Proteins & Water

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Biological Molecules
Sub Topic	Proteins & Water
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **69 minutes**

Score : **/ 57**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Fig. 4.1 shows the primary structure of a lysozyme molecule, an enzyme found in tears, saliva and in lysosomes.

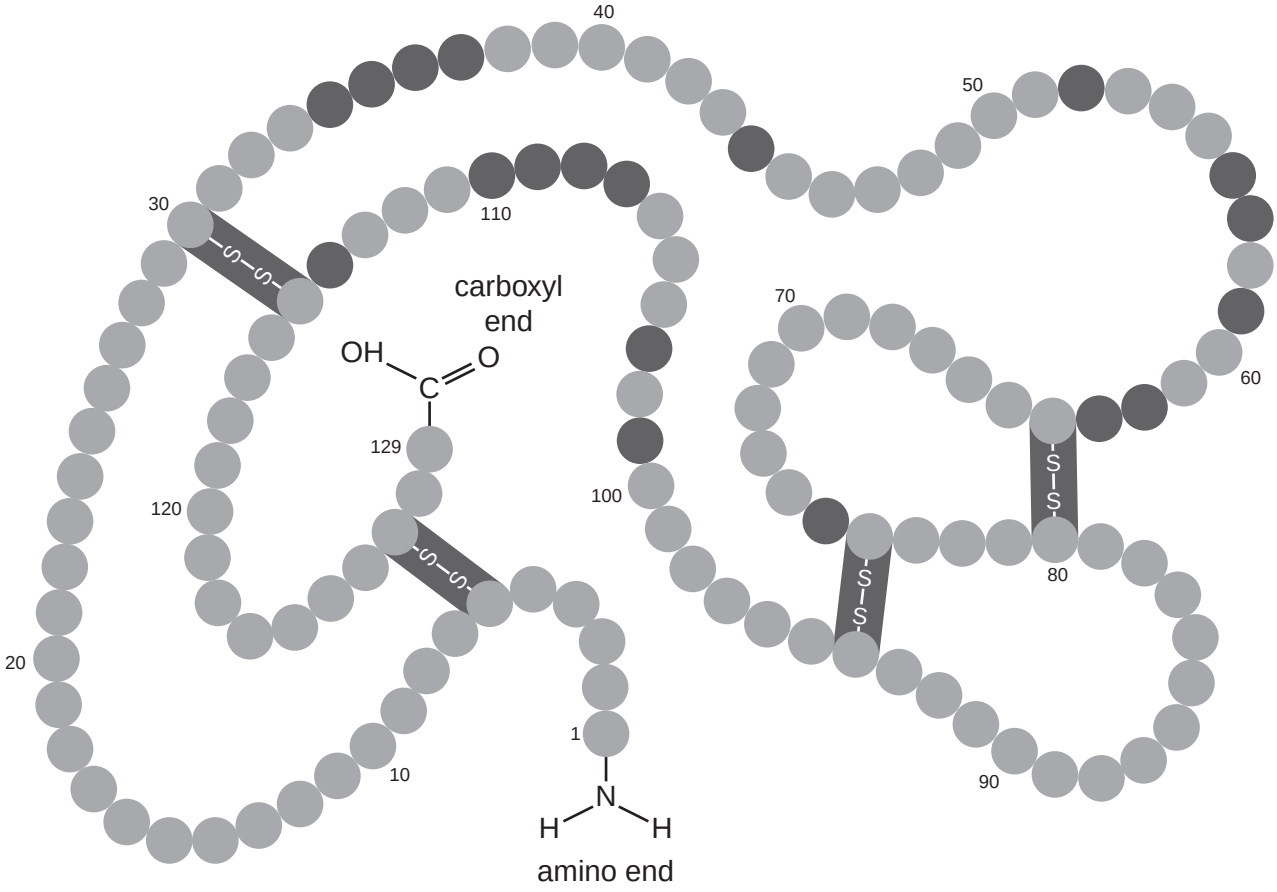

Fig. 4.1

(a) (i) Explain what is meant by the term *primary structure*.

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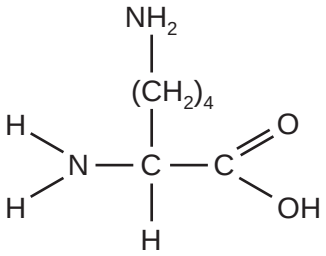
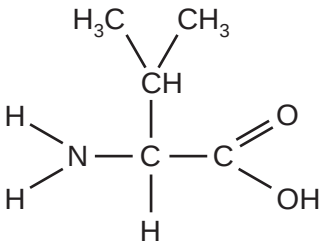
.....[1]

(ii) The molecular structure of the first two amino acids of lysozyme, lysine and valine, is shown below.

Use the space to show how these amino acids become linked in a condensation reaction.



lysine



valine

[3]

(b) Proteins, such as the enzyme lysozyme, have a secondary structure and a tertiary structure.

(i) Describe the secondary and tertiary structure of an enzymatic protein, such as lysozyme.

secondary .....

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tertiary .....

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.....[5]

(ii) State why it is important for enzymes, such as lysozyme, to possess a tertiary structure.

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.....[1]

(c) Some people have a rare disease caused by a single change in the DNA nucleotide sequence of the gene coding for lysozyme. The change leads to the formation of an insoluble protein that has a different structure to the normal soluble lysozyme molecule.

Suggest how a change in the gene can lead to the differences observed between the normal lysozyme and the changed lysozyme.

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.....[3]

[Total: 13]

2 The amino acid sequence of the protein hormone insulin is shown in Fig. 3.1.

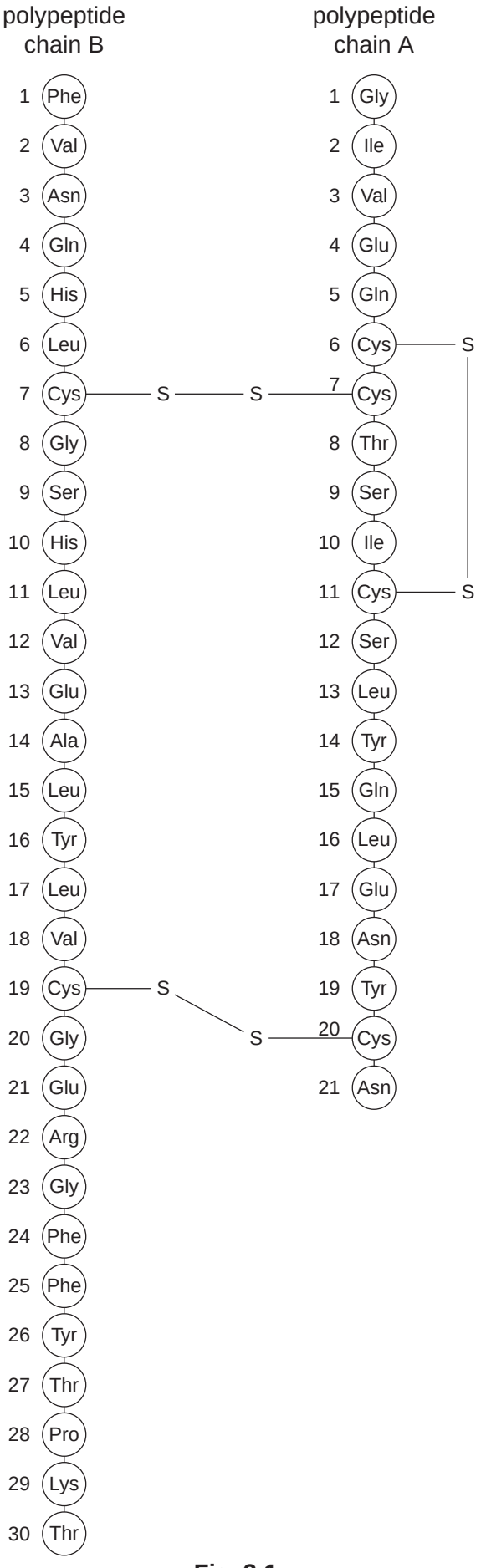


Fig. 3.1

(a) With reference to Fig. 3.1, state

(i) which two levels of protein structure are shown

1. .....

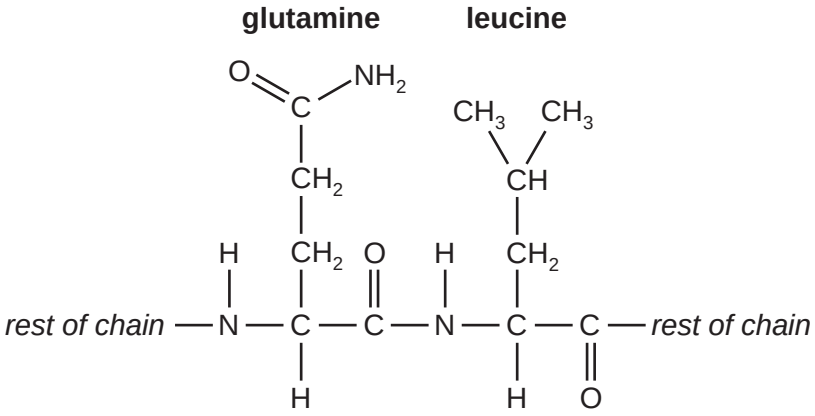
2. .....[2]

(ii) the name of the structures responsible for holding the two polypeptide chains together.

.....[1]

(b) Many people with diabetes need to take regular injections of insulin. Insulin in the form shown in Fig. 3.1 cannot be taken by mouth as it would be hydrolysed by proteases in the gut.

In the space below, draw a diagram to show how the peptide bond between glutamine 15 and leucine 16 in polypeptide chain A could be hydrolysed and show the products of the hydrolysis.



[3]

[Total: 6]

3 Haemoglobin is a globular protein with quaternary structure.

Fig. 5.1 is a diagram of the haemoglobin molecule.

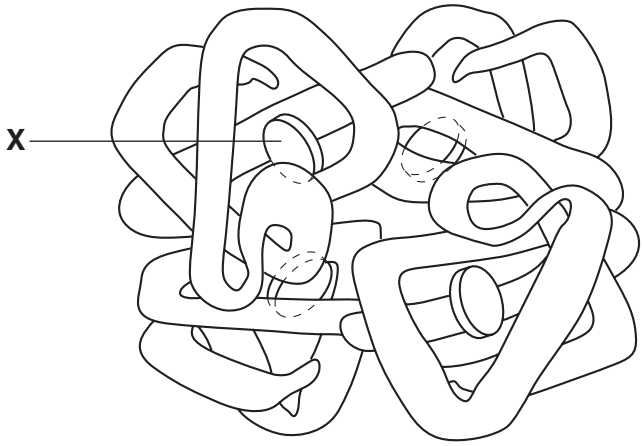


Fig. 5.1

(a) With reference to Fig. 5.1,

(i) name **X** and state its function;

.....

.....[2]

(ii) explain why haemoglobin is described as a *globular protein* with *quaternary structure*.

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.....[2]

(b) Explain why people who have a deficiency of iron in their diet are often lacking in energy and feel tired.

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.....[3]

Fig. 5.2 shows the oxygen dissociation curves for myoglobin, **M**, and haemoglobin, **H**.

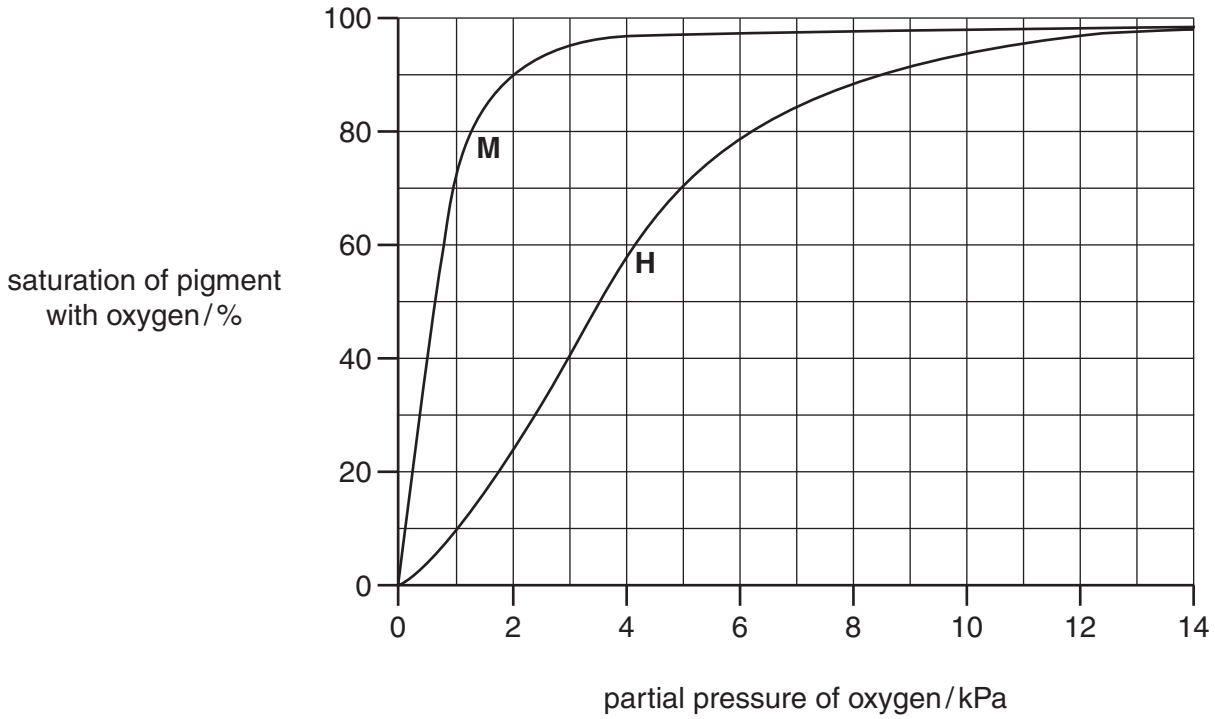

Fig. 5.2

(c) State the tissue where myoglobin is found.

.....[1]

(d) With reference to Fig. 5.2,

(i) state the percentage saturation of myoglobin and haemoglobin when the partial pressure of oxygen is 2 kPa;

myoglobin .....

haemoglobin .....[1]

(ii) explain the significance of the difference in percentage saturation that you have shown in **(i)**.

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.....[3]

(e) When a person exercises vigorously, the partial pressure of carbon dioxide in the blood increases.

Draw on Fig. 5.2 a dissociation curve for haemoglobin when the partial pressure of carbon dioxide has increased. [1]

[Total : 13]

4 **(a)** Fig. 4.1 shows a light micrograph of a section through a wheat grain.

The structure of a wheat grain is very similar to that of a maize fruit.

Fig. 4.1

On Fig. 4.1, use label lines and letters to label each of the following parts.

A endosperm

B fused testa and pericarp (fruit coat)

C embryo [3]

(b) Wheat grains are ground to make flour, which can be used for making bread.

Whole grain flour is made from the complete wheat grain.

Refined (white) flour is produced from wheat grains from which the embryo, aleurone layer and the fused testa and pericarp have been removed.

Table 4.1 shows the carbohydrate, protein and dietary fibre content of bread made from whole grain flour and white flour.

	bread made from whole grain flour	bread made from white flour
protein / g per 100 g	9.4	7.9
dietary fibre / g per 100 g	7.0	2.5
carbohydrate / g per 100 g	42	46

With reference to the structure of a wheat grain, explain the differences between the composition of the two types of bread shown in Table 4.1.

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.....[3]

(c) The glycaemic index, GI, of a carbohydrate-containing food is a measure of the effect of its consumption on blood glucose concentration. If two foods containing the same mass of carbohydrate, but different GIs, are consumed, the food with the higher GI will increase blood glucose concentration more rapidly than the food with the lower GI.

Suggest an explanation for each of the following.

(i) Foods containing starch have lower GIs than foods containing glucose.

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.....[1]

(ii) Foods containing starch made up mostly of amylose have lower GIs than foods containing starch made up mostly of amylopectin.

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.....[2]

(d) A diet containing large amounts of foods with a high GI can increase the risk of developing type II diabetes. A study was carried out into the effect of consuming whole cereal grains, refined cereal grains and fruit on the risk of developing type II diabetes.

- In 1986, questionnaires about diet were completed by 41 836 women, all between the ages of 55–69 years old, in Iowa, USA.
- The women were then divided into five groups according to their range of intake of each food type.
- In 1992 the same women were asked whether or not they had developed type II diabetes.
- Their answers were used to calculate the relative risk of developing type II diabetes for each of the five groups.

For each food type, the group with the lowest intake of that food type was allocated a risk of 1.00.

Table 4.2 shows the results of this study.

Table 4.2

food type	range of intake / servings per week	relative risk of developing type II diabetes
whole cereal grains	< 13.0	1.00
	13.0 – 18.5	0.89
	19.0 – 24.5	0.94
	25.0 – 33.0	0.81
	> 33.	0.68
refined cereal grains	< 6.0	1.00
	6.0 – 9.5	0.96
	10.0 – 13.5	1.00
	14.0 – 22.0	0.98
	> 22.	0.87
fruit	< 6.25	1.00
	6.5 – 10.0	1.05
	10.1– 13.5	1.00
	13.6 – 19.0	1.08
	> 19.	1.14

(i) Describe the effect of increased intake of whole cereal grains on the risk of developing type II diabetes.

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.....[3]

(ii) Explain why the results in Table 4.2 **cannot** be used to make a direct comparison of the effects of consuming whole cereal grains and refined cereal grains on the risk of developing type II diabetes.

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.....[2]

(iii) The results in Table 4.2 suggest that eating large quantities of fruit may slightly increase the risk of developing type II diabetes.

Suggest a reason for this.

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.....[2]

[Total: 16]

5 Fig. 3.1 shows a molecule of haemoglobin.

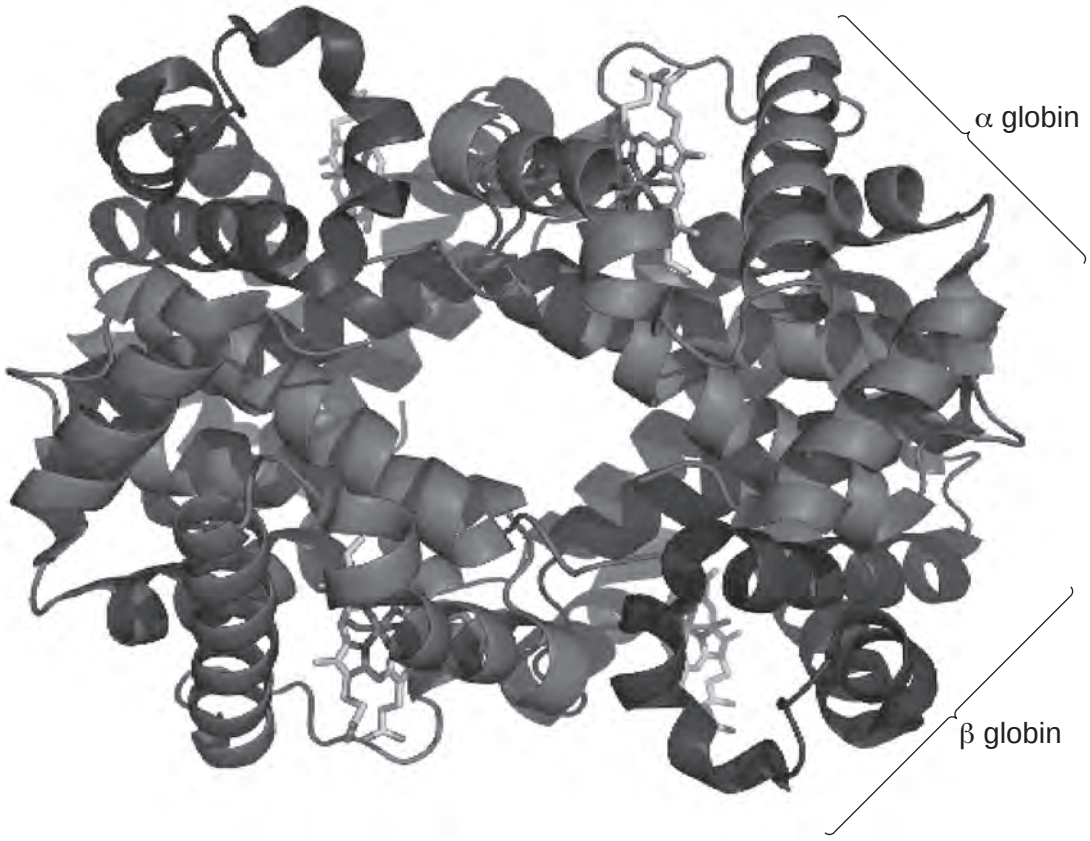

Fig. 3.1

(a) Explain how a molecule of haemoglobin shows the four levels of organisation of protein molecules.

primary structure .....

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secondary structure .....

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tertiary structure .....

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.....

quaternary structure .....

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..... [4]

There are many different variants of haemoglobin. The sequence of bases in DNA that code for the first seven amino acids in two variants of the β-globin polypeptide are shown in Fig. 3.2.

The genetic dictionary for some of the amino acids is in Table 3.1.

Variant 1

1	2	3	4	5	6	7
CAC	GTG	GAC	TGA	GGA	CTC	CTC

Variant 2

1	2	3	4	5	6	7
CAC	GTG	GAC	TGA	GGA	CAC	CTC

Fig. 3.2

Table 3.1

amino acid	**abbreviation**	**DNA triplets on the coding polynucleotide**
valine	val	CAA, CAC, CAG, CAT
proline	pro	GGA, GGC, GGG, GGT
threonine	thr	TGA, TGC, TGG, TGT
histidine	his	GTA, GTG
glutamic acid	glu	CTC, CTT
leucine	leu	AAC, AAT, GAA, GAC, GAG, GAT

(b) Use the genetic dictionary to describe the similarities and differences between the two variants of haemoglobin.

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..... [3]

(c) Collagen is a fibrous protein found in many tissues in animals.

(i) State the function of collagen in the walls of arteries.

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..... [1]

(ii) State **one** way in which the **structure** of collagen differs from the structure of haemoglobin.

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..... [1]

[Total: 9]