Proteins: AQA A Level Biology Exam Questions by Topic

18 questions · 35 marks · about 46 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2025 · Q04.1 · 1 mark

0 4 . 1 Draw the **general** structure of an amino acid.

[1 mark]

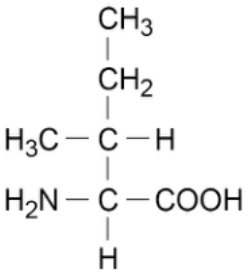
Question 2 · AS Paper 1 · June 2017 · Q05.2 · 1 mark

0 5 . 2 All amino acids have the same general structure. **Figure 4** shows the structure of the amino acid isoleucine.

Draw a box around the part of the molecule that would be the same in all amino acids.

[1 mark]

Figure 4

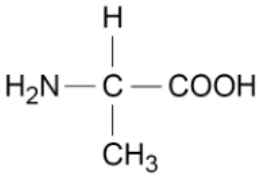


Isoleucine

Question 3 · AS Paper 1 · June 2025 · Q01.1 · 1 mark

0 1 . 1 **Figure 1** shows the structure of the amino acid alanine.

Figure 1



Name the NH_2 and COOH groups in the amino acid.

[1 mark]

NH_2 _____

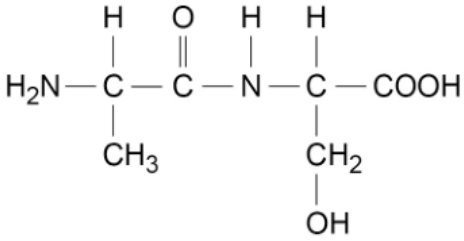
COOH _____

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Question 4 · AS Paper 1 · June 2025 · Q01.2 · 2 marks

Figure 2 shows the molecule formed from alanine and another amino acid.

Figure 2



0 1 . 2 Name the type of bond and the type of molecule formed when the two amino acids in **Figure 2** are joined.

[2 marks]

Type of bond _____

Type of molecule _____

Question 5 · AS Paper 1 · June 2025 · Q01.3 · 1 mark

0 1 . 3 **Table 1** shows the R groups of six different amino acids.

Table 1

Amino acid	R group
Alanine	CH_3
Aspartic acid	CH_2COOH
Glutamine	$(CH_2)_2CONH_2$

Amino acid	R group
Glycine	H
Serine	CH_2OH
Valine	$CH(CH_3)_2$

Use the information in **Table 1** to identify the amino acid joined to alanine in **Figure 2**.

[1 mark]

_____

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Question 6 · AS Paper 2 · June 2018 · Q02.1 · 2 marks

0 2 . 1 Describe how a peptide bond is formed between two amino acids to form a dipeptide.

[2 marks]

Question 7 · AS Paper 1 · June 2022 · Q05.1 · 3 marks

0 5 . 1 Describe how monomers join to form the primary structure of a protein.

[3 marks]

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Question 8 · AS Paper 2 · June 2018 · Q02.2 · 2 marks

0 2 . 2 The secondary structure of a polypeptide is produced by bonds between amino acids.

Describe how.

[2 marks]

Question 9 · AS Paper 2 · June 2018 · Q02.3 · 2 marks

0 2 . 3 Two proteins have the same number and type of amino acids but different tertiary structures.

Explain why.

[2 marks]

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Question 10 · A level Paper 1 · June 2022 · Q05.1 · 1 mark

0 5 Two enzymes, **P** and **Q**, are proteins with quaternary structure which catalyse the same reaction, but they have different amino acid sequences.

0 5 . 1 Define the **quaternary structure** of a protein.

[1 mark]

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Question 11 · A level Paper 1 · June 2023 · Q10.1 · 5 marks

1 0 . 1 Describe how a quaternary protein is formed from its monomers.

Do not include the process of translation in your answer.

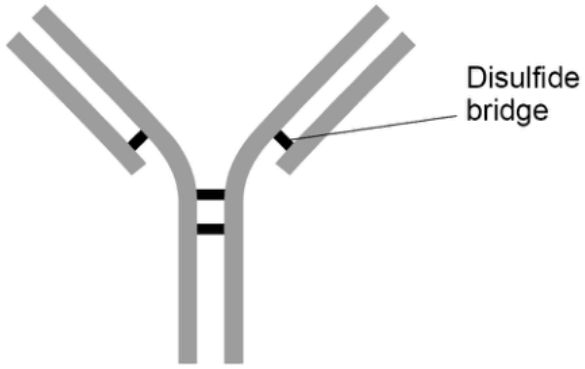
[5 marks]

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Question 12 · information from earlier in the question

0 3 . 3 **Figure 2** shows the structure of an antibody.

Figure 2



Label **Figure 2** with an **X** to show where an antigen-antibody complex forms.

[1 mark]

Question 12 · AS Paper 1 · November 2020 · Q03.4 · 1 mark

0 3 . 4 A disulfide bridge is labelled in **Figure 2**.

What is the role of the disulfide bridge in forming the quaternary structure of an antibody?

[1 mark]

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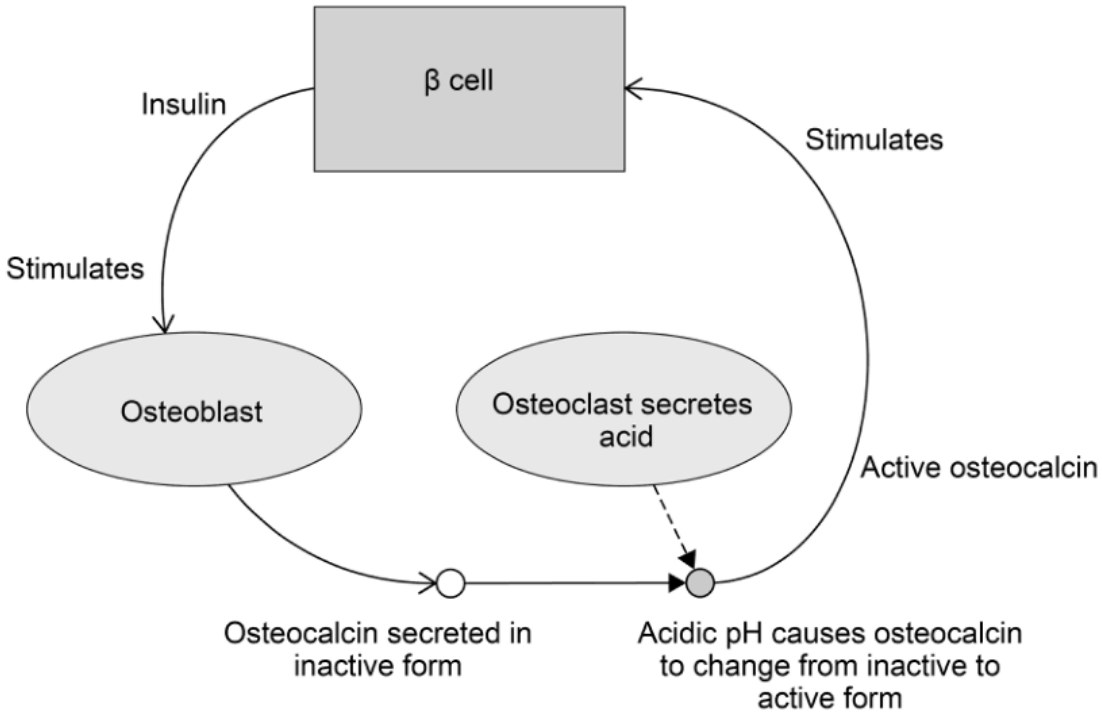
Question 13 · information from earlier in the question

0 1 Broken bones are repaired by cells called osteoclasts and osteoblasts.

Osteoblasts secrete a hormone called osteocalcin in an inactive form. Osteocalcin is a protein. The active form of osteocalcin binds to a receptor on beta (β) cells in the pancreas, stimulating them to release insulin. Osteoblasts have receptors for insulin.

Figure 1 shows how the production of osteocalcin by osteoblasts is controlled by positive feedback.

Figure 1



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Question 13 · A level Paper 3 · June 2018 · Q01.2 · 2 marks

0 1 . 2 The acidic pH conditions created by osteoclasts cause the inactive form of the protein osteocalcin to change into the active form of osteocalcin.

Suggest how.

[2 marks]

Question 14 · AS Paper 2 · June 2025 · Q01.3 · 3 marks

0 1 . 3 Many animals are adapted to their environments by having different types of haemoglobin with different tertiary structures.

Using your knowledge of the structure of proteins, explain how different types of haemoglobin can have different tertiary structures.

[3 marks]

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Question 15 · A level Paper 2 · November 2021 · Q05.1 · 2 marks

0 5 . 1 Neonatal diabetes is a disease that affects newly born children. The disease is caused by a change in the amino acid sequence of insulin.

This change prevents insulin binding to its receptor. Explain why this change prevents insulin binding to its receptor.

[2 marks]

Question 16 · AS Paper 2 · June 2025 · Q07.2 · 2 marks

0 7 . 2 *V. cholerae* produces a toxin that only binds to the cell-surface membrane of epithelial cells lining the ileum. The toxin is a protein.

Explain why the toxin can only bind to the cell-surface membrane of epithelial cells in the ileum.

[2 marks]

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Table 2 shows:

- mRNA codons and the amino acid coded for by each codon
- the type of bond formed by the R group of some of the amino acids.

Table 2

First base	Second base				Third base
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Key to the type of bond formed by the R group of each amino acid

Hydrogen bonds Ionic bonds Disulfide bridges

0 3 . 2 Crystallin is a structural protein found in the human eye. An inherited disease that leads to blindness is caused by changes in properties of crystallin. The replacement of the amino acid Arg with the amino acid Gly causes these changes.

Use information in **Table 2** to suggest why this amino acid replacement changes the properties of crystallin.

[2 marks]

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Question 18 · AS Paper 1 · June 2024 · Q02.2 · 2 marks

A student investigated starch digestion by mixing starch with a solution of the enzyme used to digest starch.

The student did a biochemical test for **protein** when starch digestion was completed.

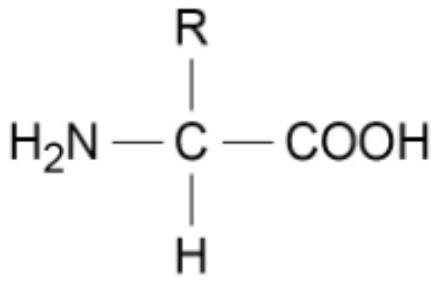
0 2 . 2 Describe a biochemical test to show the presence of protein.

[2 marks]

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Mark schemes

Question 1 · A level Paper 3 · June 2025 · Q04.1 · 1 mark

04.1		1 (1 x AO1)	Accept other correct representations

Question 2 · AS Paper 1 · June 2017 · Q05.2 · 1 mark

05.2	Draw around  ;	1

Question 3 · AS Paper 1 · June 2025 · Q01.1 · 1 mark

01.1	NH_2 = amine **and** COOH = carboxyl; Both required for 1 mark.	1 (1 x AO1)	Accept ‘amino’ Accept ‘carboxylic acid/group’

Question 4 · AS Paper 1 · June 2025 · Q01.2 · 2 marks

01.2	1. (Type of bond) peptide; 2. (Type of molecule) dipeptide;	2 (2 x AO1)	Answers must be on the correct lines

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Question 5 · AS Paper 1 · June 2025 · Q01.3 · 1 mark

01.3	Serine;	1 (1 x AO2)

Question 6 · AS Paper 2 · June 2018 · Q02.1 · 2 marks

02.1	1. Condensation (reaction) / loss of water; 2. Between amine / NH_2 and carboxyl / COOH;	2 Accept each marking point if shown clearly in diagram. 2. Accept between amino (group) and carboxylic / acid (group)

Question 7 · AS Paper 1 · June 2022 · Q05.1 · 3 marks

05.1	1. Condensation reaction between amino acids; 2. (Forming) peptide bonds; 3. Creating (specific) sequence/order of amino acids;	3 (3 x AO1)

1. Accept descriptions of condensation reaction: eg loss of water

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Question 8 · AS Paper 2 · June 2018 · Q02.2 · 2 marks

02.2	1. Hydrogen bonds; 2. Between NH (group of one amino acid) and C=O (group); **OR** Forming β pleated sheets / α helix;	2	Accept as a diagram 1. Reject N - - - C / ionic / disulfide bridge / peptide bond

Question 9 · AS Paper 2 · June 2018 · Q02.3 · 2 marks

02.3	1. Different sequence of amino acids **OR** Different primary structure; 2. Forms ionic / hydrogen / disulfide bonds in different places;

2	1. If candidate assumes proteins are the same, accept effect of different pH/ temperature

Question 10 · A level Paper 1 · June 2022 · Q05.1 · 1 mark

05.1	More than 1 polypeptide;	1 (AO1)	Ignore prosthetic group OR named interactions between chains, eg disulfide bridge

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Question 11 · A level Paper 1 · June 2023 · Q10.1 · 5 marks

10.1	1. Amino acids joined by peptide bond(s); 2. (By) condensation reaction(s); 3. Secondary structure is formed by hydrogen bonding; 4. Tertiary structure formed by interactions (between R groups); 5. Quaternary structure contains >1 <u>polypeptide</u> **OR** Quaternary structure formed by interactions/bonds between <u>polypeptides</u>;	5 (5 x AO1)

3. Accept alpha helix OR β-pleated sheet for 'secondary structure'
4. Accept 3° for tertiary
4. and 5. Accept for 'interactions', hydrogen bonds OR disulfide bridges OR ionic bonds OR hydrophobic OR hydrophilic interactions
5. Ignore peptide

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Question 12 · AS Paper 1 · November 2020 · Q03.4 · 1 mark

03.4	Joins two (different) <u>polypeptides</u>;	1	Accept holds/attaches Accept 'prevents polypeptide chains separating'

TOTAL		**7**	

Question 13 · A level Paper 3 · June 2018 · Q01.2 · 2 marks

01.2	1. (Change in pH) changes / breaks ionic / hydrogen bonds; 2. Changes tertiary structure;	2	1. Ignore ref. to peptide or sulfur-sulfur bonds 1. Accept polar bonds 2. Ignore changes to primary structure 2. Reject ref. to active site / enzyme 2. Accept forms binding site 2. Ignore 3D 2. Accept 3°

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Question 14 · AS Paper 2 · June 2025 · Q01.3 · 3 marks

01.3	1. (Polypeptides have) different sequences of amino acids/different primary structures; 2. (So different) secondary structure determined by (position of) hydrogen bonds; 3. Different hydrogen/ionic/disulfide bonds (in tertiary structure);

3 (3 x AO1)	1. Ignore different amino acids 2. Reject ionic/disulfide bonds 2 and 3. Reject peptide bonds

Question 15 · A level Paper 2 · November 2021 · Q05.1 · 2 marks

05.1	1. Changes <u>tertiary</u> structure; 2. No longer <u>complementary</u> (to receptor);	2	1. Reject change in tertiary structure of receptor. 2. Reject 'active site' or reference to enzyme or substrate.

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Question 16 · AS Paper 2 · June 2025 · Q07.2 · 2 marks

07.2	1. Has (specific) <u>tertiary</u> structure/shape; 2. Structures are <u>complementary;</u>	2 (2 x AO2)	1. Ignore 3D shape 1. Accept in context of receptor or toxin 2. Accept in correct context of receptor and/or toxin in relation to MP1. Reject only once reference to active site/enzyme/ substrate/induced fit/antibody

Question 17 · A level Paper 1 · November 2021 · Q03.2 · 2 marks

03.2	1. Hydrogen bonds form instead of ionic bonds; 2. Changes the tertiary structure (of the crystallin);	2	2. Ignore reference to active site

Question 18 · AS Paper 1 · June 2024 · Q02.2 · 2 marks

02.2	1. Add biuret (solution); 2. Purple (colour produced);	2 (2 x AO1)	1. Reject burette or Beirut 1. Reject heat 1. Accept a description of the biuret test: eg copper sulfate and sodium hydroxide or $CuSO_4$ + NaOH or alkaline copper sulfate 2. Accept lilac/violet/mauve for purple

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