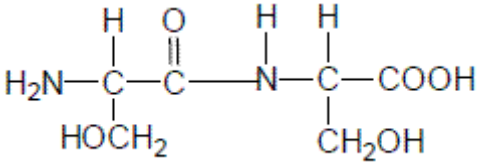
allow $-CO_2H$



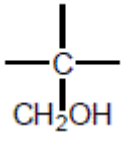
allow limit as
+ on N or outside [ ]

1

(ii)



allow $-CO_2H$ allow –CONH– or –COHN–
allow NH_2-

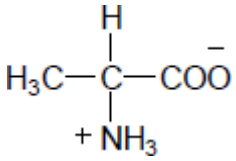


allow limit as

1

[6]

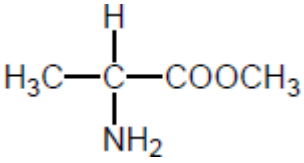
M3.(a)



Allow $-NH_3^+$ and $^+NH_3-$

1

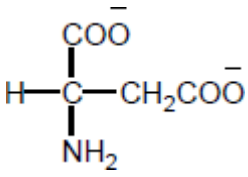
(b)



Allow protonated form, i.e. $-NH_3^+$ or $^+NH_3-$

1

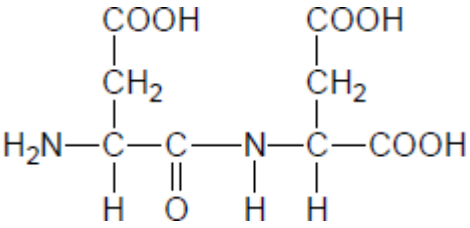
(c)



Allow – CO_2^-

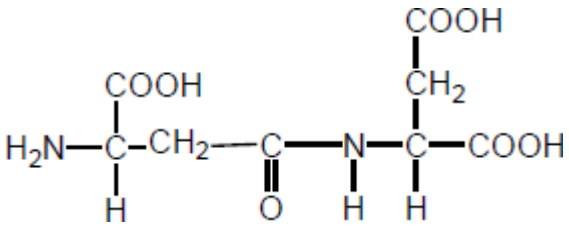
1

(d)



Allow zwitterion with any COO^-

Allow use of "wrong" COOH



1

[4]

M4.(a) Heating <u>speeds up</u> (hydrolysis / breaking of peptide bonds)

OR forms non-sweet (amino acids)

1

(b) (2-)aminobutan**<u>e</u>**dioic acid OR

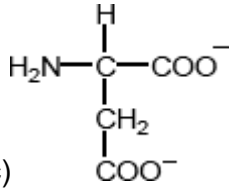
2 not necessary but penalise other numbers at start

(2-)aminobutan**<u>e</u>**(-1,4-)dioic acid

1,4 not necessary but penalise other numbers and 1,4 must be in correct place (QoL)

1

(c)

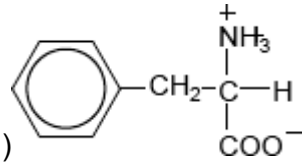


allow $-CO_2^-$

allow NH_2-

1

(d)



allow $-CO_2^-$

allow $+NH_3-$

don't penalize position of + on NH_3

1

(e) (i) **M1** Compounds/molecules with same <u>structural formula</u>

Not just structure

1

M2 But with <u>bonds/atoms/groups</u> arranged differently <u>in space</u> or <u>in 3D</u>

Allow –with different <u>spatial</u> arrangement of <u>atom/bond/group</u>

1

Independent marks

(ii) (Plane) polarised light

1

<u>Rotated</u> in opposite directions

Not bent or turned or twisted; not different directions (QoL)

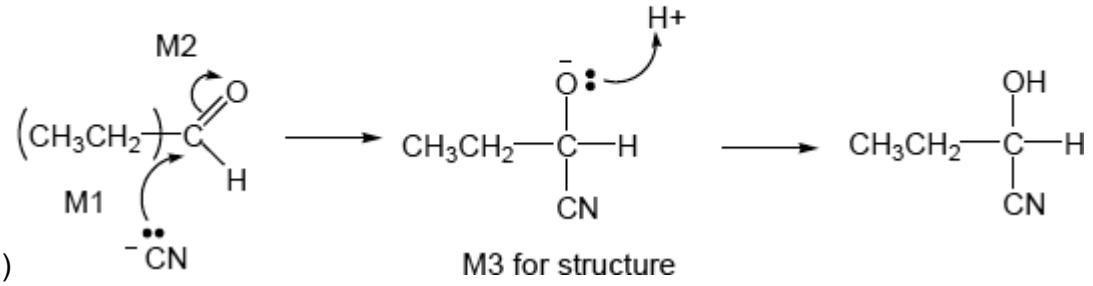
1

[8]

M5.(a)

nucleophilic addition

M4 for lp and arrow to H^+



M3 for structure

- *allow :CN–*
- *M2 not allowed independent of M1, but*
- *allow M1 for correct attack on C+*
- *+ rather than δ+ on C=O loses M2*
- *M3 is for correct structure including minus sign but lone pair is part of M4*
- *Allow C_2H_5*
- *M1 and M4 for lp and curly arrow*

1

4

(b) *2-bromobutanenitrile*

Allow 2-bromobutane-1-nitrile

1

(c) ***M1*** *ammonia or NH_3*

Ignore temp or pressure

1

M2 *excess (ammonia)* *excess tied to NH_3 and may score in M1 unless contradicted*

Ignore concentrated or sealed container, Acid loses conditions mark

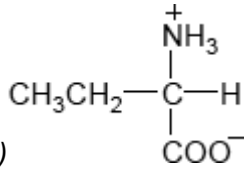
1

M3 *nucleophilic substitution*

Allow close spelling

1

(d) (i)



Allow C_2H_5

Allow $–CO_2^-$

Allow $^+NH_3–$

Don't penalize position of + on NH_3

1

(ii) ***M1*** *electrostatic <u>forces between ions</u> in **X*** ***QOL***

Allow ionic bonding.

1

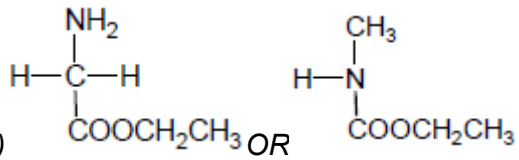
Marks independent

M2 *(stronger than) <u>hydrogen bonding</u> between $CH_3CH_2CH(OH)COOH$*

CE *mention of molecules of **X** or inter molecular forces between **X** loses both marks*

1

(e) (i)



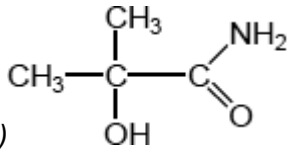
OR

Isomer of $C_4H_9NO_2$

Allow NH_2–

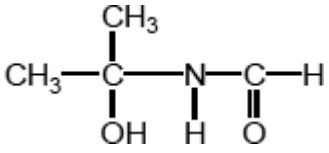
1

(ii)



Isomer of $C_4H_9NO_2$ allow NH_2–

Allow

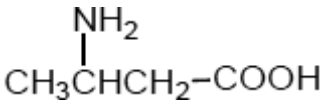


1

(iii) $H_2N–CH_2CH_2CH_2–COOH$ *or* $H_2N–(CH_2)_{3–COOH}$

Isomer of $C_4H_9NO_2$ allow NH_2–

OR

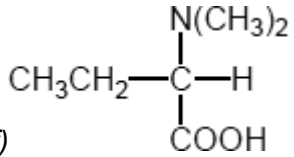


*Do **not** allow $–C_3H_6-$*

*Beware – do not credit **X** itself*

1

(f)



*Answer has 6 carbons so **NOT** isomer of **X***

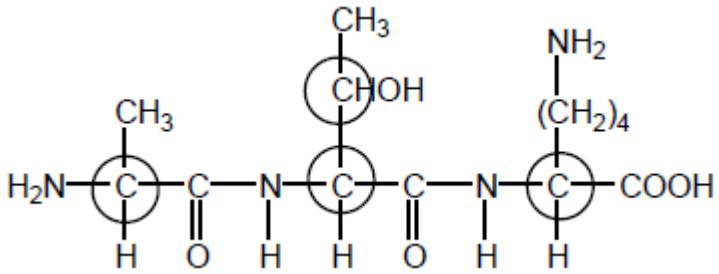
Allow C_2H_5

Must have bond from C to N not to methyl group

1

[16]

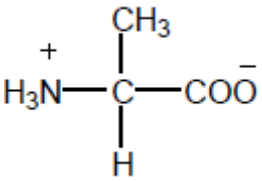
M6.*(a)* *(i)*



These four only

1

(ii)



Allow − NH_3^+ and $^+NH_3^-$

1

(iii) *2-amino-3-hydroxybutanoic acid*

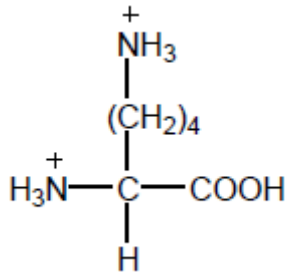
Ignore 1 in butan-1-oic acid

Do not penalise commas or missing hyphens

Penalise other numbers

1

(iv)



Allow $-NH_3^+$ and $^+NH_3-$

1

(b) *(i)* *Condensation*

Allow polyester

1

(ii) *propan**e**-1,3-diol*

Must have e

*Allow 1,3-propan**e**diol*

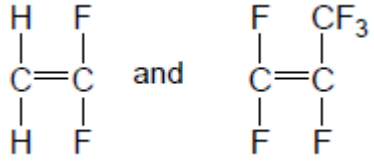
1

(c) *(i)* *Addition*

Not additional

1

(ii)

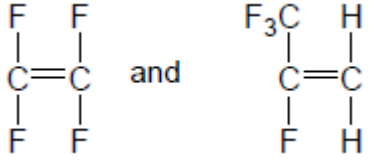


Allow monomers drawn either way round

Allow bond to F in CF_3

1

OR



1 for each structure within each pair

1

(d) *c*

If wrong, CE = 0

1

C-C or C-F bonds too strong

1

[11]