InkBiology

ANSWER BOOK

Proteins: from one amino acid to a working shape

Biological molecules, water and inorganic ions · Unit B02

AQA 3.1.4.1, 3.1.4.2 · OCR A 2.1.2 (e)-(h) · Edexcel A Topic 1.9-1.11 · CAIE 2.3.1-2.3.6

7 questions · 21 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **B1** an amine group, a carboxyl group and a hydrogen atom, all attached to the same central carbon. **B1** they differ only in the R group, also accepted as the side chain. [2]

A2 **A1** a peptide bond, formed between the amine group of one amino acid and the carboxyl group of the next. **A1** water is the molecule released, the reaction being a condensation. [2]

SECTION B · Standard, 3 to 5 marks

B1 **B1** primary structure is the sequence of amino acids in the polypeptide, held by peptide bonds. **B1** secondary structure is the regular coiling into an α-helix or pleating into a β-pleated sheet, held by hydrogen bonds between groups in the backbone. **B1** tertiary structure is the overall three-dimensional fold of one polypeptide, held by hydrogen bonds, ionic bonds, disulfide bridges and hydrophobic interactions between side chains. **B1** quaternary structure is the arrangement of two or more polypeptides, together with any prosthetic groups, in the finished protein. [4]

B2 **B1** haemoglobin is globular and compact, whereas collagen is fibrous and forms long strands. **B1** haemoglobin has an irregular amino acid sequence, whereas collagen has a repetitive one in which about every third amino acid is glycine. **B1** haemoglobin carries hydrophilic side chains on the outside so it is soluble and can be transported in solution, whereas collagen is insoluble, which suits it to a structural role. **B1** haemoglobin is four polypeptides each holding one haem prosthetic group that binds one oxygen molecule, whereas collagen is three chains wound round each other and cross-linked, giving strength in tension. [4]

B3 **M1** number of water molecules released = 3582 divided by 18. **M1** = 199 molecules of water, which is also the number of peptide bonds formed. **A1** 200 amino acids, because n amino acids give n - 1 peptide bonds. [3]

B4 **B1** the heat breaks the hydrogen bonds and ionic bonds holding the tertiary structure together. **B1** the chain unfolds, so the specific three-dimensional shape is lost and with it the function, which is denaturation. **B1** peptide bonds are covalent and survive, so the primary structure is unchanged. [3]

B5 **B1** two cysteine side chains anywhere in the chain can bond to each other, forming a disulfide bridge. **B1** a disulfide bridge is covalent and therefore much stronger than the hydrogen and ionic bonds that also hold the tertiary structure. **B1** heat that breaks those weaker bonds does not break the disulfide bridges, so the fold is held at a temperature that would denature the human protein. [3]