



Biology
Standard and Higher level
B1.2 Proteins
Paper 1A

23 August 2026

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

1 hour [Paper 1A]

Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- All of the questions here are original and written by me.
- **None of the questions are from past papers.**
- The maximum mark for paper 1A is **[40 marks]**.

1. What distinguishes amino acids from each other?
 - A. The presence of the R group
 - B. The identity of the R group
 - C. The identity of the central carbon
 - D. The position of the amino group

2. What is **correct** about double bonds in amino acids?
 - I. The number of double bonds is always 1 due to the carboxyl
 - II. The number of double bonds depends on the side chain
 - III. All amino acids have at least one C=C double bond due to the carboxyl
 - A. I only
 - B. II only
 - C. II and III only
 - D. I and III only

3. How many water molecules are produced by the condensation of 8 amino acids?
 - A. 7
 - B. 8
 - C. 9
 - D. 4

4. How many amino groups are involved in peptide bonds during the condensation of 10 amino acids?
 - A. 10
 - B. 9
 - C. 5
 - D. 8

5. What is a consequence of condensation between two amino acids?

- A. The amino group loses a hydrogen and the carboxyl loses a hydroxyl from the same amino acid
- B. The amino group loses a hydroxyl and the carboxyl loses a hydrogen from the same amino acid
- C. The amino group in one amino acid loses a hydroxyl and the carboxyl in the next amino acid loses a hydrogen
- D. The amino group in one amino acid loses a hydrogen and the carboxyl in the next amino acid loses a hydroxyl

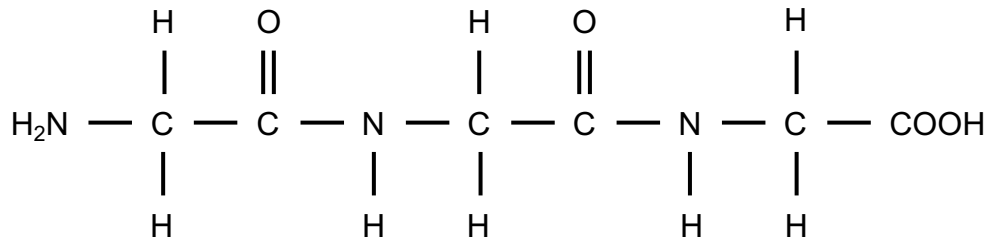
6. The amino acid sequence of a small peptide is shown.

Methionine – Valine – Proline – Tryptophan – Lysine

Which part of this peptide can form new peptide bonds?

- I. Methionine
 - II. Lysine
 - III. Tryptophan
- A. I only
 - B. II only
 - C. I and II only
 - D. I and III only

7. The structure of a tripeptide formed from the same amino acid is shown.

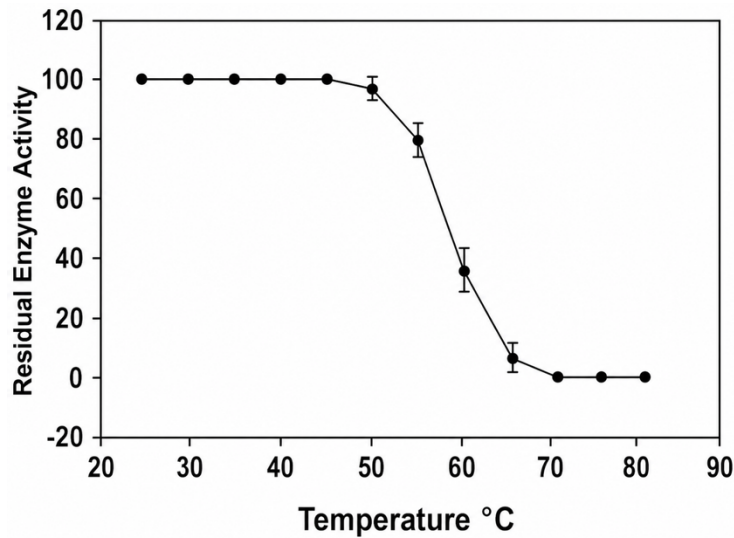


What is **correct**?

- A. The amino acid in the center lost H₂O
 - B. The amino acid at the N-terminal lost H
 - C. The amino acid at the C-terminal lost OH
 - D. All amino acids lost water to form two peptide bonds
8. What is **correct** about non-essential amino acids?
- A. Humans do not need them for survival
 - B. They can be synthesized from essential amino acids
 - C. They cannot be synthesized by human cells
 - D. Plants do not synthesize them
9. Why is total protein intake not a good measure of the nutritional value of a diet?
- A. Some protein sources are not absorbed by the human body
 - B. Some protein sources have more fat than others
 - C. Some protein sources lack essential amino acids
 - D. Some protein sources lack non-essential amino acids
10. What determines the amino acid sequence of a protein?
- A. The kinds of amino acids in the protein
 - B. The DNA sequence of a gene
 - C. The genetic code
 - D. The proteome

- 11.** How many different dipeptides can be formed by the genetic code?
- A. 40
 - B. 2^{20}
 - C. 20^2
 - D. 200
- 12.** What is protein denaturation?
- A. The process by which the amino acids coded by the genome are modified
 - B. The process by which proteins break down due to pH or temperature changes
 - C. The process by which the amino acid sequence of proteins is altered
 - D. The process by which the 3D structure of proteins is disrupted
- 13.** How does pH cause denaturation?
- A. Interactions within proteins are altered by hydrogen ions
 - B. The polarity of water surrounding proteins changes due to hydrogen ions
 - C. R groups of amino acids are chemically modified by hydrogen ions
 - D. The order of amino acids in the protein is disrupted by hydrogen ions
- 14.** How does an increase in temperature cause protein denaturation?
- A. Heat destabilizes peptide bonds between proteins
 - B. Heat destabilizes peptide bonds between amino acids
 - C. Heat destabilizes intermolecular forces between proteins
 - D. Heat destabilizes intermolecular forces between amino acids
- 15.** What is the difference between protein denaturation and hydrolysis?
- A. Only hydrolysis affects the linkages between amino and carboxyl groups
 - B. Only hydrolysis changes the order of amino acids in a protein
 - C. Only denaturation affects the linkages between amino and carboxyl groups
 - D. Only denaturation changes the order of amino acids in a protein

16. Scientists studied the effect of temperature on the enzymatic activity of galactosidase (a protein).



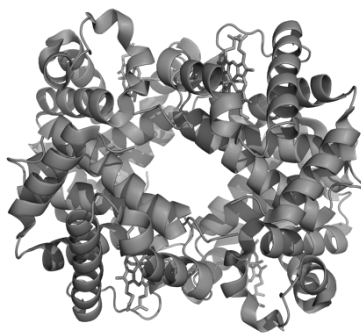
What is a valid conclusion?

- A. The protein loses its structure at lower temperatures
 - B. The protein functions at all temperature except between 50°C and 70°C
 - C. The protein loses its structure at temperatures above 50°C
 - D. The protein structure is not correlated with enzymatic activity
17. **[AHL]** How are positively charged amino acids formed?
- A. By addition of a hydrogen ion to the amino group bonded to the central carbon
 - B. By loss of a hydrogen ion from the carboxyl bonded to the central carbon
 - C. By addition of a hydrogen ion to the amino group within the side chain
 - D. By loss of a hydrogen ion from the carboxyl within the side chain
18. **[AHL]** Can R-groups form covalent bonds with each other?
- A. No because they only interact via intermolecular forces
 - B. No because covalent links only occur between amino acids in peptide bonds
 - C. Yes because they can form ionic bonds with covalent properties
 - D. Yes because they can form disulfide links between cysteines

19. **[AHL]** What is the order of amino acids joined by peptide bonds?
- A. The primary structure of a protein
 - B. The secondary structure of a protein
 - C. The tertiary structure of a protein
 - D. The quaternary structure of a protein
20. **[AHL]** A researcher discovers two polypeptides with the same number and type of amino acids. Which statement **correctly** describes their structures?
- A. They have identical 3D structures
 - B. They have the same physical and chemical properties
 - C. Their structures depend on the order of their amino acids
 - D. Their structures depend on where they are synthesized in the cell
21. **[AHL]** Which interactions form secondary protein structures?
- A. Hydrogen bonding between amino and carboxyl groups of side chains
 - B. Hydrogen bonding between amino and carboxyl groups of central carbons
 - C. Hydrogen bonding between charged amino and carboxyl groups in side chains
 - D. Hydrogen bonding between amino and carboxyl groups of polar amino acids
22. **[AHL]** What is the difference between alpha helices and beta pleated sheets?
- A. Alpha helices occur between every fourth R-group
 - B. Alpha helices occur between every fourth strand of a polypeptide
 - C. Beta pleated sheets occur within side chains containing acidic or basic groups
 - D. Beta pleated sheets occur between different strands of a polypeptide
23. **[AHL]** Which interaction between R-groups is covalent?
- A. Interactions between charged R-groups
 - B. Interactions between polar R-groups
 - C. Interactions between hydrophobic R-groups
 - D. Interactions between sulfur-containing R-groups

24. **[AHL]** A researcher wants to mutate a protein by replacing a hydrophobic amino acid in a protein with a different amino acid. Which mutation would lead to the greatest change in the structure and function of the protein?
- A. Replacing the amino acid with a larger hydrophobic amino acid
 - B. Replacing the amino acid with a smaller hydrophobic amino acid
 - C. Replacing the amino acid with a charged amino acid
 - D. Replacing the amino acid with a polar amino acid
25. **[AHL]** How do hydrophobic R-groups orient themselves in the cytosol?
- A. Towards hydrophilic amino acids
 - B. Towards other hydrophobic R-groups
 - C. Towards water molecules
 - D. Towards other amino acids
26. **[AHL]** The 2024 Nobel prize was awarded to an AI software that can predict the 3D structure of proteins. What level of protein structure enables the development of this kind of predictive technology?
- A. Primary structure
 - B. Secondary structure
 - C. Tertiary structure
 - D. Quaternary structure
27. **[AHL]** Which statement **correctly** describes how the polarity of amino acids affects the tertiary structure of proteins?
- A. R-group polarity affects where peptide bonds are formed and leads to amino acid sequences with unique tertiary structures
 - B. The polarity of proteins has consequences for tertiary folding because the order of amino acids determines spatial geometry
 - C. R-group polarity influences how amino acids interact with the environment and leads to spatial rearrangements that affect the 3D structure of proteins
 - D. The polarity of amino acids affects how the protein interacts with its aqueous or hydrophobic environment

28. [AHL] What is the difference between tertiary and quaternary protein structure?
- A. Tertiary folding describes the spatial arrangement of one polypeptide
 - B. Tertiary folding describes the bonding of multiple chains by R-groups
 - C. Quaternary folding describes how multiple protein subunits are synthesized
 - D. Quaternary folding describes the structure of proteins with prosthetic groups
29. [AHL] The structure of hemoglobin is shown.



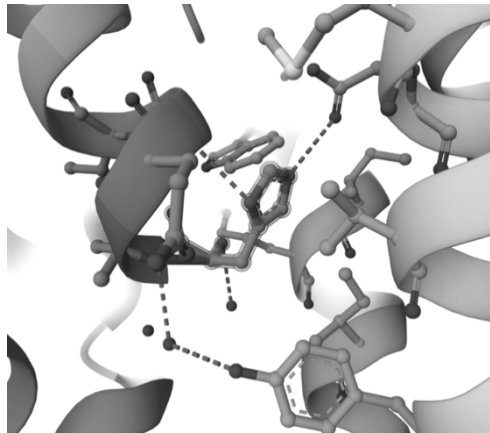
What kind of folding can be observed in hemoglobin?

- A. Beta pleated sheets
 - B. Prosthetic folding
 - C. Alpha helices
 - D. Pleated helices
30. [AHL] What is **correct** about conjugated proteins?
- A. All conjugated proteins have prosthetic groups and single polypeptide chains
 - B. All conjugated proteins have prosthetic groups and multiple polypeptide chains
 - C. All conjugated proteins have quaternary structures
 - D. All conjugated proteins have prosthetic groups

31. **[AHL]** Which statement **correctly** describes the structure of collagen?
- A. Three non-conjugated polypeptide chains forming a fibrous triple helix
 - B. Three non-conjugated polypeptide chains forming a globular triple helix
 - C. Three conjugated polypeptide chains forming a fibrous triple helix
 - D. Three conjugated polypeptide chains forming a globular triple helix
32. **[AHL]** Which statement **correctly** describes how insulin is synthesized?
- A. Two polypeptide chains from different genes are linked by disulfide bridges
 - B. A polypeptide from different genes is split and its strands are linked by disulfide bridges
 - C. Two polypeptide chains from the same gene are linked by disulfide bridges
 - D. A polypeptide from the same gene is split and its strands are linked by disulfide bridges
33. **[AHL]** Why are proteins classified as globular or fibrous?
- A. Globular proteins are water soluble whereas fibrous proteins are not
 - B. Differences in the patterns of amino acid sequences and their regularity
 - C. Patterns of protein folding at different levels produce proteins with two major shapes and properties
 - D. Fibrous and globular proteins share common patterns in solubility and function
34. **[AHL]** What is the difference between globular and fibrous proteins?
- A. Globular proteins have more structural roles than fibrous proteins
 - B. Fibrous proteins have more structural roles than globular proteins
 - C. Globular proteins undergo less solvation in water than fibrous proteins
 - D. Fibrous proteins have more irregular shapes than globular proteins

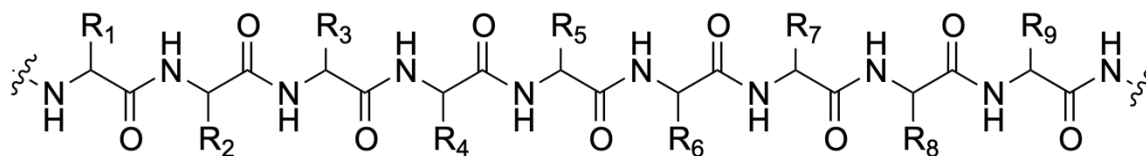
35. **[AHL]** What is **not** a function of globular proteins?
- A. Increasing the rate of metabolic reactions
 - B. Transporting solutes and ions
 - C. Endocrine signalling
 - D. Supporting the structure of tissue
36. **[AHL]** Which amino acid(s) would most likely exist in the inner lining of membrane transport proteins?
- I. Polar amino acids
 - II. Hydrophilic amino acids
 - III. Charged amino acids
- A. I only
 - B. II only
 - C. I and II only
 - D. I and III only
37. **[AHL]** How has cryogenic microscopy enabled scientists to study proteins?
- A. It enables the high resolution study of protein structure only
 - B. It enables the high resolution study of protein interactions only
 - C. It enables the high resolution study of protein structure and interactions
 - D. It enables the high resolution study of protein intermolecular forces

38. **[AHL]** The image shows interactions between individual amino acids in semaglutide (Ozempic). What kind of interaction is shown?



- A. Disulfide linking
 - B. Ionic bonding
 - C. Hydrophobic interactions
 - D. Hydrogen bonding
39. **[AHL]** What is the consequence of a mutation that replaces cysteine in insulin with another amino acid?
- A. Insulin is released less frequently from the pancreas
 - B. The body becomes more resistant to insulin
 - C. Insulin function is reduced
 - D. The body compensates by increasing insulin release

40. [AHL] The structure of a polypeptide chain is shown. What **correctly** describes the intermolecular attractions of the amino acid with side chain R5?



- A. The N–H will form a hydrogen bond with N–H of R9 and the C=O will form a hydrogen bond with C=O of R1
 - B. The N–H will form a hydrogen bond with C=O of R1 and the C=O will form a hydrogen bond with N–H of R9
 - C. The N–H will form a hydrogen bond with the C=O of R4
 - D. The N–H will form a hydrogen bond with the C=O of R6
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References:

16. **Graph:** Kishore D, Kundu S, Kayastha AM. Thermal, chemical and pH induced denaturation of a multimeric β - galactosidase reveals multiple unfolding pathways. PLoS One. 2012;7(11):e50380. doi:10.1371/journal.pone.0050380
40. **Image:** https://www.bu.edu/aldolase/biochemistry/html_docs/Exam2A2__2014.pdf

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