



bio letters

B1.1 Topical Questions Markscheme

Biology

Standard and Higher level

Paper 2

Question			Answers	Total
1.	a		4 single bonds	1
1.	b		a. carbon has <u>four valence electrons</u> and can therefore form up to <u>four covalent bonds</u> b. carbon can form single bonds or combinations of single and double bonds c. carbon can bond with itself and other non-metallic elements, allowing branched/unbranched chains and single/multiple rings to form	3

Question			Answers	Total
2.	a		molecules with the same chemical formula but different arrangements of atoms in space	1
2.	b		Award [1] for any two: a. solubility: glucose is polar/hydrophilic and can form hydrogen bonds with water (due to the presence of OH groups), so it can dissolve in aqueous solutions. b. transportability: due to its solubility and chemical stability, it is easy to transport in aqueous media like the cytosol or blood. c. chemical stability: the hydrocarbon ring of glucose provides the chemical stability needed to store energy and build up polysaccharides. d. energy yield: oxidation of glucose releases a lot of energy that can be used to make ATP	2
2.	c		a. α-glucose has the hydroxyl group on carbon 1 pointing down whereas β-glucose has it pointing up b. this creates different arrangements of bonding to form different polymers c. 1-4 linkages of α-glucose lead to amylose whereas 1-4 linkages of β-glucose lead to cellulose	2

Question			Answers	Total
3.	a		a. polymers are formed by condensation reactions that link monomers and release water b. polymers are broken by hydrolysis reactions that use water to break the links between monomers	2
3.	b		Award [1] each for any valid <u>paired</u> differences: a. cellulose contains β -glucose whereas starch contains α -glucose b. cellulose forms straight linear chains whereas amylose in starch forms helices c. cellulose chains are unbranched whereas amylopectin in starch is branched d. successive β -glucose monomers in cellulose are rotated 180° whereas this alternating orientation is not present in starch	3
3.	c		a. starch is relatively insoluble because of its large molecular size and therefore has little effect on osmolarity b. coiling and branching make starch compact, allowing large amounts to be stored c. α -glucose monomers can be readily added or removed by condensation and hydrolysis, allowing energy stores to be built or mobilized	2

Question			Answers	Total
4.	a		glycoproteins consist of carbohydrate and protein whereas lipoproteins consist of lipid and protein	1
4.	b		a. glycoproteins/antigens on red blood cell surfaces differ between ABO blood groups b. ABO glycoproteins help to distinguish foreign cells from self-cells c. an incompatible glycoprotein/antigen can be recognized by the recipient as foreign d. this causes an immune response, which may be severe or fatal, so compatible blood must be used	3
4.	c		from an evolutionarily perspective, higher intraspecies variation increases the adaptive potential of populations	1

Question			Answers	Total
5.	a		a. lipids include fats, oils, waxes and steroids b. lipids contain abundant hydrocarbon chains or rings with non-polar C–H bonds, which makes them hydrophobic c. lipids are insoluble or only sparingly soluble in polar solvents such as water	3
5.	b		the large non-polar hydrocarbon chain outweighs the effect of the polar carboxyl group	1
5.	c		a. the phospholipid bilayer has a hydrophobic core b. non-polar steroid hormones can pass directly through the hydrophobic region of the phospholipid bilayer	2

Question			Answers	Total
6.	a		a fatty acid containing two or more carbon–carbon double bonds	1
6.	b		a. triglycerides provide long-term energy storage b. triglycerides stored in adipose tissue provide thermal insulation	2
6.	c		a. saturated fatty acids have no C=C bonds and therefore form relatively straight chains that have higher melting points b. cis C=C bonds introduce kinks/bends into fatty acid chains and lower their melting points by decreasing intermolecular forces c. trans C=C bonds do not produce the same kink, so trans fatty acids have higher melting points than comparable cis fatty acids	3

Question			Answers	Total
7.	a		a. glycogen is a <u>polysaccharide</u> composed of <u>α-glucose monomers</u> b. α-glucose monomers are joined by <u>1–4 glycosidic linkages</u> c. glycogen is highly branched due to frequent <u>1–6 glycosidic linkages</u>	3
7.	b		a. glycogen can be hydrolyzed to release glucose AND b. glucose can then be oxidized to release energy/produce ATP	1
7.	c		triglycerides	1

Question			Answers	Total
8.	a		a. α-glucose and β-glucose contain the same numbers and types of atoms and therefore have the same chemical formula b. they differ in the spatial arrangement of the hydroxyl group on carbon 1, which points down in α-glucose and up in β-glucose c. this difference in arrangement produces different polymer structures and therefore different physical and biological properties	3
8.	b		a. one glycerol molecule and three fatty acid molecules are involved in triglyceride formation b. the <u>hydroxyl</u> groups of glycerol react with the <u>carboxyl</u> groups of the fatty acids c. a new <u>covalent ester bond</u> forms between glycerol and each fatty acid d. <u>three</u> ester bonds are formed in one triglyceride molecule e. <u>three water molecules are released</u> as a result of the three condensation reactions	5
8.	c		a. carbon can form four covalent bonds, allowing many different molecular structures to form b. carbon atoms can form chains, branches and rings that give biomolecules different overall structures c. hydroxyl groups make carbohydrates such as glucose polar and capable of hydrogen bonding with water d. the abundance of hydroxyl groups therefore makes many small carbohydrates water-soluble and transportable e. long hydrocarbon regions containing non-polar C–H bonds make lipids largely hydrophobic f. the addition of a phosphate group to a phospholipid creates a hydrophilic region alongside hydrophobic fatty-acid regions g. this combination of hydrophilic and hydrophobic regions makes phospholipids amphipathic and allows bilayer formation h. carbon–carbon double bonds can alter fatty-acid shape and therefore melting point i. different combinations and arrangements of atoms therefore produce different chemical properties and biological functions	7

Question			Answers	Total
9.	a		a. glycoproteins are proteins with carbohydrate associated with them b. glycoproteins on cell surfaces act as markers that allow cells to recognize other cells c. they allow organisms to distinguish self-cells from foreign cells, for example ABO antigens on red blood cells	3
9.	b		a. glucose contains several hydroxyl groups that make the molecule polar/hydrophilic b. glucose can form hydrogen bonds with water and is therefore soluble in aqueous solutions c. its solubility allows it to be transported readily in blood/cytosol d. its hydrocarbon ring gives sufficient chemical stability for glucose to function as an energy store/building block for polysaccharides e. oxidation of glucose releases substantial energy that can be used to produce ATP	5
9.	c		a. starch functions as an energy-storage polysaccharide in plants b. starch is composed of α -glucose and includes amylose and amylopectin c. coiling and branching make starch compact for storage d. starch is relatively insoluble and therefore has little effect on osmolarity e. glycogen functions as an energy-storage polysaccharide in animals f. glycogen is highly branched, allowing α -glucose monomers to be readily added or removed when energy stores are built or mobilized g. cellulose functions as a structural polysaccharide in plant cell walls h. cellulose consists of β -glucose monomers arranged in straight chains i. hydrogen bonds form between neighbouring cellulose chains, producing strong cellulose fibres	7