Proteins and Enzymes (Topic 2): Edexcel SNAB A Level Biology Exam Questions by Topic

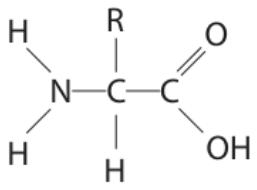
20 questions · 50 marks · about 60 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 1 · June 2019 · Q6(a)(i) · 1 mark

6 Proteins can be used as a source of energy. This involves the removal of the amine group.

(a) (i) Draw a circle around the amine group on the diagram of an amino acid.

(1)

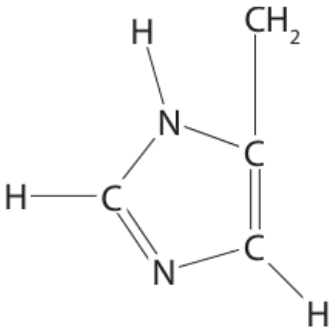


Question 2 · AS Paper 1 · June 2022 · Q3(b)(ii) · 3 marks

(ii) The diagram shows a complete R group.

Complete the diagram to show the position of this R group in an amino acid.

(3)



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Question 3 · A level Paper 1 · June 2019 · Q7(a) · 2 marks

7 Some species of bacteria have developed resistance to antibiotics.

This has led scientists to investigate many molecules for antimicrobial properties.

Peptides extracted from broad bean plants and cowpea plants have been studied.

(a) Describe how a peptide bond is formed.

(2)

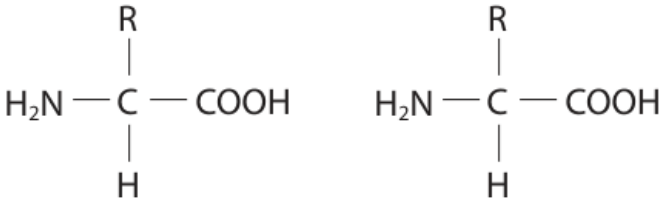
Question 4 · A level Paper 2 · June 2019 · Q7(a)(iii) · 2 marks

(iii) During protein synthesis, two amino acids are joined together to form a dipeptide.

The diagram shows two identical amino acids.

Complete the diagram to show how the dipeptide is formed from these two amino acids.

(2)

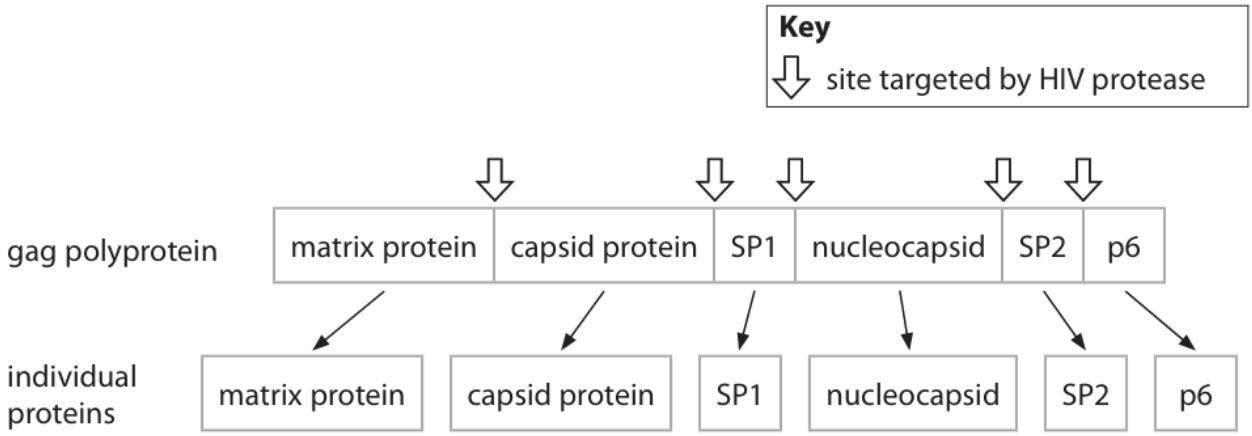


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(b) During viral replication, virus mRNA molecules are translated into a virus polyprotein called gag. A polyprotein is a chain of smaller proteins.

This polyprotein is then split into individual proteins by the HIV protease.

The diagram shows the individual proteins produced from the polyprotein by HIV protease.



Deduce how HIV protease can split the gag polyprotein into individual proteins.

(3)

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Question 6 · A level Paper 1 · June 2022 · Q4(b)(i) · 2 marks

(b) Malaria can be controlled by killing the mosquitoes that transmit the disease.

Scientists are genetically modifying *Metarhizium pingshaense*, a fungus that infects mosquitoes.

The genetically modified (GM) fungus contains a gene from a species of spider. This gene codes for a protein that kills mosquitoes.

(i) The GM fungus transcribes and translates the gene for this protein.

Describe the primary structure of a protein.

(2)

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Question 7 · AS Paper 1 · June 2016 · Q2(c) · 4 marks

(c) Haemophilia is a disease that affects blood clotting. People with haemophilia are sometimes given a protein called factor VIII. Factor VIII is an enzyme that is involved in the process of blood clotting.

Explain how a change in the primary structure of factor VIII could cause difficulties with blood clotting.

(4)

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Question 8 · AS Paper 1 · June 2019 · Q3(b)(iii) · 4 marks

(iii) Explain how a change of one amino acid could lead to a change in the structure and properties of the haemoglobin protein.

(4)

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Question 9 · A level Paper 1 · June 2024 · Q4(c) · 3 marks

(c) The most common mutation in the CFTR gene produces a protein that has the incorrect shape.

Explain why a change in the primary structure of a protein changes the three-dimensional (3D) structure of this protein.

(3)

Question 10 · A level Paper 1 · June 2018 · Q4(a)(iii) · 3 marks

(iii) Describe how the primary structure of leptin enables it to be soluble in water.

(3)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 11 · AS Paper 1 · June 2016 · Q5(a) · 4 marks

5 Muscle cells contain globular and fibrous proteins.

(a) Compare and contrast the molecular structures of globular and fibrous proteins.

(4)

Question 12 · A level Paper 1 · June 2025 · Q3(c)(ii) · 2 marks

(ii) Red blood cells contain haemoglobin, a globular protein.

Describe the structure of a **globular protein**.

(2)

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Question 13 · AS Paper 1 · June 2025 · Q6(a)(ii) · 2 marks

(ii) Describe the structure of collagen.

(2)

Question 14 · information from earlier in the question

(b) Collagen has low solubility in water.

Question 14 · AS Paper 1 · June 2025 · Q6(b)(ii) · 2 marks

(ii) Explain why collagen has a low solubility in water.

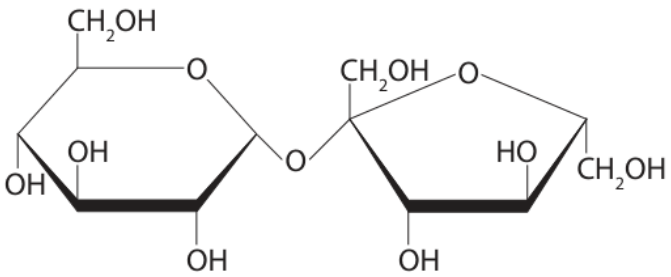
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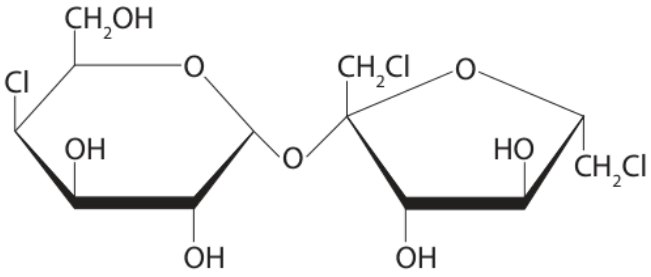
Question 15 · AS Paper 1 · June 2019 · Q2(c) · 2 marks

(c) Sucralose is a disaccharide that has been modified from sucrose.
The enzyme sucrase is used to break down sucrose into glucose and fructose.
Sucralose cannot be broken down by this enzyme.

The diagram shows the structures of sucrose and sucralose.



Sucrose



Sucralose

Explain why sucralose cannot be broken down by sucrase.

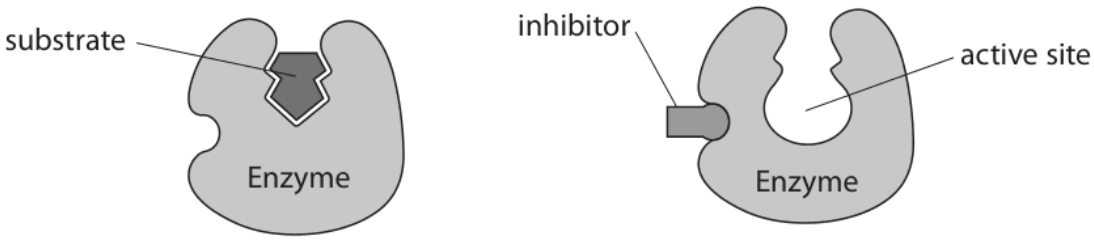
(2)

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Question 16 · AS Paper 1 · June 2022 · Q7(c) · 2 marks

(c) The rate of a reaction, controlled by an enzyme, can be affected by an enzyme inhibitor.

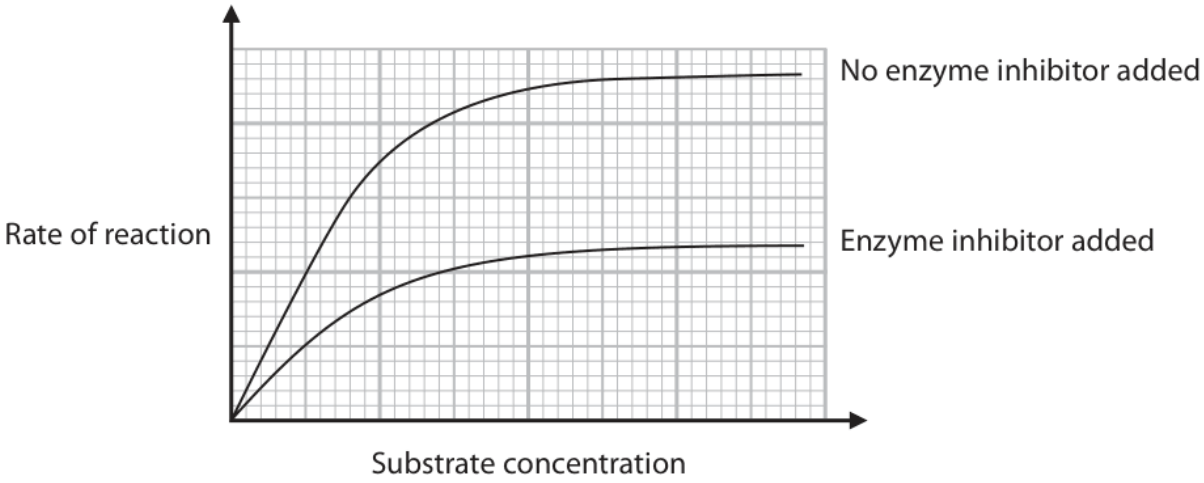
An enzyme inhibitor can change the shape of an enzyme as shown in the diagram.



The effect of this enzyme inhibitor on the rate of reaction was investigated.

The concentration of enzyme was controlled.

The graph shows the rate of reaction with and without the enzyme inhibitor.



Explain why the inhibitor has decreased the maximum rate of reaction.

(2)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 17 · A level Paper 1 · October 2020 · Q1(b)(ii) · 3 marks

(ii) Cells in people with these diseases produce incorrectly folded enzyme molecules.

Explain why enzymes that are incorrectly folded cannot carry out their function.

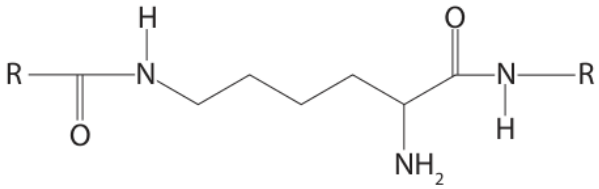
(3)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 18 · A level Paper 2 · June 2018 · Q9(b) · 3 marks

(b) The active site of the plasmin enzyme binds to the amino acid lysine on the fibrin protein molecule.

Plasmin binds to part of the fibrin molecule in order to break down the fibrin. The diagrams show the structure of lysine in the fibrin polypeptide and the structure of tranexamic acid.



Lysine in the fibrin polypeptide



tranexamic acid

Deduce why tranexamic acid prevents plasmin breaking down fibrin.

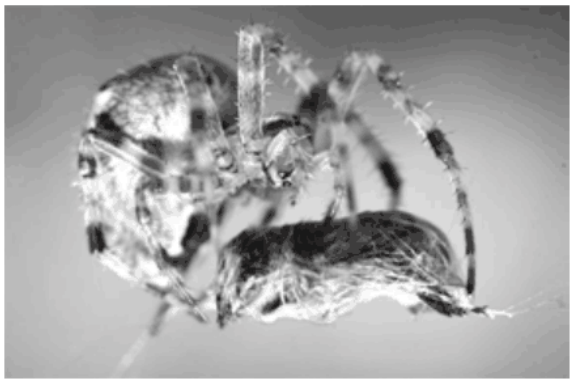
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Question 19 · AS Paper 1 · June 2017 · Q8(a) · 1 mark

8 Spiders inject a mixture of digestive enzymes into the body of their prey and feed on the products of this digestion.

The photograph shows a spider with its prey.



(a) State why enzymes are described as biological catalysts.

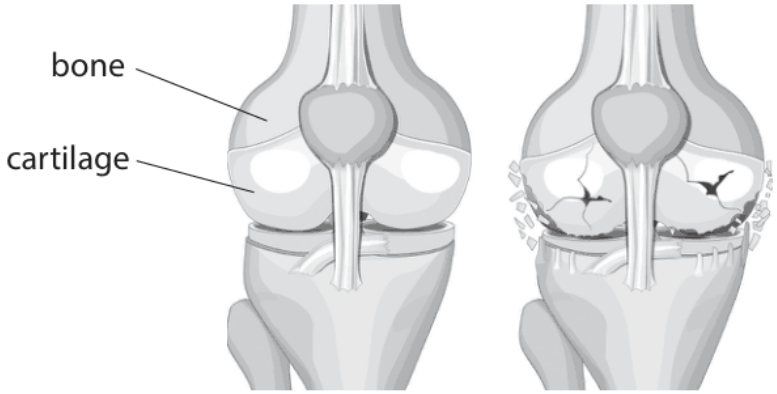
(1)

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Question 20 · AS Paper 1 · June 2025 · Q6(c) · 2 marks

(c) Collagen is a component of cartilage in joints.

The diagram shows damage inside a knee joint of a person with osteoarthritis.



(Source: © Tetiana Zhabska/Alamy Stock Vector)

The collagen is broken down by collagenase enzymes made by cells in the joint.

These enzymes can be intracellular or extracellular.

Give **one** similarity and **one** difference between the action of an **intracellular** enzyme and an **extracellular** enzyme.

(2)

Similarity

.....

.....

.....

Difference

.....

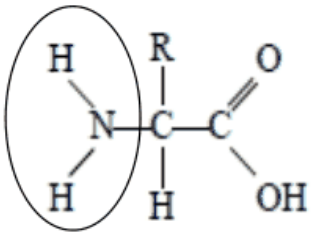
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Mark schemes

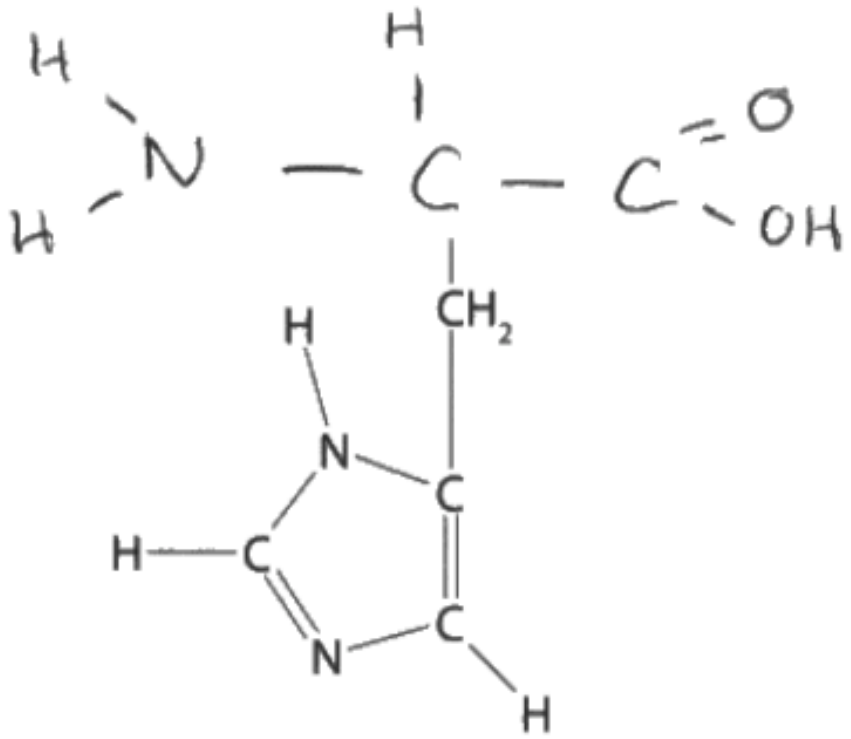
Question 1 · AS Paper 1 · June 2019 · Q6(a)(i) · 1 mark

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	• amine group correctly circled on diagram		(1)

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Question 2 · AS Paper 1 · June 2022 · Q3(b)(ii) · 3 marks

Question Number	Answer
3(b)(ii)	• central carbon attached to CH_2 of the R group provided and to a H atom (1) • carboxylic acid group correct and attached to central carbon (1) • amine group correct and attached to central carbon (1)

Additional Guidance	Mark
Example of diagram 	(3)

Question 3 · A level Paper 1 · June 2019 · Q7(a) · 2 marks

Question Number	Answer
7 (a)	A description that makes reference to the following: • (a peptide bond is formed by a) condensation reaction (1) • between the {amine group / NH_2} and the {carboxyl group / COOH} of adjacent amino acids (1)

Additional guidance	Mark
ALLOW 'amino' for 'amine' and 'carboxylic acid' for 'carboxyl'	**(2)**

Question 4 · A level Paper 2 · June 2019 · Q7(a)(iii) · 2 marks

Question Number	Answer	Additional Guidance	Mark
7(a)(iii)	An answer that makes reference to the following: • dipeptide correctly drawn with peptide bond (1) • water molecule released (1)		**(2)**

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Question 5 · A level Paper 3 · June 2024 · Q5(b) · 3 marks

Question number	Answer
5(b)	An answer that makes reference to three of the following: • hydrolysis (1) • of peptide bond(s) (1) • at parts of polyprotein recognised by the protease (1)

Additional guidance	Mark
IGNORE other bonds ALLOW complementary to the active site	Choose an item. (3)

Question 6 · A level Paper 1 · June 2022 · Q4(b)(i) · 2 marks

Question Number	Answer	Additional guidance	Mark
4(b)(i)	A description that makes reference to the following • sequence of amino acids (1) • joined together by peptide bonds (1)		(2)

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Question 7 · AS Paper 1 · June 2016 · Q2(c) · 4 marks

Question Number	Answer
2(c)	An explanation that makes reference to the following: • (different primary structure) results in a different sequence of amino acids (1) • change in R groups changes { folding / bonding / secondary structure / tertiary structure } (1) • changing { shape / charge } of the active site prevents substrate from being able to bind (1) • { stopping / reducing } the production of fibrin (1)

Additional Guidance	Mark
Do not accept peptide bonds ALLOW another specific aspect of blood clotting cascade	(4)

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Question 8 · AS Paper 1 · June 2019 · Q3(b)(iii) · 4 marks

Question Number	Answer
3(b)(iii)	An explanation that makes reference to the following: • different {sequence of amino acids / primary structure} (1) • (a different amino acid will have a) different R group (1) • (therefore) {secondary / tertiary / quaternary} structure will change (1) • (due to a) change in a named bond (holding molecule in its three-dimensional shape) (1) • (haemoglobin) may not bond to oxygen (1)

Additional Guidance	Mark
ALLOW different polypeptide chain i.e. hydrogen bonds, disulfide bridges, ionic bonds DO NOT ALLOW peptide bonds ALLOW may not bond to haem group ALLOW may not carry oxygen	**(4)**

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Question 9 · A level Paper 1 · June 2024 · Q4(c) · 3 marks

Question number	Answer
4(c)	An explanation that makes reference to three of the following • the amino acids (in the protein) are changed (1) • (therefore) there will be different R groups (1) • this will change bonds formed between { amino acids / R groups } (1) • (polypeptide) folds differently / different tertiary structure (of protein) (1)

Additional Guidance	Mark
ALLOW correctly named bonds such as ionic, disulfide, hydrogen	(3)

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Question 10 · A level Paper 1 · June 2018 · Q4(a)(iii) · 3 marks

Question Number	Answer
4(a)(iii)	A description that makes reference to three of the following: • {primary structure / sequence of the amino acids} determines the folding (of the polypeptide) (1) • forming a globular structure (1) • hydrophobic (R) groups located in the centre of the protein / hydrophilic (R) groups located on the outside of the protein (1) • water forms hydrogen bonds with { protein / hydrophilic groups} (1)

Additional Guidance	Mark
ALLOW position of R groups ALLOW determines tertiary structure ALLOW polar for hydrophilic / non-polar for hydrophobic ALLOW dipole-dipole / hydrophilic interactions (between water and the protein)	**(3)**

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Question 11 · AS Paper 1 · June 2016 · Q5(a) · 4 marks

Question Number	Answer
5(a)	An answer which makes reference to four of the following: • both are chains of amino acids joined by peptide bonds (1) • both contain named bonds (holding molecule in its three dimensional shape) (1) • globular proteins have hydrophilic groups on the outside whereas fibrous proteins have hydrophobic groups on the outside (1) • globular have tertiary or quaternary structures whereas fibrous have little or no tertiary structure (1) • globular are folded into compact shapes whereas fibrous have long chains (1)

Additional Guidance	Mark
i.e. hydrogen bonds, disulfide bridges, ionic bonds Allow converse ALLOW globular being spherical and fibrous being long strands	(4)

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Question 12 · A level Paper 1 · June 2025 · Q3(c)(ii) · 2 marks

Question Number	Answer
3(c)(ii)	A description that makes reference to two of the following: • {polypeptide / chain of amino acids} folded (1) • held together by {ionic / hydrogen / disulfide} bonds (1) • (bonds) between the R groups (1) • hydrophilic R groups arranged on the outside / hydrophobic R groups on the inside (1)

Additional guidance	Mark
IGNORE ref to tertiary and quaternary structure throughout ALLOW 3D shape / spherical for folded ALLOW primary structure for polypeptide IGNORE {peptide / polypeptide} bonds ALLOW polar / non-polar for hydrophilic / hydrophobic	(2)

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Question 13 · AS Paper 1 · June 2025 · Q6(a)(ii) · 2 marks

Question Number	Answer
6(a)(ii)	A description that makes reference to two of the following: • fibrous protein (1) • three polypeptide chains in a helix (1) • {polypeptide chains / helix} held together by hydrogen bonds (1) • every third amino acid is glycine (1)

Additional Guidance	Mark
ALLOW polypeptide chains form a triple helix ALLOW repeating triplets of amino acids (proline, glycine, hydroxyproline) in each chain	(2)

Question 14 · AS Paper 1 · June 2025 · Q6(b)(ii) · 2 marks

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	An explanation that makes reference to two of the following: • (collagen) is {a large molecule / non-polar} (1) • hydrogen bonds cannot form (between water and collagen) (1) • because it {contains non-polar amino acids / has hydrophobic R groups on the outside} (1)		(2)

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Question 15 · AS Paper 1 · June 2019 · Q2(c) · 2 marks

Question Number	Answer
2(c)	An explanation that makes reference to two of the following: • sucralose contains chlorine (1) • therefore the shape of the molecule has been changed (1) • sucralose is not complementary to active site of sucrase / enzyme-substrate complex does not form (1)

Additional Guidance	Mark
ALLOW Cl / chloride	(2)

Question 16 · AS Paper 1 · June 2022 · Q7(c) · 2 marks

Question Number	Answer	Additional Guidance	Mark
7 (c)	An explanation which makes reference to the following: • decreased due to fewer enzyme-substrate complexes being formed (per second) (1) • as (some) {sucrase / enzyme} active sites are no longer complementary to the {sucrose / substrate} (1)	ALLOW substrate no longer able to {fit into / bind to} active site	(2)

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Question 17 · A level Paper 1 · October 2020 · Q1(b)(ii) · 3 marks

Question Number	Answer
1(b)(ii)	An explanation that makes reference to the following • (if the protein is not folded correctly) the {tertiary structure / 3D shape} would be different (1) • therefore the active site of the enzyme would not { fit / bind with } the substrate / it would not be able to form an enzyme substrate complex (1) • therefore it would not be able to catalyse the reaction (1)

Additional guidance	Mark
ALLOW not complementary	**(3)**

Question 18 · A level Paper 2 · June 2018 · Q9(b) · 3 marks

Question Number	Answer
9(b)	An answer that makes reference to the following: • tranexamic acid has a (very) similar {structure / shape} to lysine (1) • tranexamic acid { binds to the active site on plasmin / acts as a competitive inhibitor } (1) • stopping plasmin binding to { fibrin / lysine } (1)

Additional Guidance	Mark
ALLOW preventing plasmin and fibrin forming enzyme –substrate complex	**(3)**

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Question 19 · AS Paper 1 · June 2017 · Q8(a) · 1 mark

Question Number	Answer
8 (a)	An answer that makes reference to the following: • (proteins which) reduce activation energy of biological reactions (1)

Additional Guidance	Mark
ALLOW increase rate of biological reactions ALLOW references to {in cells / in living organisms}	(1)

Question 20 · AS Paper 1 · June 2025 · Q6(c) · 2 marks

Question Number	Answer
6(c)	An answer that makes reference to the following: • (similarity) catalyse chemical reactions / form enzyme-substrate complexes / lower activation energy (1) • (difference) intracellular enzymes work inside cells whereas extracellular enzymes {work / are secreted} outside cells (1)

Additional Guidance	Mark
ALLOW both increase rate of reaction	(2)

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