



bio letters

B1.2 Topical Questions Markscheme

Biology

Standard and Higher level

Paper 2

Question			Answers	Total
1.	a		<u>central carbon</u> atom of an amino acid bonded to <u>four</u> atoms or groups	1
1.	b		a. <u>alpha carbon</u> is bonded to an <u>amino group</u> and a <u>carboxyl group</u> b. amino group is basic and carboxyl group is acidic c. alpha carbon is bonded to a <u>hydrogen atom</u> and a <u>variable R group</u>	2
1.	c		a. amino acids can be covalently linked via <u>condensation</u> reactions b. condensation involves the formation of a covalent bond through the <u>loss of 1 water molecule</u> c. the covalent bond linking amino acids is a <u>peptide bond</u> between amino and carboxyl groups	2

Question			Answers	Total
2.	a		essential amino acids cannot be synthesized by the organism and must be obtained from food whereas non-essential amino acids can be synthesized by the organism	1
2.	b		a. foods differ in the types and amounts of amino acids that they contain b. most plant-based food has less essential amino acids than meat food c. vegan diets thus require careful selection of foods to obtain all essential amino acids and avoid deficiencies	2

Question			Answers	Total
3.	a		set of all polypeptides produced by a cell / <i>OWTTE</i>	1
3.	b		a. twenty different amino acids are coded for in the genetic code and can occur in any order b. for a polypeptide with n amino acids there are 20^n possible sequences	2
3.	c		a. information encoded in genes determines the amino acid sequences of polypeptides b. expression of information in the genome therefore determines which polypeptides form the proteome of a cell	2

Question			Answers	Total
4.	a		denaturation	1
4.	b		a. higher temperatures can disrupt the intermolecular forces that stabilize protein folding b. loss of these interactions changes the three-dimensional conformation of the protein and can cause denaturation	2
4.	c		a. cellular proteins may change conformation or become denatured if pH moves away from their optimum range b. changes in hydrogen ion concentration disrupt interactions involving R groups that stabilize protein folding	2

Question			Answers	Total
5.	a		a. <u>R groups</u> of amino acids have diverse chemical properties including hydrophobic, hydrophilic, polar, charged, acidic and basic properties b. differences in the <u>number, type and sequence of amino acids</u> produce immense variation in polypeptide structure and therefore protein form and function	2
5.	b		a. primary structure determines the identity and position of amino acids within the polypeptide b. interactions determined by this sequence cause the polypeptide to fold into a specific three-dimensional conformation	2
5.	c		a. non-polar hydrophobic R groups tend to cluster in the interior of water-soluble globular proteins away from the aqueous environment b. polar or charged hydrophilic R groups tend to face outward where they can interact with the aqueous environment	2

Question			Answers	Total
6.	a		conjugated proteins contain a non-amino-acid component whereas non-conjugated proteins consist only of polypeptide chains	1
6.	b		a. collagen is a fibrous protein that consists of three helical polypeptide chains combined into a triple helix b. insulin is a globular protein that consists of two polypeptide chains linked by disulfide bridges	2
6.	c		a. haemoglobin consists of two alpha and two beta polypeptide chains arranged as a tetramer b. haemoglobin contains iron-containing <u>heme groups</u> as prosthetic groups	2

Question			Answers	Total
7.	a		a. hydrogen bonds form between polar N–H and C=O groups of the polypeptide backbone b. hydrogen bonding between groups at regular positions within the same chain stabilizes alpha helices c. hydrogen bonding between different strands of the same polypeptide stabilizes beta-pleated sheets d. since the secondary structure does not involve R-group interactions, it forms spontaneously in most proteins	4
7.	b		a. tertiary structure is the three-dimensional folding of a polypeptide b. hydrogen bonds form between polar R groups containing O–H or N–H groups and help stabilize protein folding c. ionic bonds form through electrostatic attraction between oppositely charged R groups d. hydrophobic interactions occur between non-polar R groups which tend to cluster together away from water and contribute to protein stability e. disulfide covalent bonds form between sulfur atoms in the R groups of pairs of cysteine residues and provide strong stabilization	4
7.	c		a. increased temperature increases vibration, which can overcome weak intermolecular attractions that stabilize protein folding b. increased temperature can disrupt hydrogen bonds between N–H and C=O groups of the polypeptide backbone, altering alpha helices and beta-pleated sheets in the secondary structure c. increased temperature can also disrupt hydrogen bonds, ionic attractions and hydrophobic interactions between R groups, altering tertiary structure d. increased temperature can disrupt quaternary structure by weakening intermolecular attractions between polypeptide chains e. changes in pH change the concentration of hydrogen ions and therefore the protonation of acidic and basic R groups f. gain or loss of hydrogen ions can change the electrical charges of R groups, preventing attraction between previously oppositely charged R groups and disrupting ionic bonds g. changes in pH can alter the intermolecular attractions between polypeptide chains and disrupt quaternary structure	7

Question			Answers	Total
8.	a		a. cryo-EM allows frozen protein specimens to be examined at very low temperatures using electron microscopy b. low temperatures reduce damage to protein specimens caused by electron radiation c. this allows individual protein molecules and their interactions with other molecules to be visualized at high resolution	3
8.	b		a. mutations can alter the nucleotide sequence coding for one of the antibody polypeptide chains b. this can change the identity or position of an amino acid and therefore alter the primary structure of the subunit c. different R groups can produce different interactions and therefore change folding of the polypeptide d. the resulting change in three-dimensional structure can alter the shape or chemical properties of the antibody binding region e. reduced <u>complementary binding</u> between the antibody and its antigen can reduce recognition or neutralization of the pathogen and weaken the immune response	5
8.	c		a. each amino acid contains an amino group and a carboxyl group attached to its alpha carbon b. amino and carboxyl groups participate in condensation reactions that join amino acids c. condensation forms peptide bonds and allows amino acids to assemble into polypeptide chains d. amino and carboxyl groups can also occur within amino acid R groups e. amine-containing R groups can bind hydrogen ions and become positively charged f. carboxyl-containing R groups can dissociate hydrogen ions and become negatively charged g. charged R groups can form ionic interactions that contribute to tertiary protein folding and make protein structure sensitive to changes in pH	7