A-Level Chemistry

Proteins and Amino Acids

Mark Scheme

Time available: 56 minutes
Marks available: 53 marks

1.

(a) electron deficient H

Allow H delta plus / slightly positive

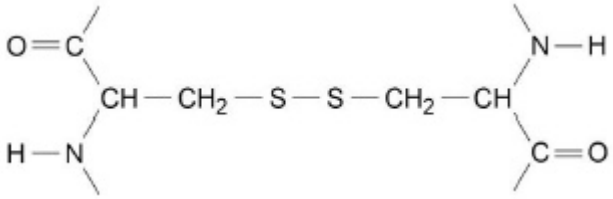
M1

(Which attracts) lone pair/electron pair on O

Penalise lone pair/electron pair donation

M2

(b)



Penalise dashed/dotted S—S

Ignore extra additions to structures

1

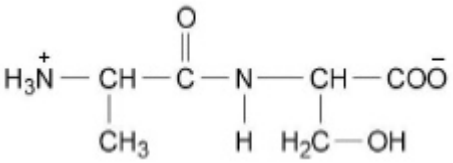
(c) Tertiary or Quaternary

Allow 3° or 4°

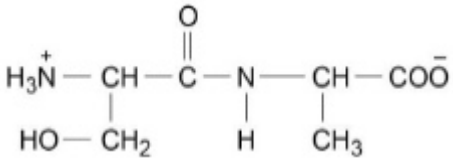
do not penalise minor error in spelling e.g. Quarternary

1

(d)



OR



Incorrect peptide bond CE=0

M1 for correct dipeptide

M2 for correct charges

Ignore additional dipeptide in working

Allow –CONH— or –COHN—

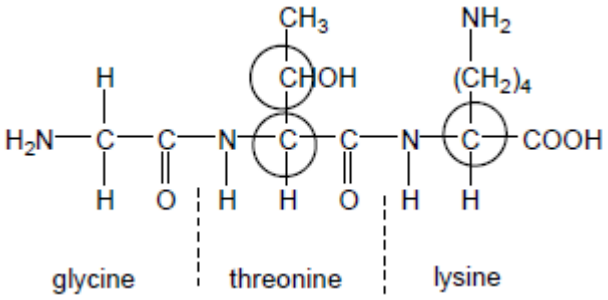
1

1

[6]

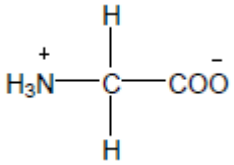
2.

(a)



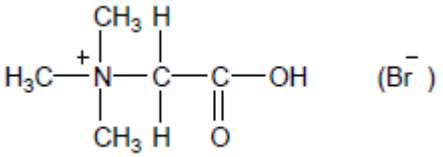
1

(b)

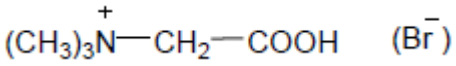


1

(c)



Allow

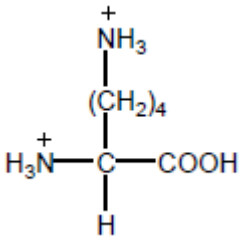


1

(d) 2-amino-3-hydroxybutanoic acid

1

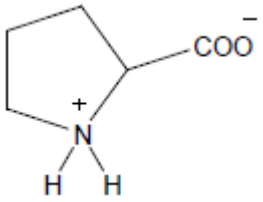
(e)



1

[5]

3. (a) (i)



Allow CO_2^- and NH_2^+

1

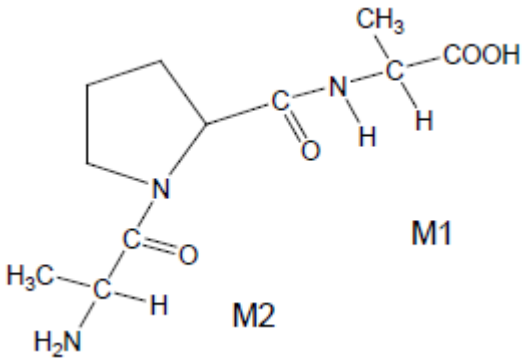
(ii) NOTE − **Two** marks for this clip

M1 for alanine section bonded through N

M2 for alanine section bonded through C

But penalise error in proline ring

1



Allow MAX 1 for correct tripeptide in polymer structure

1

(b) (i) 3-methylpent-2-ene

Ignore E-Z, commas, spaces or missing hyphens

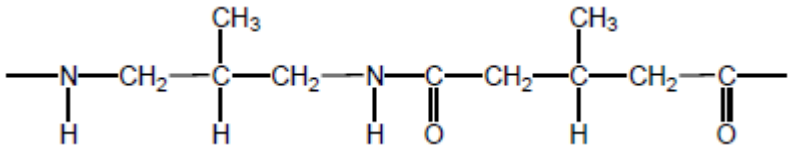
1

(ii) 4-amino-3-methylbutanoic acid

Ignore commas, spaces or missing hyphens

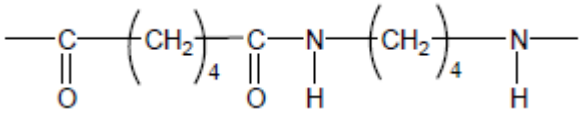
1

(iii)



or any polyamide section containing

8 carbons plus two C=O plus two N-H, such as



Trailing bonds are required

1

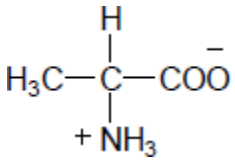
(iv) Non polar OR no polar groups / bonds (for attack by water / acids / alkalis / nucleophiles or for hydrolysis)

C-C bonds are strong

1

[7]

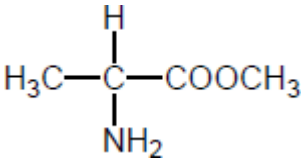
4. (a)



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

1

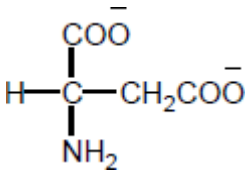
(b)



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

1

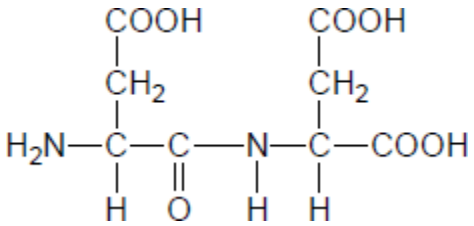
(c)



Allow $-CO_2^-$

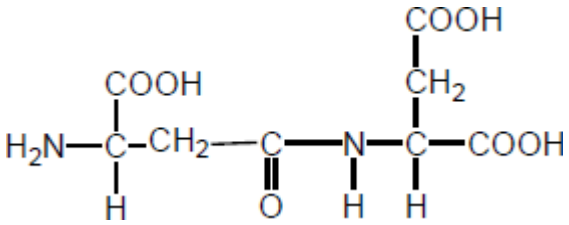
1

(d)



Allow zwitterion with any COO^-

Allow use of "wrong" COOH



1

[4]

5. (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

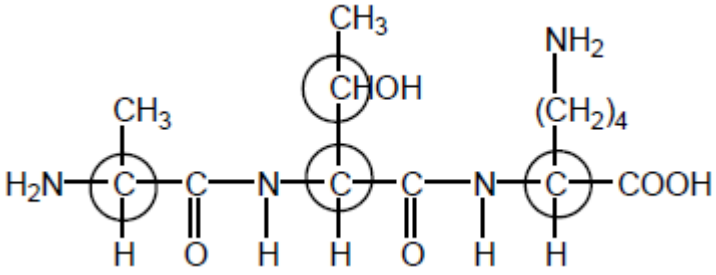
1

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

1

[5]

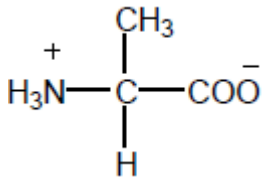
6. (a) (i)



These four only

1

(ii)



Allow − NH_3^+ and $^+NH_3^-$

1

(iii) <u>2-amino-3-hydroxybutanoic acid</u>

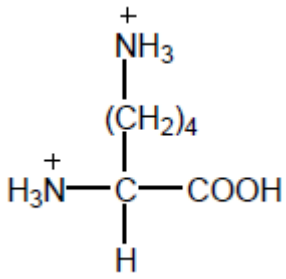
Ignore 1 in butan-1-oic acid

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) <u>propan**e**-1,3-diol</u>

Must have e

*Allow 1,3-propan**<u>e</u>**diol*

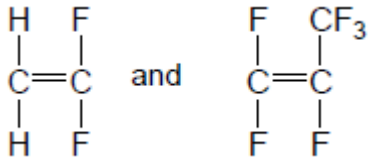
1

(c) (i) Addition

Not additional

1

(ii)

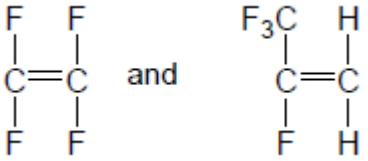


Allow monomers drawn either way round

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

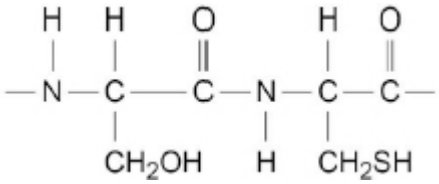
1

[11]

7. (a) Primary

1

(b)

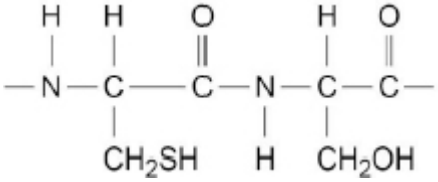


M1 for correct peptide link (Allow -CONH- as a minimum)

M2 for the correct amino acid R groups

M1

OR



*Trailing bonds **not** needed*

M2

(c) Water

1

(d) Two Cys R groups form a disulfide bridge

Could score via a correct diagram showing min -SS-

M1

Ser and Asp R groups form Hydrogen bonds

M2

Disulfide bridges are stronger than H bonds

M3

Because disulfide bridges are covalent bonds while H bonds aren't

M4

(e) Ionic bond

1

[9]

8. (a) (i) hydrolysis

not hydration

1

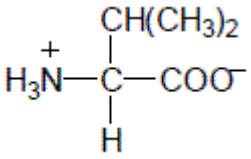
(ii) 2-aminopropanoic acid

ignore alanine

QoL

1

(iii)



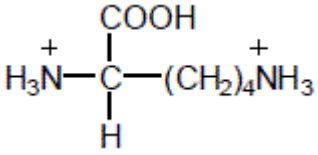
allow $-CO_2^-$

allow $^+NH_3-$

don't penalize position of + on NH_3

1

(iv)



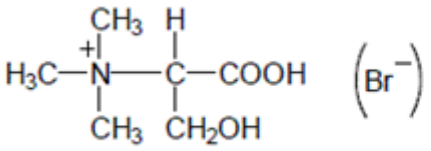
allow $-CO_2^-$

allow $^+NH_3-$

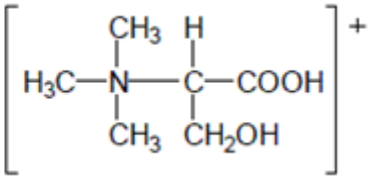
don't penalize position of + on NH_3

1

(b) (i)

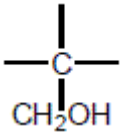


(Br^-) or



allow $-CO_2H$

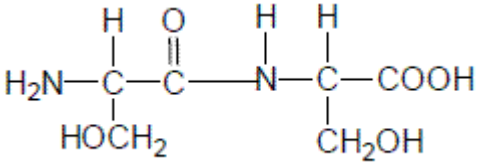
allow limit as



+ on N or outside [ ]

1

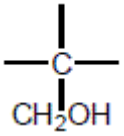
(ii)



allow $-CO_2H$ allow –CONH– or –COHN–

allow NH_2–

allow limit as



1

[6]