# Biological Molecules

## Question Paper 1

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|---|---|
| Level | A Level |
| Subject | Biology |
| Exam Board | OCR |
| Module | Foundations in Biology |
| Topic | Biological Molecules |
| Booklet | Question Paper 1 |

**Time allowed:** **95 minutes**

**Score:** **/70**

**Percentage:** **/100**

**Grade Boundaries:**

| A* | A | B | C | D | E |
|---|---|---|---|---|---|
| >69% | 56% | 50% | 42% | 34% | 26% |

Fig. 22 shows a triglyceride molecule found in sunflower oil.

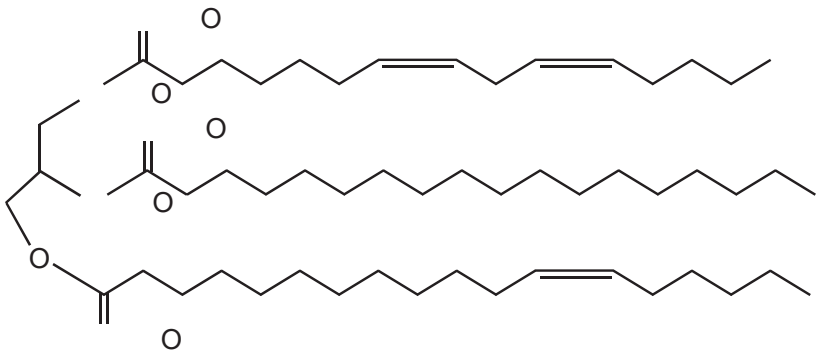


**Fig. 22**

**(a)** On Fig. 22 circle an ester bond. **[1]**

[Answer on Fig. 22]

**(b)** Sunflower oil is used to make biodiesel, which contains methyl esters. The fatty acids in the triglyceride molecule are reacted with methanol in a process called transesterification.

After the reaction, two liquid products form which naturally separate from each other. The methyl esters float on top of a more dense liquid.

Name the part of the molecule seen in Fig. 22 that forms this more dense liquid. **[1]**

**(c)** Living organisms have many uses for triglycerides, one of which is the production of phospholipids.

**(i)** Name three **other** functions of triglycerides in living organisms. **[3]**

**(ii)** Table 22 shows the melting points of some of the methyl esters made from the transesterification of sunflower oil fatty acids.

| Methyl ester | Formula | Melting point (°C) |
|---|---|---|
| Methyl sterate | $C_{19}H_{38}O_2$ | 39.1 |
| Methyl oleate | $C_{19}H_{36}O_2$ | –19.9 |
| Methyl linoleate | $C_{19}H_{34}O_2$ | –35.0 |

**Table 22**

Describe and explain the pattern of the melting points of these three methyl esters.

**[2]**

**(d)** Phospholipid molecules also contain fatty acids.

Explain how the fatty acids in phospholipids allow the formation of membranes. **[2]**

**[Total: 9]**

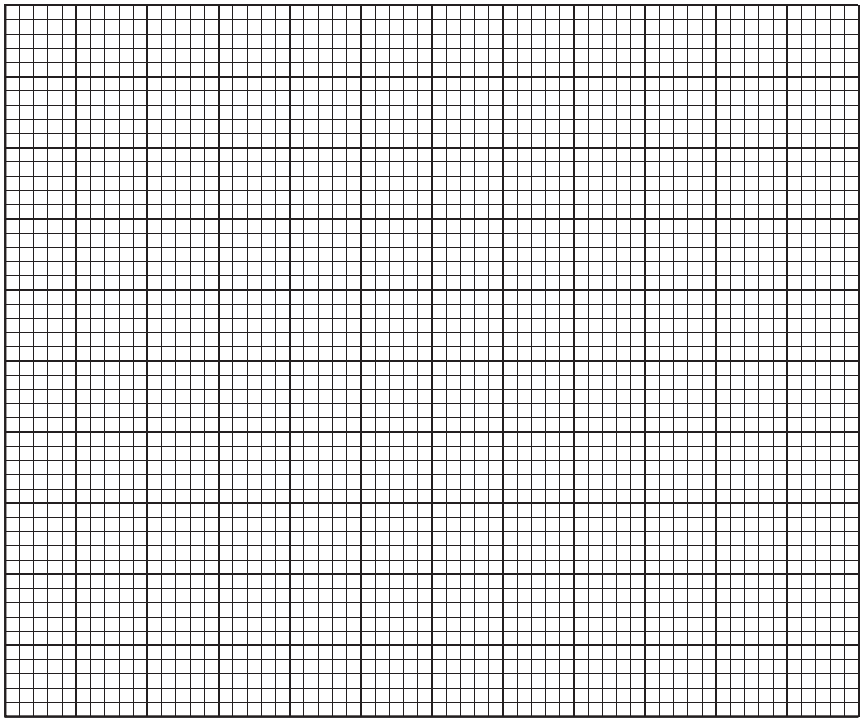
A group of students decided to investigate the glucose content of three types of fruit juice. They carried out the Benedict's test on known concentrations of glucose solutions and used these to calibrate a colorimeter.

The results of their calibration are shown in Table 6.

| glucose concentration (mmol $dm^{-3}$) | % absorbance | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 1.0 | 67 | 68 | 65 | 67 |
| 2.0 | 54 | 52 | 55 | 54 |
| 3.0 | 47 | 46 | 48 | 47 |
| 4.0 | 41 | 41 | 40 | 41 |
| 5.0 | 27 | 25 | 25 | 26 |
| 6.0 | 16 | 16 | 17 | 16 |

**Table 6**

**(a) (i)** Plot a graph of the mean % absorbance at each glucose concentration.



**[3]**

**(ii)** The students were provided with three different fruit juices labelled A, B and C. The Benedict's test was carried out on each fruit juice and samples were prepared for the colorimeter.

Explain how the students would use the calibration curve to estimate the glucose concentration of the fruit juices. **[2]**

(b) The students wrote the following hypothesis:

'The higher the concentration of glucose in the fruit juice, the sweeter it will be.'

(i) Describe how you would carry out a controlled experiment to test this hypothesis **without** using a colorimeter. **[4]**

**(ii)** Suggest one reason why the results for this experiment might **not** support the students' hypothesis. **[1]**

**(c)** Glucose and cholesterol are both molecules transported in the bloodstream that may need monitoring in people with different medical conditions.

Fig. 6 represents the structure of a cholesterol molecule.

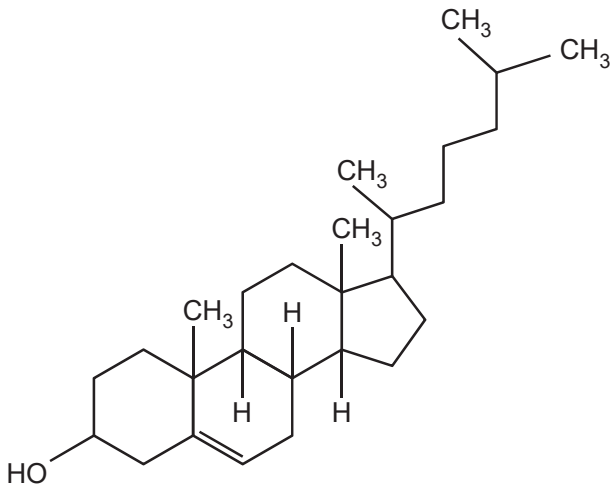



**Fig. 6**

**(i)** State **two** ways in which the molecular structure of cholesterol is similar to the molecular structure of glucose. **[2]**

**(ii)** Glucose is an important biological molecule required by cells for cellular respiration.

State the physical property of glucose that allows it to be easily transported in the bloodstream. **[1]**

**[Total: 13]**

**(a)** A student wanted to observe some red blood cells under the microscope. The student placed a small sample of blood onto a microscope slide and added a drop of distilled water. When viewed at high power, the student observed that the red blood cells had burst.

In a similar procedure using plant epidermis, the student observed that the plant cells did not burst.

(i) Explain these observations.

*In your answer you should use appropriate technical terms, spelt correctly.*

**[5]**

**(ii)** Suggest how the student could modify the procedure to observe red blood cells without them bursting.

**[1]**

**(b)** Oxygen enters red blood cells as they pass through the capillaries in the lungs.

Name the mechanism by which oxygen enters the red blood cells. **[1]**

**(c)** The cells in the epidermis of a plant root are specialised to absorb minerals from the surrounding soil.

State the process by which root epidermal cells absorb minerals from the soil **and** describe how these cells are specialised to achieve absorption.

**[3]**

**[Total: 10]**

**(a)** Polymers are important molecules that have structural and functional roles in organisms.

Chitin is a polymer that is found in insects, where it forms a major part of the structure of the exoskeleton.

- Chitin is a macromolecule that is similar to a polysaccharide.
- Chitin is composed of molecules of N-acetylglucosamine, the structure of which is shown in Fig. 3.1 below.
- The monomers of N-acetylglucosamine join by 1–4 glycosidic bonds to form the chitin molecule.

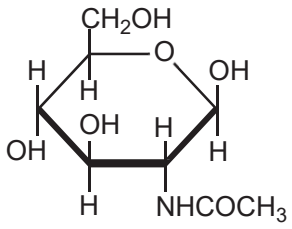



**Fig. 3.1**

**(i)** How does the composition of N-acetylglucosamine differ from the composition of a monosaccharide sugar? **[1]**

**(ii)** Which monosaccharide sugar does N-acetylglucosamine most closely resemble? . **[2]**

**(iii)** Using your knowledge of the formation of structural polysaccharides, describe the formation of the chitin molecule from its monomer and predict its structure. **[4]**

**(b)** Fig. 3.2 is a photomicrograph of the trachea of a honeybee, *Apis mellifera*.

The trachea of this honeybee is infected with honeybee tracheal mites, *Acarapis woodi*. Some of these mites are labelled **M** on Fig. 3.2.

The trachea and tracheoles of insects have circular bands of chitin. One of these bands is labelled **C** on Fig. 3.2.

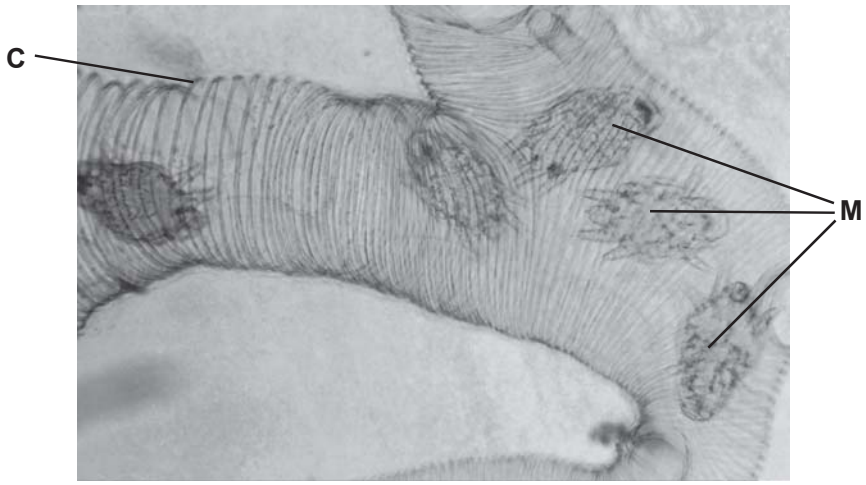



**Fig. 3.2**

**(i)** What is the function of the circular bands of chitin labelled **C**? **[1]**

**(ii)** The mites use their mouthparts to bite through the walls of the trachea. They then feed off the haemolymph, the blood-like liquid that bathes the cells and organs of the honeybee.

Suggest **one** other way in which the presence of the mites might affect the honeybee.

**[1]**

**[Total: 9]**

In cells, glucose can exist as α-glucose or as β-glucose.

(a) Fig. 1.1 represents the structural formula of a molecule of α-glucose.

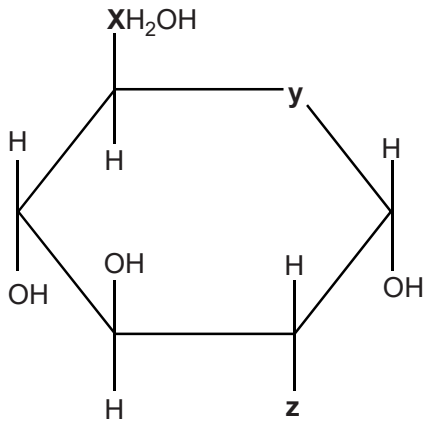



**Fig. 1.1**

**(i)** In Fig. 1.1 some atoms or groups have been replaced by the letters **X**, **Y** and **Z**.

Identify the correct atom or group that has been replaced by each letter.

**X**

**Y**

**Z**

**[3]**

**(ii)** Describe how the structure drawn in Fig. 1.1 above would be different if it represented a molecule of **β-glucose**.

**[2]**

**(iii)** Two α-glucose molecules can be joined to form a disaccharide molecule.

State the **precise** name of the covalent bond that forms between the two glucose molecules and the name of the disaccharide that is formed.

**[2]**

(b) Glucose, glycogen and amylose are carbohydrates.

- Glycogen and amylose are used for energy storage.
- Glycogen is found in animals.
- Amylose is found in plants.

Describe how the structure of glycogen allows it to perform its function **and** explain the advantage to animals of using glycogen as an energy store.

*In your answer you should make clear the links between structure and function.* **[7]**

(c) Alpha (α) and beta (β) are prefixes that are frequently used to describe a range of biological molecules, such as α-glucose and β-glucose.

The prefixes α and β can also be used when describing protein structure.

Complete the following statements about proteins using the most appropriate terms.

- The secondary structure of a protein may contain many regions folded in zig-zag patterns known as ..... .
- The secondary structure of a protein is determined by the arrangement of ..... bonds, which stabilise the structure.
- The ..... structure of collagen is described as a left-handed helix because of the direction in which the polypeptide twists.
- Polypeptides known as alpha (α) and beta (β) ..... form part of the ..... structure of haemoglobin. **[5]**

**[Total: 19]**

Lipids are a group of fatty or waxy compounds.

Triglyceride, phospholipid and cholesterol are examples of lipid compounds that are important in living organisms.

(a) Table 7.1 lists a number of statements that could apply to these compounds.

Complete the table by indicating with a tick (✓) which of the compounds applies to each statement.

You may use more than one tick in a row.

| Statement | Triglyceride | Phospholipid | Cholesterol |
|---|---|---|---|
| Contains only the elements carbon, hydrogen and oxygen | | | |
| Insoluble in water | | | |
| Contains glycerol | | | |
| Contains ester bonds | | | |
| Important in membrane structure | | | |
| Contains fatty acids | | | |

**Table 7.1**

**[6]**

(b) Describe how to do the emulsion test for lipids and how a positive result would be identified.

**[2]**

(c) Lipids form an essential part of a balanced diet. Some food, such as mycoprotein, is produced by microorganisms.

How might the **lipid** content of mycoprotein differ from food that comes from animals? **[2]**

**[Total: 10]**