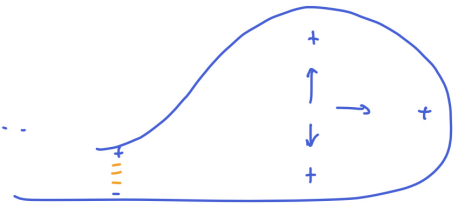
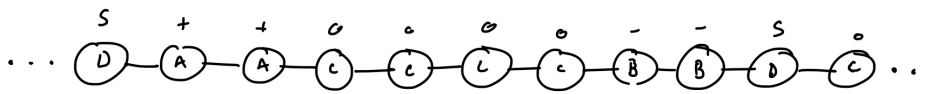
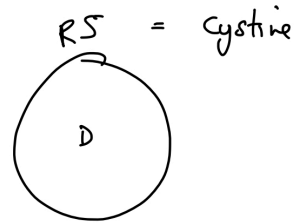
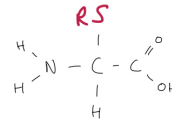
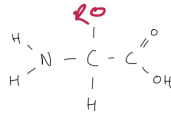
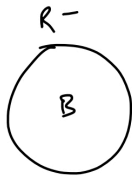
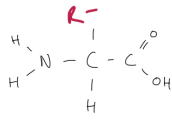
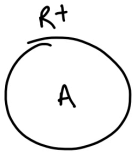
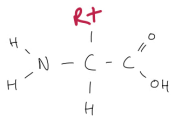




Protein Structure

Primary Structure			
Secondary Structure			
Tertiary Structure			
Quaternary Structure			

PROTEIN STRUCTURE





4 Proteins are important biological molecules.

(a) Protein structure can be represented at four levels: primary, secondary, tertiary and quaternary.

Below is a set of features that may be used when describing the structure of a protein such as haemoglobin.

Features	Letter
hydrogen bonds	A
peptide bonds	B
α and β subunits	C
the sequence of amino acids	D
the initial folding of the polypeptide chain	E
the overall 3D shape	F
ionic bonds	G

(i) Select the letters of the features that describe the primary level of protein structure.

..... [1]

(ii) Select the letter or letters of the feature(s) found in the secondary level of protein structure that are **not** present in the primary structure.

..... [1]

(iii) Select the letter or letters of the feature(s) that are found in the tertiary level of protein structure that are **not** present in the primary and secondary structures.

..... [1]

(iv) Select the letter or letters of the feature(s) found only in the quaternary level of protein structure.

..... [1]



25 Fig. 25.1 represents the tertiary structure of the enzyme lysozyme.

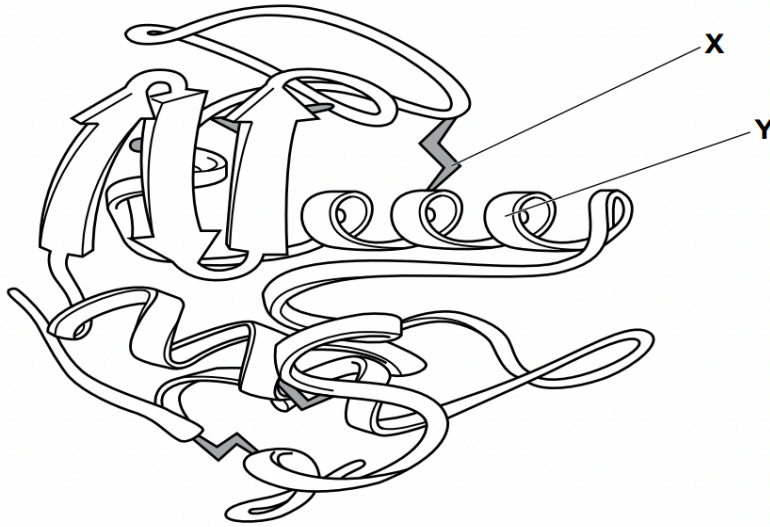


Fig. 25.1

(a) (i) Name the covalent chemical bond labelled **X** which links two cysteine amino acids.

[1]

(ii) Name the structure labelled **Y** which forms part of the secondary structure of lysozyme.

[1]

(iii) Lysozyme consists of a single polypeptide chain of 129 amino acids.

State which level of protein structure is **not** shown by lysozyme.

[1]

(b) The function of lysozyme is to break down the cell walls of bacteria.

(i) Name the molecule that is found in the cell walls of bacterial cells.

[1]

(ii) Lysozyme is also known as a glycoside hydrolase.

Suggest the type of chemical bond that lysozyme breaks and name the molecule other than the substrate that is needed for this reaction

Type of bond

Other molecule needed for this reaction

[2]



Question	Answer	Mark	Guidance
4 (a) (i)	primary B <u>and</u> D;	1	DO NOT CREDIT if another letter is shown
(ii)	secondary A <u>and</u> E;	1	DO NOT CREDIT if another letter is shown
(iii)	tertiary F <u>and</u> G;	1	DO NOT CREDIT if another letter is shown
(iv)	quaternary C;	1	DO NOT CREDIT if another letter is shown

25 Fig. 25.1 represents the tertiary structure of the enzyme lysozyme.

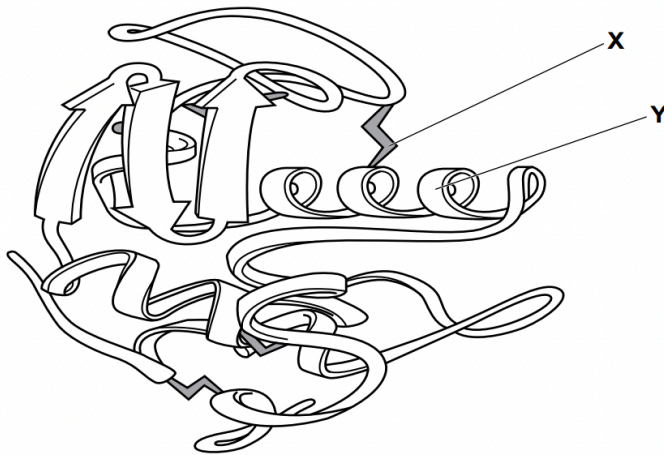


Fig. 25.1

(a) (i) Name the covalent chemical bond labelled X which links two cysteine amino acids.

disulfide ✓

[1]

(ii) Name the structure labelled Y which forms part of the secondary structure of lysozyme.

α-helix ✓ **DO NOT ALLOW** a-helix

[1]

(iii) Lysozyme consists of a single polypeptide chain of 129 amino acids.

State which level of protein structure is **not** shown by lysozyme.

quaternary ✓

[1]

; P1 19 Q25b

(b) The function of lysozyme is to break down the cell walls of bacteria.

(i) Name the molecule that is found in the cell walls of bacterial cells.

peptidoglycan / murein ✓

[1]

(ii) Lysozyme is also known as a glycoside hydrolase.

Suggest the type of chemical bond that lysozyme breaks and name the molecule other than the substrate that is needed for this reaction.

Type of bond glycosidic ✓

Other molecule needed for this reaction water ✓

[2]

IGNORE H₂O



Question		Expected Answer	Mark	Additional Guidance
7	(a)	<p>1 <u>sequence / chain</u>, of amino acids ;</p> <p>2 (amino acids) joined by peptide bonds ;</p> <p><i>secondary</i></p> <p>S1 alpha / α, helix ;</p> <p>S2 <u>small regions of</u>, beta / β, pleated sheet / fold ;</p> <p>S3 hydrogen / H, bonds ;</p> <p><i>tertiary</i></p> <p>T1 secondary structure / helix / polypeptide chain, undergoes further, coiling / folding ;</p> <p>T2 <i>3 bonds / interactions from:</i> disulfide / ionic / hydrogen / hydrophobic or hydrophilic ;</p> <p>T3 hydrophilic <u>R groups</u> on outside (of molecule) / hydrophobic <u>R groups</u> on inside (of molecule) ;</p> <p><i>quaternary</i></p> <p>Q1 <u>4</u>, polypeptides / subunits ;</p> <p>Q2 2, alpha / α, chains and 2, beta / β, chains ;</p> <p>Q3 1 haem (group) per polypeptide / 4 haems (per molecule) ;</p> <p>3 prosthetic group (is) haem, (which) contains Fe^{2+} ;</p>		<p>CREDIT marking points from a clearly labelled diagram</p> <p>1 IGNORE polypeptide</p> <p>S3 Must be in context of secondary structure</p> <p>T1 ACCEPT polypeptide chain folds further</p> <p>T2 IGNORE if clearly in context of secondary or quaternary structures</p> <p>T2 H bond must be in context of tertiary structure</p> <p>'contains 2 α and 2 β polypeptides' = 2 marks (Q1 and Q2)</p> <p>Q3 IGNORE protein in ref to 1 haem (group) per polypeptide</p> <p>3 ACCEPT iron ion / Fe^+ / Fe^{3+}</p> <p>3 DO NOT CREDIT iron / Fe unqualified</p>
		<p>QWC - correct refs to secondary, tertiary and quaternary structure ;</p>	6 max	1