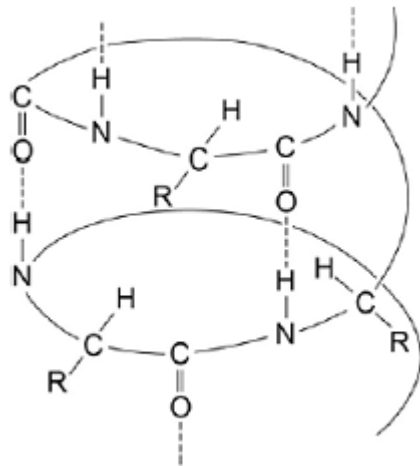


**Q1.**The following figure shows a simplified representation of the arrangement of some amino acids in a portion of a protein structure in the form of an  $\alpha$ -helix.



(a) Name the type of protein structure in the figure.

.....

(1)

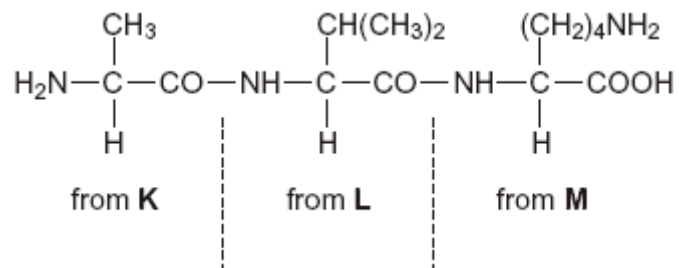
(b) Explain the origin of the interaction represented by the dotted lines in the figure above.

.....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....  
 .....

(4)

(Total 5 marks)

- Q2.** (a) Consider the tripeptide shown below that is formed from three amino acids, **K**, **L** and **M**.



- (i) Name the process by which the tripeptide is split into three amino acids.

.....

(1)

- (ii) Give the IUPAC name for the amino acid **K**.

.....

(1)

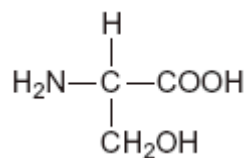
- (iii) Draw the structure of the zwitterion of amino acid **L**.

(1)

- (iv) Draw the structure of the species formed by amino acid **M** at low pH.

(1)

(b) Consider the amino acid serine.



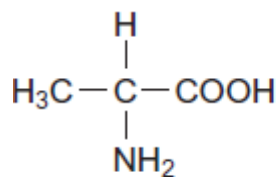
(i) Draw the structure of the product formed when serine reacts with an excess of  $\text{CH}_3\text{Br}$

(1)

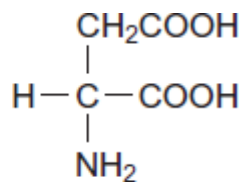
(ii) Draw the structure of the dipeptide formed by two molecules of serine.

(1)  
(Total 6 marks)

**Q3.** Alanine and aspartic acid are naturally occurring amino acids.



alanine



aspartic acid

- (a) Draw the structure of the zwitterion formed by alanine.

(1)

- (b) Draw the structure of the compound formed when alanine reacts with methanol in the presence of a small amount of concentrated sulfuric acid.

(1)

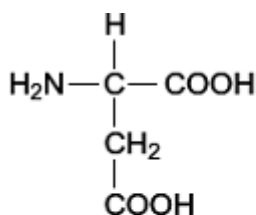
- (c) Draw the structure of the species formed by aspartic acid at high pH.

(1)

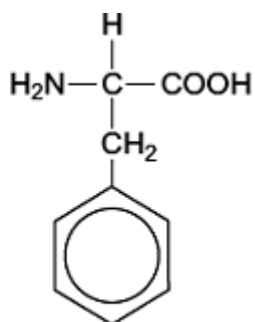
- (d) Draw the structure of a dipeptide formed by two aspartic acid molecules.

(1)  
(Total 4 marks)

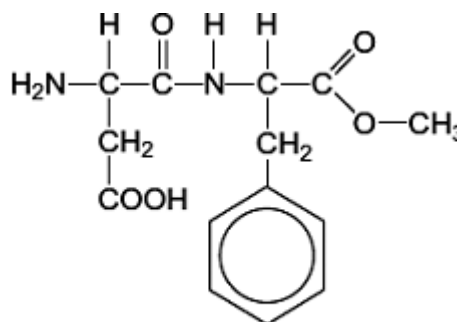
**Q4.** The amino acids aspartic acid and phenylalanine react together to form a dipeptide. This dipeptide can be converted into a methyl ester called aspartame.



aspartic acid



phenylalanine



aspartame

Aspartame has a sweet taste and is used in soft drinks and in sugar-free foods for people with diabetes.

Hydrolysis of aspartame forms methanol initially. After a longer time the peptide link breaks to form the free amino acids. Neither of these amino acids tastes sweet.

- (a) Apart from the release of methanol, suggest why aspartame is **not** used to sweeten foods that are to be cooked.

.....  
.....  
(Extra space) .....  
.....

(1)

- (b) Give the IUPAC name of aspartic acid.

.....

(1)

- (c) Draw the organic species formed by aspartic acid at high pH.

(1)

(d) Draw the zwitterion of phenylalanine.

(1)

(e) Phenylalanine exists as a pair of stereoisomers.

(i) State the meaning of the term *stereoisomers*.

.....  
.....  
.....  
.....

(2)

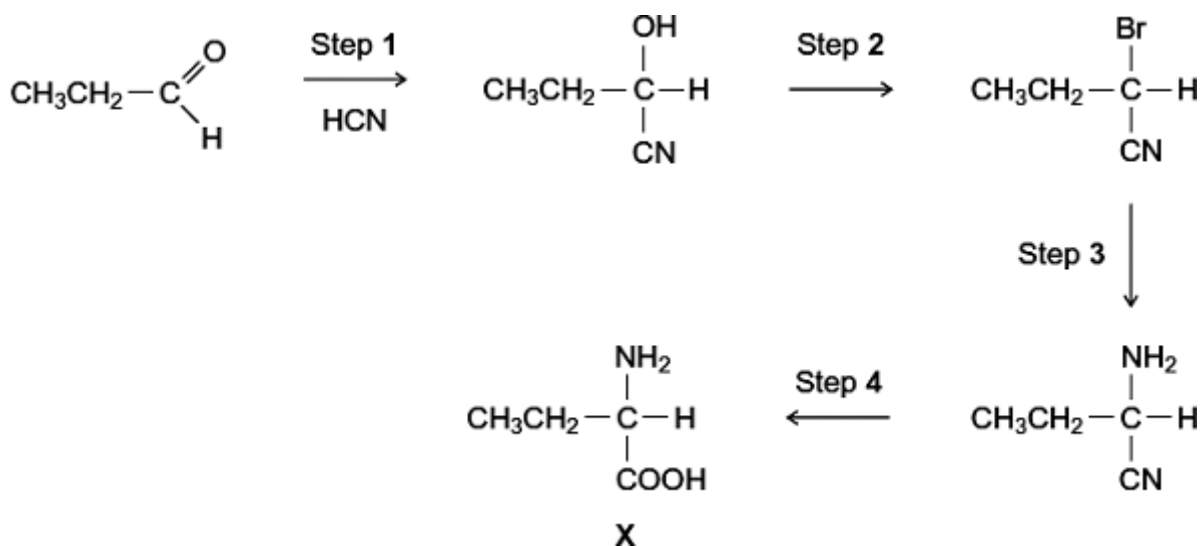
(ii) Explain how a pair of stereoisomers can be distinguished.

.....  
.....  
.....  
.....  
(Extra space) .....  
.....

(2)

**(Total 8 marks)**

**Q5.** A possible synthesis of the amino acid **X** is shown below.



(a) Name and outline a mechanism for Step 1.

Name of mechanism .....

Mechanism

(5)

(b) Give the IUPAC name of the product of Step 2.

.....

(1)

(c) For Step 3, give the reagent, give a necessary condition and name the mechanism.

Reagent .....

Condition .....

Name of mechanism .....

(3)

(d) At room temperature, the amino acid **X** exists as a solid.

(i) Draw the structure of the species present in the solid amino acid.

(1)

(ii) With reference to your answer to part (d)(i), explain why the melting point of the amino acid **X** is higher than the melting point of  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{COOH}$ .

.....  
.....  
.....  
.....  
.....  
.....  
(Extra space) .....

(2)

(e) There are many structural isomers of **X**,  $\text{CH}_3\text{CH}_2\text{CH}(\text{NH}_2)\text{COOH}$ .

(i) Draw a structural isomer of **X** that is an ethyl ester.

(1)

(ii) Draw a structural isomer of **X** that is an amide and also a tertiary alcohol.



(1)

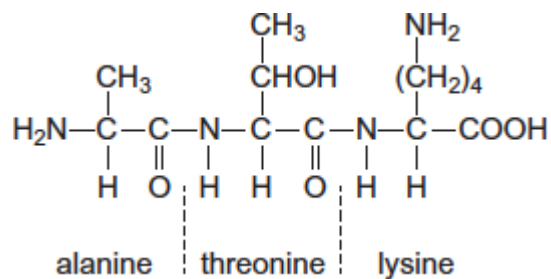
- (iii) Draw a structural isomer of **X** that has an unbranched carbon chain and can be polymerised to form a polyamide.

(1)

- (f) Draw the structure of the tertiary amine formed when **X** reacts with bromomethane.

(1)  
(Total 16 marks)

- Q6.(a)** The tripeptide shown is formed from the amino acids alanine, threonine and lysine.



- (i) Draw a separate circle around **each** of the asymmetric carbon atoms in the tripeptide.

(1)

(ii) Draw the zwitterion of alanine.

(1)

(iii) Give the IUPAC name of threonine.

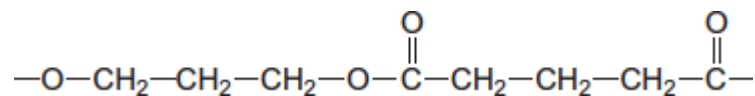
.....

(1)

(iv) Draw the species formed by lysine at low pH.

(1)

(b) The repeating unit shown represents a polyester.



(i) Name this type of polymer.

.....

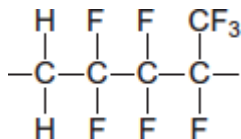
(1)

(ii) Give the IUPAC name for the alcohol used to prepare this polyester.

.....

(1)

(c) The repeating unit shown represents a polyalkene co-polymer. This co-polymer is made from two different alkene monomers.



- (i) Name the type of polymerisation occurring in the formation of this co-polymer.

.....

(1)

- (ii) Draw the structure of each alkene monomer.

Alkene monomer 1

Alkene monomer 2

(2)

- (d) One of the three compounds shown in parts (a), (b) and (c) cannot be broken down by hydrolysis.

Write the letter **(a)**, **(b)** or **(c)** to identify this compound and explain why hydrolysis of this compound does **not** occur.

Compound .....

Explanation .....

.....

.....

(2)

(Total 11 marks)