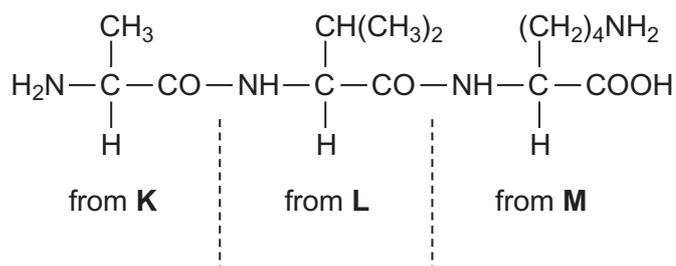


Amino Acids, Protein  
and DNA

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



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

.....  
(1 mark)

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

.....  
(1 mark)

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

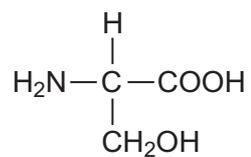
(1 mark)

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

(1 mark)



6 (b) Consider the amino acid serine.



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

(1 mark)

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

(1 mark)

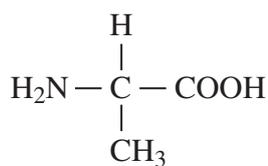
6

Turn over for the next question

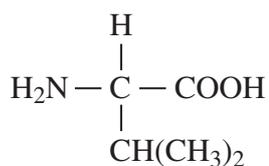
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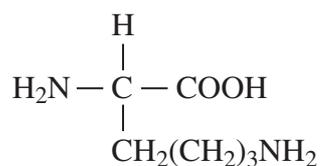
6 The three amino acids shown below were obtained by hydrolysis of a protein.



alanine



valine



lysine

6 (a) (i) Draw the zwitterion of alanine.

(1 mark)

6 (a) (ii) Draw the species formed when valine is dissolved in an alkaline solution.

(1 mark)

6 (a) (iii) Draw the species formed by lysine at low pH.

(1 mark)



6 (b) Draw the two dipeptides formed by the reaction of alanine with valine.

(2 marks)

6 (c) Name a suitable method by which the mixture of amino acids formed by hydrolysis of the protein can be separated.

.....  
(1 mark)

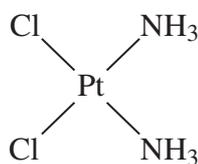
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**Turn over for the next question**

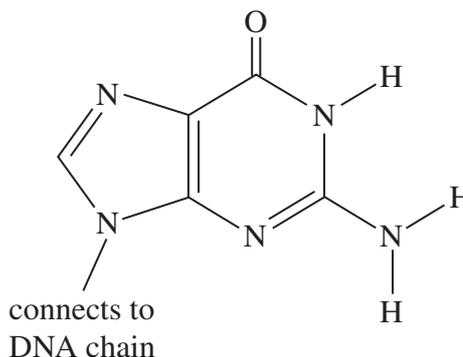
**Turn over ►**



- 6 The complex cisplatin acts as an anticancer drug by changing the properties of DNA when it reacts with guanine, a component of DNA.



cisplatin



guanine

When cisplatin is absorbed into the human body, it undergoes a ligand substitution reaction and one chloride ligand is replaced by a water molecule forming a complex ion **Q**.

- 6 (a) Write an equation for this substitution reaction to form the complex ion **Q**.

.....  
(2 marks)

- 6 (b) The complex ion **Q** can bond to guanine in two different ways.

- 6 (b) (i) The first way involves a hydrogen atom, from one of the ammonia ligands on **Q**, bonding to an atom in a guanine molecule. State the type of bond formed to guanine and identify an atom in guanine that could form a bond to this hydrogen atom.

Type of bond .....

Atom in guanine .....

(2 marks)

- 6 (b) (ii) The second way involves a ligand substitution reaction in which an atom in a guanine molecule bonds to platinum by displacing the water molecule from **Q**. State the type of bond formed between guanine and platinum when a water molecule is displaced and identify an atom in guanine that could bond to platinum in this way.

Type of bond .....

Atom in guanine .....

(2 marks)



**6** (c) State and explain **one** risk associated with the use of cisplatin as an anticancer drug.

Risk .....

Explanation .....  
(2 marks)

8

**Turn over for the next question**

**Turn over ►**





7 (d) Draw the zwitterion of phenylalanine.

(1 mark)

7 (e) Phenylalanine exists as a pair of stereoisomers.

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

.....

.....

.....

.....

(2 marks)

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

.....

.....

.....

.....

(2 marks)

(Extra space) .....

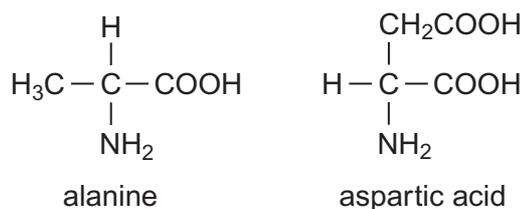
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Turn over ►



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



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

(1 mark)

**6 (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 mark)

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

(1 mark)

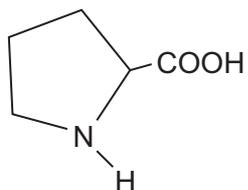
**6 (d)** Draw the structure of a dipeptide formed by two aspartic acid molecules.

(1 mark)

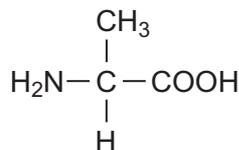
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7 (a) The structures and common names of two amino acids are shown.



proline



alanine

7 (a) (i) Draw the structure of the zwitterion of proline.

[1 mark]

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

[2 marks]



- 5** Proteins contain sequences of amino acids joined by peptide links.  
Amino acid chains (polypeptides) are attracted to each other by hydrogen bonding.

- 5 (a) (i)** A section of a protein is formed from one molecule of each of the amino acids glycine ( $\text{H}_2\text{NCH}_2\text{COOH}$ ) and alanine ( $\text{H}_2\text{NCH}(\text{CH}_3)\text{COOH}$ ).

Add bonds and atoms to the diagram to complete a structural formula for this section of the protein.

**[2 marks]**

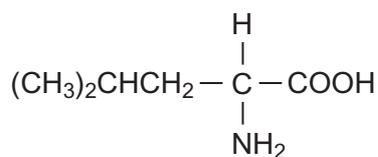


- 5 (a) (ii)** Draw a diagram to show how an amino acid chain can form a hydrogen bond with another amino acid chain.  
Your diagram need only show the relevant atoms from one amino acid in each chain.

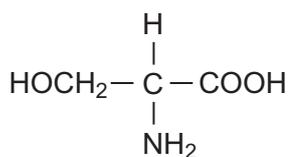
**[1 mark]**



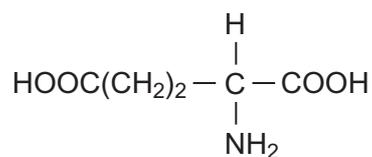
**5 (b)** Leucine, serine and glutamic acid are naturally-occurring amino acids.



leucine



serine



glutamic acid

**5 (b) (i)** Give the IUPAC name of leucine.

[1 mark]

---

**5 (b) (ii)** Draw the structure of the zwitterion of serine.

[1 mark]

**5 (b) (iii)** Draw the structure of the ester formed by two molecules of serine.

[1 mark]

**5 (b) (iv)** Draw the structure of the species formed by glutamic acid at low pH.

[1 mark]

7
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Turn over ►

