

2.2 Carbohydrates & Lipids

Question Paper

Course	DP IB Biology
Section	2. Molecular Biology
Topic	2.2 Carbohydrates & Lipids
Difficulty	Medium

Time allowed: 60
Score: /49
Percentage: /100

Question 1a

- a) The table below contains statements that could apply to three polysaccharides. Complete the table with a tick (✓) in each box if the statement applies correctly.

Statement	Glycogen	Cellulose	Starch
Contains 1-6 links			
Contains α -glucose			
Contains hydrogen bonds			

[3 marks]

Question 1b

- b) Explain the name of the type of reaction that forms the carbohydrates in part (a) from their monomers.

[2 marks]

Question 1c

- c) State **one** feature of starch and explain how this feature allows it to act as a storage substance.

[2 marks]

Question 1d

- d) Two molecules of a disaccharide are condensed together to form a larger sugar molecule. The chemical formula of the disaccharide is $C_{12}H_{22}O_{11}$.

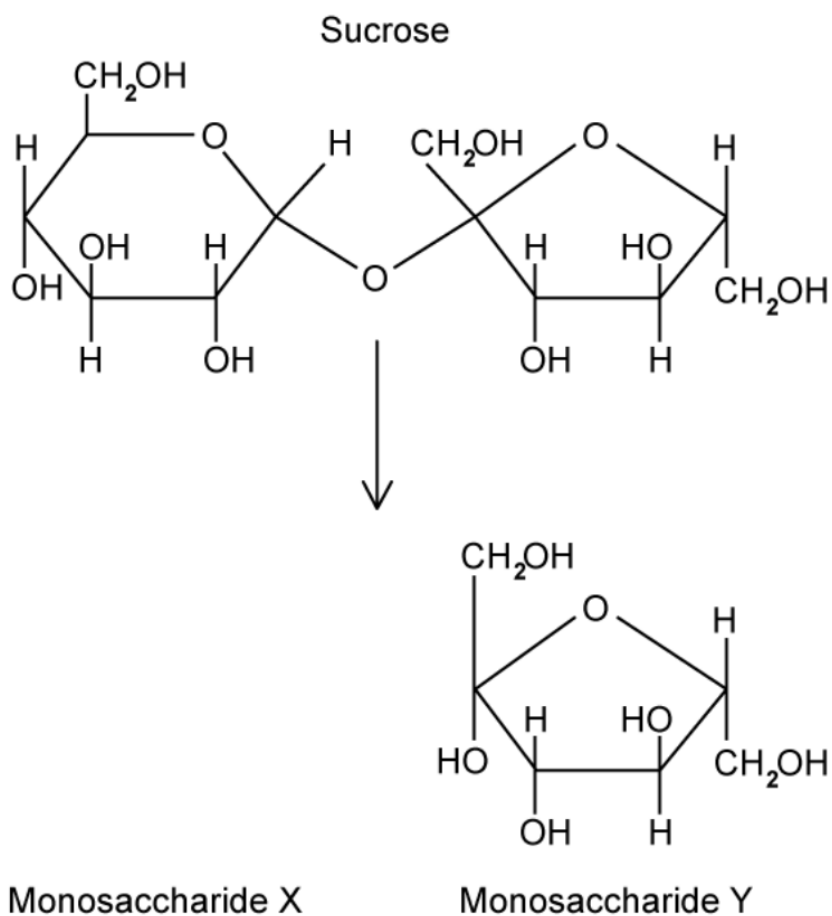
Deduce the formula of the resulting larger sugar molecule.

[1 mark]

Question 2a

- a) Sucrose is formed from monosaccharides **X** and **Y**.
The diagram below shows the structure of sucrose and monosaccharide **Y**.

Figure 1



Draw and identify monosaccharide **X**.

[2 marks]

Question 2b

- b) Fructose and glucose have the same molecular formula, $C_6H_{12}O_6$. However, their differing structures give them different properties; for example, fructose tastes sweeter than glucose.

Suggest one advantage to the food industry of this difference.

[1 mark]

Question 2c

- c) Molecular analysis was carried out using various laboratory techniques to distinguish between samples of three different polysaccharides. Starch was separated into its constituent polysaccharides (amylose and amylopectin) before analysis. The results are shown in the table below.

Sample	Branches per molecule	Speed of hydrolysis / arbitrary units
A	87	35
B	1 467	80
C	1 780	98

The three samples were **amylopectin**, **glycogen** and **amylose** (not necessarily in that order).

Use your knowledge of polysaccharide structure to assign each sample to one of those three polysaccharides.

Sample	Polysaccharide
A	
B	
C	

[3 marks]

Question 2d

- d) Within animal cells, fats are used as a long-term energy storage. A carbohydrate, glycogen, is used as a short-term energy storage molecule as well.

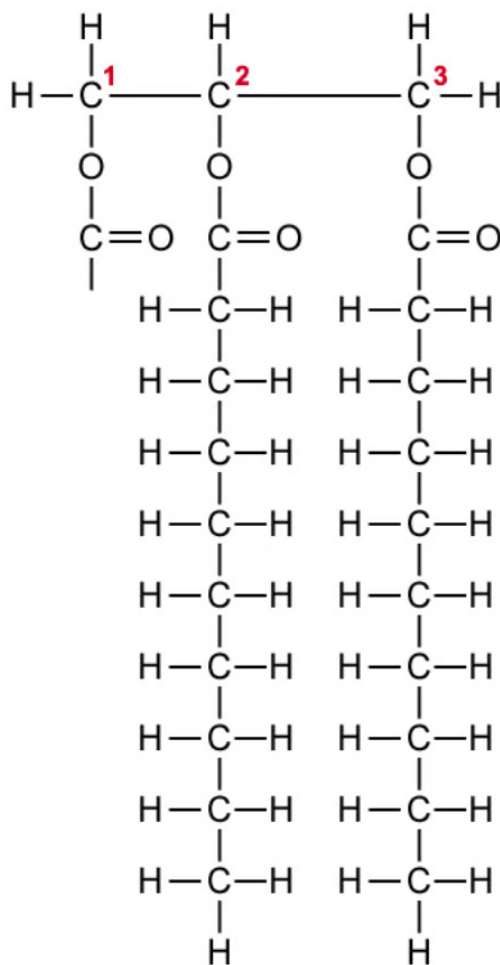
Explain the benefits of having this kind of short-term storage system.

[2 marks]

Question 3a

- a) The diagram below shows an incompletely-drawn triglyceride molecule.

Complete the drawing to show a trans-monounsaturated fatty acid chain at position 1 of the glycerol molecule.



[2 marks]

Question 3b

- b) As part of a 50-year study into health and diet, data was gathered in 1960 and 2000 for the numbers of deaths due to cardiovascular disease in a western European country. This data was compared to the percentage of energy provided by trans-fats in the diets of elderly men (aged 70 and above). Some of the research findings are shown below.

Year	Proportion of dietary energy from trans-fats / %	Deaths from cardiovascular disease in that year
1960	7	20 185
2000	1	15 542

Calculate the percentage decrease in numbers of deaths from cardiovascular disease between 1960 and 2000.

[2 marks]

Question 3c

- c) Referring to the study described in (b), post-mortem investigations of some patients who had died from cardiovascular disease revealed that fatty deposits in their diseased arteries contained high concentrations of trans-fats.

Explain why this finding, though positively correlated, does not prove causation.

[2 marks]

Question 3d

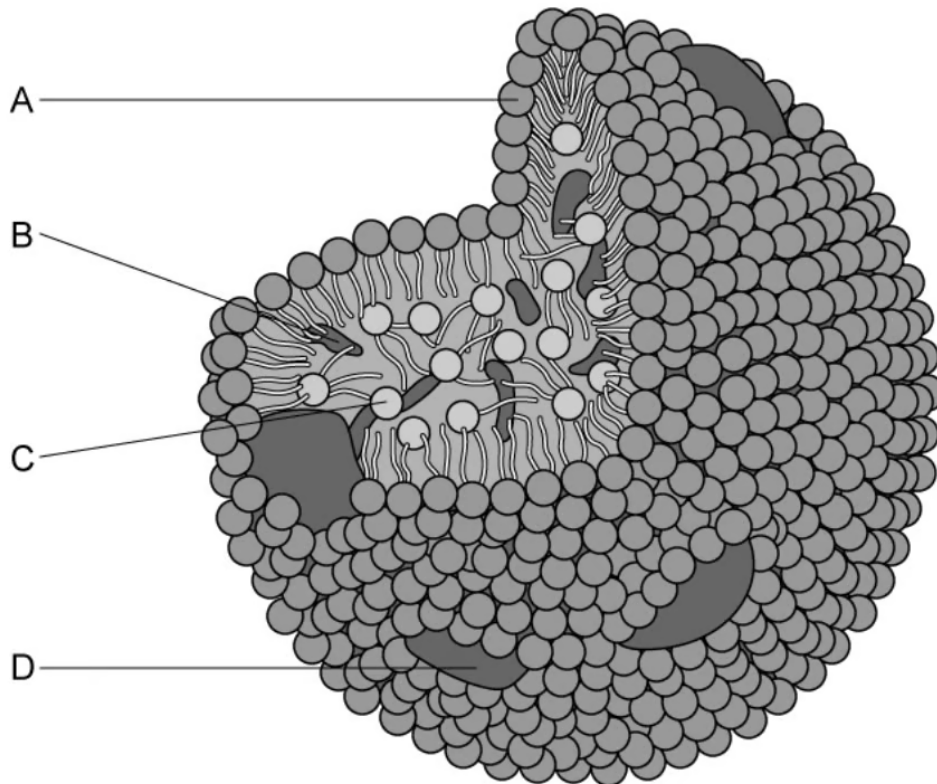
- d) Trans-fats have been favoured by manufacturers of processed foods.

Outline how one structural property of trans-fatty acids makes trans-fats a more attractive ingredient of choice for processed food manufacturers.

[3 marks]

Question 4a

- a) Label the four components **A-D** of a low-density lipoprotein (LDL) complex shown in the diagram below.



[4 marks]

Question 4b

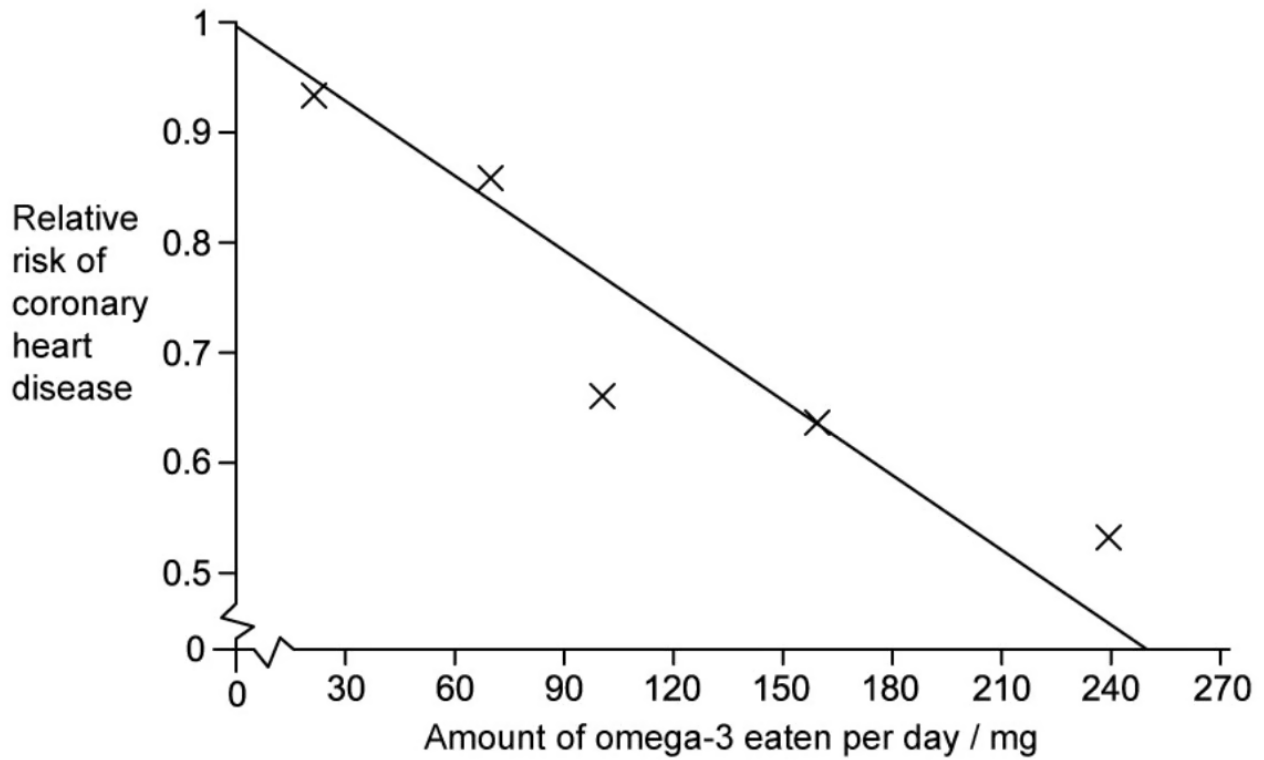
- b) State **one** function of a lipoprotein complex such as that illustrated in question (a).

[1 mark]

Question 4c

- c) The graph below shows the data obtained by scientists investigating the effect of omega-3 fatty acid consumption on the relative risk of coronary heart disease in humans.

Figure 1



Using the data in the graph, evaluate whether coronary heart disease can be prevented by increasing omega-3 intake.

[3 marks]

Question 4d

- d) Omega-3 fats are all examples of lipids that contain polyunsaturated cis-fatty acids. In the space below, draw the appearance of one carbon-to-carbon double bond as found in a cis-fatty acid's structure. You should include in your drawing all atoms connected to each carbon atom in that double bond.

[1 mark]

Question 5a

One mark is available for clarity of communication throughout this question.

- a) Draw a diagram of a section of a molecule of cellulose.

Your drawing should contain no fewer than three monomers joined together.

[4 marks]

Question 5b

- b) Outline why lipids are more suitable for long-term energy storage than carbohydrates in animals.

[3 marks]

Question 5c

- c) Discuss the advantages and disadvantages of using Body Mass Index (BMI) as a measure of a person's health.

Your answer should include a description of how BMI is calculated, with units, in the absence of a nomogram.

[8 marks]