

Biological Molecules

1. Elements

- **Carbohydrates and Lipids:** Composed of carbon, hydrogen, and oxygen.
- **Proteins:** Contain carbon, hydrogen, oxygen, and nitrogen.

2. Structure

- Large molecules are formed from smaller, basic units.
 - **Carbohydrates:** Starch, cellulose, and glycogen are large carbohydrates (polysaccharides) made from smaller glucose units (monosaccharides).
 - **Proteins:** Made from smaller units called amino acids.
 - **Lipids:** Formed from fatty acids and glycerol.

3. Chemical Tests

- **Starch:** Tested using iodine solution. A positive result is a color change from orange-brown to blue-black.
- **Reducing Sugars (e.g., glucose, maltose):** Tested using Benedict's solution. The solution is heated in a water bath. A positive result is a color change from blue to green, yellow, orange, or brick-red precipitate.
- **Proteins:** Tested using the Biuret test. The reagent contains copper sulfate and sodium hydroxide. A positive result is a color change from blue to violet or purple.
- **Lipids (Fats and Oils):** Tested using the ethanol emulsion test. The sample is mixed with ethanol and then poured into cold water. A positive result is the formation of a cloudy white emulsion.

Past Paper Questions with Constructed Answers and Examiner Reports

Question 1

- **Question:** Describe the tests you would carry out to test for the presence of starch and protein in a food sample. For each test, describe the reagents used and the positive result. (6 marks)
- **Answer:**

- **Starch Test:** Add a few drops of iodine solution to the food sample. The initial color of the iodine is orange-brown. A positive result is a color change to blue-black.
- **Protein Test:** Add Biuret reagent (which contains sodium hydroxide and copper sulfate) to the food sample. The initial color of the reagent is blue. A positive result is a color change to purple or violet.
- **Examiner Report:** This is a common question. Candidates should be careful to name the reagents correctly (iodine solution and Biuret reagent). It is also crucial to state both the initial and final colors to get full marks. Some candidates confuse the tests or mix up the color changes, which loses marks.

Question 2

- **Question:** Explain why a balanced diet is important for the human body, referring to the roles of carbohydrates and proteins. (4 marks)
- **Answer:** A balanced diet provides all the essential biological molecules in appropriate quantities for proper bodily function. Carbohydrates are the primary source of energy for the body. Proteins are essential for building and repairing tissues, as well as for the formation of enzymes, hormones, and antibodies.
- **Examiner Report:** Strong answers explained the specific functions of each molecule, linking them to a healthy diet. Weaker answers gave generic statements about 'energy' and 'growth' without providing detailed roles of the molecules. Mentioning enzymes and antibodies shows a higher level of understanding.

Question 3

- **Question:** Starch and glycogen are both polysaccharides made from simple sugars. Explain the structural differences between them and their functions in living organisms. (3 marks)
- **Answer:** Both are polymers of glucose. Starch is the energy storage molecule in plants, while glycogen is the energy storage molecule in animals. Starch can be a linear chain (amylose) or a branched chain (amylopectin), whereas glycogen is a highly branched chain.
- **Examiner Report:** Most students correctly identified the basic units as glucose. The key to getting full marks was to specify that starch is for energy storage in plants and glycogen is for energy storage in animals. Mentioning the difference in branching structure was a distinguishing factor for top grades.

Question 4

- **Question:** Describe the procedure for the Benedict's test to detect the presence of reducing sugars in a solution. (3 marks)
- **Answer:** Add Benedict's solution to the food sample in a test tube. Heat the test tube in a water bath at 60-70°C for a few minutes. A positive test is indicated by a color change from blue to green, yellow, orange, or brick-red precipitate.
- **Examiner Report:** Candidates must mention both the reagent (Benedict's solution) and the need for heating. Stating the initial color of the solution (blue) and the final positive result color(s) is essential. Common errors include forgetting to mention heating or stating incorrect color changes.

Question 5

- **Question:** A student tests a food sample and gets a positive result for the Biuret test and the ethanol emulsion test, but a negative result for the Benedict's test and iodine test. What are the main biological molecules present in the sample? (2 marks)
- **Answer:** The food sample contains protein and lipids (fats/oils).
- **Examiner Report:** This is a good question for testing understanding of food tests. Students must correctly link the positive results of the Biuret test to protein and the ethanol emulsion test to lipids. The negative results for the other tests are equally important in confirming the absence of reducing sugar and starch.

Question 6

- **Question:** Explain the difference between saturated and unsaturated fats, providing a structural reason for the difference. (2 marks)
- **Answer:** Saturated fats contain no double bonds between the carbon atoms in their fatty acid chains, making the chain straight. Unsaturated fats contain at least one double bond, which causes a 'kink' or bend in the fatty acid chain.
- **Examiner Report:** This question tests a more detailed understanding of lipids. The key marking points are the presence or absence of double bonds and the resulting shape of the molecule.

Question 7

- **Question:** Explain why enzymes are often described as being made of protein. (2 marks)

- **Answer:** Enzymes are biological catalysts that speed up chemical reactions in the body. They are made from a sequence of amino acids joined together, which then fold into a specific 3D shape, defining them as proteins. This shape is crucial for their function.
- **Examiner Report:** The best answers linked the structure of proteins (amino acid chains) to the function of enzymes. Mentioning the specific 3D shape and its importance for catalysis was key.

Question 8

- **Question:** State the function of cellulose in plants. (1 mark)
- **Answer:** Cellulose provides rigidity and support for the plant cell wall.
- **Examiner Report:** Most students got this correct. The answer must relate to the cell wall and the structural role it plays.

Question 9

- **Question:** Describe the structure of a lipid molecule. (2 marks)
- **Answer:** A lipid molecule (triglyceride) is composed of one glycerol molecule chemically bonded to three fatty acid chains.
- **Examiner Report:** Marks were awarded for correctly identifying both glycerol and fatty acids as the basic units. Mentioning the ratio of 1 glycerol to 3 fatty acids was required for a full answer.

Question 10

- **Question:** Explain why carbohydrates are a primary source of energy for the body. (2 marks)
- **Answer:** Carbohydrates, such as glucose, are easily metabolized (broken down) in cells to release energy for cellular activities. This process, known as respiration, provides a quick and readily available source of energy.
- **Examiner Report:** The best answers explained the link between carbohydrates and respiration to produce energy. Simply stating "they provide energy" was not sufficient.

Multiple-Choice Questions

1. Which of the following elements is found in proteins but not in carbohydrates?

- A) Carbon
- B) Hydrogen

C) Nitrogen

D) Oxygen

Answer: C

2. Which food-testing reagent shows a positive result when it turns from blue to purple?

A) Benedict's solution

B) Biuret reagent

C) Ethanol

D) Iodine solution

Answer: B

3. Which of these is digested by protease?

A) Starch

B) Amino acid

C) Glucose

D) Protein

Answer: D

4. Which simple molecules are the basic units of protein?

A) Amino acids

B) Fatty acids

C) Sugars

D) Vitamins

Answer: A

5. What are the smaller basic units of starch and glycogen molecules?

A) Amino acids

B) Simple sugars

C) Fatty acids and glycerol

D) Simple sugars and amino acids

Answer: B

6. A student carries out two food tests on solution X. The Biuret test gives a purple color, and the Benedict's test gives a brick-red precipitate. Which nutrients are present in solution X?

- A) Protein and starch
- B) Protein and reducing sugar¹
- C) Starch and fat²
- D) Starch and sugar³

Answer: B⁴

7. Which row shows the elements and basic units that are used in the construction of large food molecules?⁵

Food molecules ⁶	Elements ⁷	Basic units ⁸
A	Fats	carbon, hydrogen, oxygen, nitrogen
B	Fats	carbon, hydrogen, oxygen
C	Starch	carbon, hydrogen, oxygen
D	Starch	carbon, hydrogen, oxygen, nitrogen

8. **Answer: C**

9. Which biomolecule is also known as enzymes?

- A) Carbohydrate
- B) Lipid
- C) Nucleic Acid
- D) Protein

Answer: D

10. A student tests a food sample and gets a cloudy white emulsion. Which food group is present?

- A) Starch
- B) Protein
- C) Reducing sugar
- D) Lipid

Answer: D

11. What is a correct statement about biological molecules?

- A) Biuret reagent is used to test for reducing sugars.
- B) Glycogen is made of smaller glycerol molecules.
- C) Oils contain the chemical elements carbon, hydrogen, oxygen and nitrogen.
- D) Protein is made of smaller amino acid molecules.

Answer: D