1.1 Biological Molecules: 30-minute Pack

AQA 7402 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 This question tests key facts about carbohydrate, lipid and protein structure. For each part, identify the correct option.

(a) Which bond links two glucose molecules together in maltose? **(1)**

- ☐ A) Peptide bond
- ☐ B) Ester bond
- ☐ C) Glycosidic bond
- ☐ D) Phosphodiester bond

(b) Which statement correctly describes the structure of cellulose that gives it high tensile strength? **(1)**

- ☐ A) Alpha-glucose monomers form coiled, branched chains
- ☐ B) Beta-glucose monomers form straight chains cross-linked by hydrogen bonds into microfibrils
- ☐ C) Glucose monomers are linked by peptide bonds into sheets
- ☐ D) Beta-glucose monomers form a highly branched, compact molecule

(c) Which class of lipid has a phosphate group replacing one fatty acid, making it amphipathic? **(1)**

- ☐ A) Triglyceride
- ☐ B) Steroid
- ☐ C) Phospholipid
- ☐ D) Wax ester

(d) Which level of protein structure is defined as the sequence of amino acids joined by peptide bonds? **(1)**

- ☐ A) Primary structure
- ☐ B) Secondary structure
- ☐ C) Tertiary structure
- ☐ D) Quaternary structure

(Total for Question 1 is 4 marks)

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2 Monosaccharides can be joined together to form larger carbohydrate molecules.

(a) Name the type of bond formed when two monosaccharides join, and name the type of reaction by which it forms. **(2)**

(b) Glucose exists as two isomers, α-glucose and β-glucose. State the structural difference between them. **(1)**

(c) State the monomer used to build (i) amylose (a component of starch) and (ii) cellulose, then describe one difference between the glycosidic bonds/chain shape formed in amylose compared with cellulose. **(3)**

(d) Explain how the structure of cellulose molecules relates to their function in plant cell walls. **(3)**

(Total for Question 2 is 9 marks)

3 Triglycerides are a major class of lipid found in living organisms.

(a) Name the two types of molecule that combine to form a triglyceride, and name the type of bond formed between them. **(3)**

(b) Explain, in terms of molecular structure, why lipids containing unsaturated fatty acids tend to have a lower melting point than lipids containing only saturated fatty acids. **(3)**

(c) Calculate the number of water molecules released when one molecule of triglyceride is formed from one glycerol molecule and three fatty acid molecules. Show your working. **(2)**

(d) A triglyceride has a relative molecular mass of 806. Its fatty acid components each contribute a relative mass of 256, and glycerol has a relative molecular mass of 92. Calculate the total relative mass lost as water when this triglyceride forms, and give your answer to an appropriate number of significant figures. **(3)**

(Total for Question 3 is 11 marks)

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Mark scheme · 1.1 Biological Molecules: 30-minute Pack

Question 1

(a) C **B1**

(a) Answer: C

(b) B **B1**

(b) Answer: B

(c) C **B1**

(c) Answer: C

(d) A **B1**

(d) Answer: A

Question 2

(a) glycosidic bond **B1**

(a) condensation reaction **B1**

(a) Answer: Glycosidic bond; condensation reaction.

(b) the -OH group on carbon 1 is below the plane of the ring in α-glucose and above the plane of the ring in β-glucose oe **B1**

(b) Answer: Position of the -OH group on carbon 1 differs (below the ring in α, above in β).

(c) (i) α-glucose **B1**

(c) (ii) β-glucose **B1**

(c) amylose monomers are joined by 1,4-glycosidic bonds forming a coiled/helical chain, whereas cellulose monomers are joined by 1,4-glycosidic bonds (with alternate glucose rotated 180 degrees) forming long straight/unbranched chains oe **B1**

(c) Answer: Amylose: α-glucose, coiled chain. Cellulose: β-glucose, straight unbranched chain.

(d) β-glucose monomers joined by 1,4-glycosidic bonds, with alternate glucose molecules rotated 180 degrees, produce long straight, unbranched chains oe **M1**

(d) many hydrogen bonds cross-link adjacent parallel cellulose chains, bundling them into microfibrils oe **M1**

(d) the large number of cross-links gives microfibrils high tensile strength, allowing cellulose to provide structural support/rigidity to the plant cell wall oe **A1**

(d) Answer: Straight chains cross-linked by hydrogen bonds into strong microfibrils give the cell wall tensile strength.

Question 3

(a) glycerol **B1**

(a) (three) fatty acids **B1**

(a) ester bond **B1**

(a) Answer: Glycerol and three fatty acids joined by ester bonds.

(b) unsaturated fatty acids contain one or more C=C double bond(s), which create a kink/bend in the hydrocarbon tail oe **M1**

(b) this prevents the fatty acid chains from packing closely together **A1**

(b) resulting in weaker intermolecular forces between chains, so less energy is needed to separate them, giving a lower melting point (liquid/oil at room temperature) oe **A1**

(b) Answer: Kinks from C=C bonds stop close packing, weakening intermolecular forces and lowering melting point.

(c) 3 ester bonds are formed (one between glycerol and each fatty acid), each by a condensation reaction that releases one water molecule oe **M1**

(c) 3 (water molecules) cao **A1**

(c) Answer: 3 water molecules.

(d) total mass of reactants = 92 + (3 x 256) = 860 **M1**

(d) mass lost as water = 860 - 806 **M1**

(d) = 54 (g mol^{-1}) awrt 54 **A1**

(d) Answer: 54 g mol^{-1} lost as water.

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