



# **A-Level Chemistry**

## **Proteins and Amino Acids**

### **Question Paper**

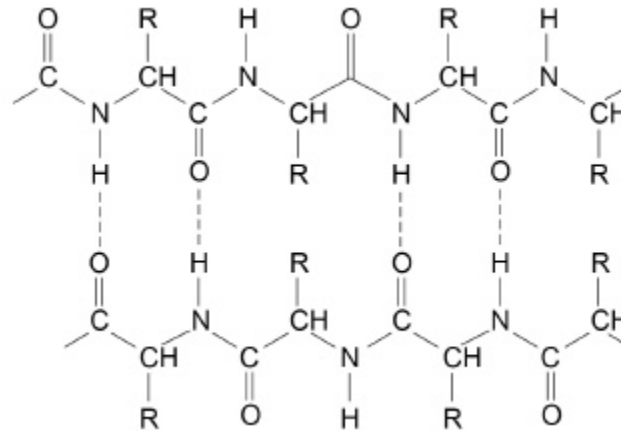
**Time available: 56 minutes**

**Marks available: 53 marks**

**[www.accesstuition.com](http://www.accesstuition.com)**

1.

Use the Data Booklet to help you answer this question about amino acids. The diagram shows parts of two polypeptide chains in a beta-pleated sheet of a protein.



- (a) The polypeptide chains are held together by hydrogen bonding as shown in the diagram.

Explain how these hydrogen bonds form.

---

---

---

---

---

(2)

- (b) A different type of bond can form between two polypeptide chains when the chains each contain the amino acid cysteine.

Complete the structure to show the bond that forms between the side chains of two cysteine molecules.



(1)

- (c) The type of bond in **part (b)** between two polypeptide chains influences the three-dimensional structure of the protein.

Name this type of protein structure.

---

(1)

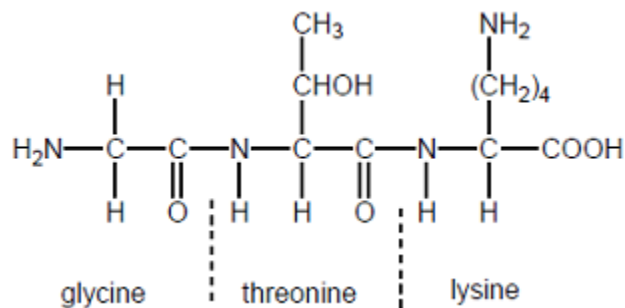
(d) Draw the structure of the zwitterion of a dipeptide formed by alanine and serine.

(2)

(Total 6 marks)

2.

The tripeptide shown in the following figure is formed from the amino acids glycine, threonine and lysine.



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

(1)

(b) Draw the zwitterion of glycine.

(1)

(c) Draw the structure of the species formed when glycine reacts with an excess of bromomethane.

(1)

(d) Deduce the IUPAC name of threonine.

---

(1)

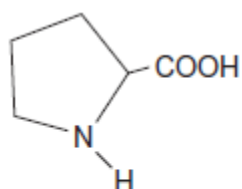
(e) Draw the structure of the species formed by lysine at low pH.

(1)

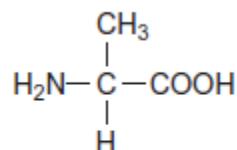
**(Total 5 marks)**

**3.**

- (a) The structures and common names of two amino acids are shown.



proline



alanine

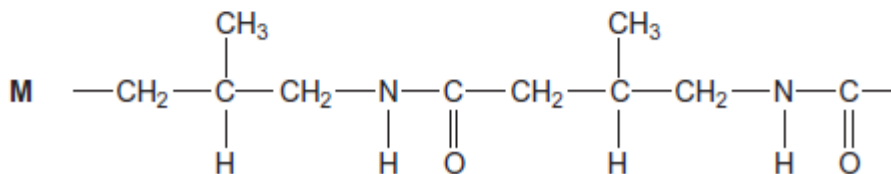
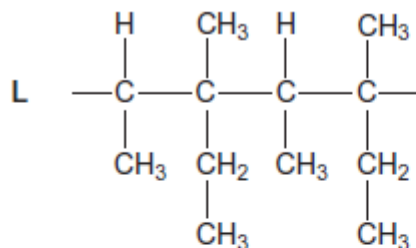
- (i) Draw the structure of the zwitterion of proline.

(1)

- (ii) Draw the structure of the tripeptide formed when a proline molecule bonds to two alanine molecules, one on each side.

(2)

- (b) Sections of two polymers,
- L**
- and
- M**
- , are shown.



- (i) Give the IUPAC name of a monomer that forms polymer
- L**
- .

(1)

(ii) Give the IUPAC name of the monomer that forms polymer **M**.

\_\_\_\_\_

(1)

(iii) Draw the section of a polymer made from a dicarboxylic acid and a diamine that is isomeric with the section of polymer **M** shown.

(1)

(vi) Explain why polymer **L** is non-biodegradable.

\_\_\_\_\_

\_\_\_\_\_

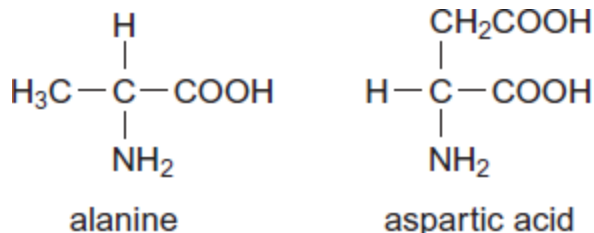
\_\_\_\_\_

(1)

(Total 7 marks)

4.

Alanine and aspartic acid are naturally occurring amino acids.



(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)

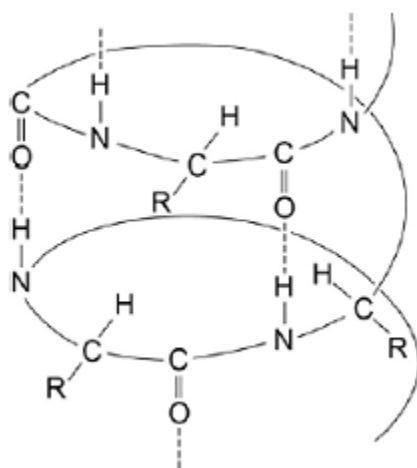
(d) Draw the structure of a dipeptide formed by two aspartic acid molecules.

(1)

(Total 4 marks)

5.

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.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

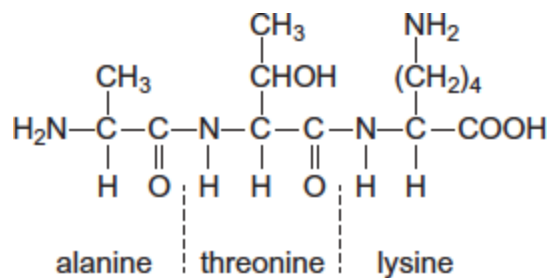
---

(4)

(Total 5 marks)

6.

(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.

---

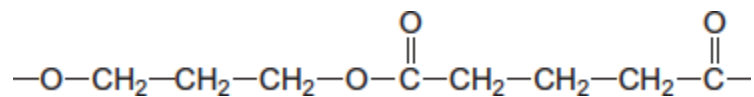
(1)



(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.

\_\_\_\_\_

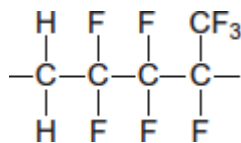
(1)

(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 \_\_\_\_\_

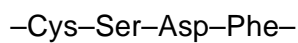
\_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 11 marks)

7.

Proteins are polymers made from amino acids.  
Part of the structure of a protein is shown.



Each amino acid in the protein is shown using the first three letters of its name.

- (a) Identify the type of protein structure shown.

Tick (✓) **one** box.

Primary

Secondary

Tertiary

(1)

- (b) Draw a structure for the –Cys–Ser– section of the protein.  
Use the Data Booklet to help you answer this question.

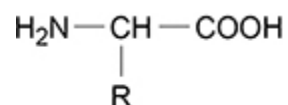
(2)

- (c) Name the other substance formed when two amino acids react together to form part of a protein chain.

---

(1)

The general structure of an amino acid is shown.



R represents a group that varies between different amino acids.  
R groups can interact and contribute to protein structure.

- (d) Explain why the strength of the interaction between two cysteine R groups differs from the strength of the interaction between a serine R group and an aspartic acid R group.

Use the Data Booklet to help you answer this question.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

(4)

- (e) Deduce the type of interaction that occurs between a lysine R group and an aspartic acid R group.

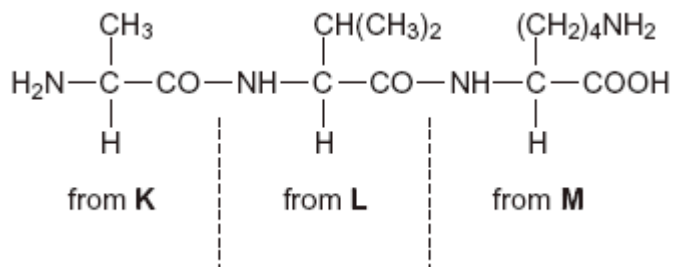
---

(1)

(Total 9 marks)

8.

- (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)

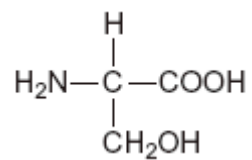
(iii) Draw the structure of the zwitterion of amino acid **L**.

(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)