Chapter: 4 Biological molecules
Book/PDF: Chapter-4.pdf
Pages: 1–21
Exam level: Cambridge IGCSE (0610)

1) Big-picture overview (100–150 words)

This chapter introduces the fundamental building blocks of life: biological molecules. You'll learn about the four main types: **carbohydrates**, **fats**, **proteins**, and **DNA**. The key idea is that large, complex molecules (polymers) are built from smaller, repeating sub-units (monomers). For example, carbohydrates like starch are made from glucose units, and proteins are made from amino acids. Understanding their structure is crucial as it determines their function, whether for energy (glucose), energy storage (starch, glycogen, fats), structure (cellulose, proteins), or carrying genetic information (DNA). A major practical part of this chapter is learning the simple biochemical tests used to identify these nutrients in food, a common topic in exams. This knowledge forms the foundation for understanding digestion, respiration, and genetics in later chapters.

2) Syllabus mapping

Outcome description	Where covered (page)
Identify the chemical elements in carbohydrates, fats, and proteins.	2, 5, 7, 8
Understand that large molecules are made from smaller sub-units (monomers to polymers).	1
Describe the structure of a carbohydrate as simple sugars (e.g., glucose) and complex carbohydrates (e.g., starch, glycogen, cellulose).	2, 3
State the functions of glucose, starch, glycogen, and cellulose.	3, 20
Describe the structure of fats and oils as one glycerol and three fatty acids.	6
State the function of fats.	6
Describe the structure of proteins as long chains of amino acids.	7
State the functions of proteins (e.g., structural, enzymes).	6, 7
Describe the structure of a DNA molecule as two strands coiled to form a double helix.	9
Understand that the strands are linked by paired bases (A with T, C with G).	9
Describe the biochemical tests for starch, reducing sugars, protein, and fat.	16, 17
Describe the test for Vitamin C using DCPIP.	17

3) Key terms and definitions

Term	One-sentence definition	First appears (page)	Example/application
Monomer	[cite_start]A small, simple repeating sub-unit that can be joined together to form a polymer (p. 1)[cite: 15].	1	[cite_start]Glucose is the monomer for starch[cite: 50].
Polymer	[cite_start]A large molecule made from long chains of monomers held together by chemical bonds (p. 2)[cite: 16, 17].	2	[cite_start]Polysaccharides (like starch) and proteins are polymers[cite: 17].
Carbohydrate	[cite_start]A biological molecule containing only carbon, hydrogen, and oxygen, used for energy or structure (p. 2)[cite: 25].	2	[cite_start]Glucose, starch, glycogen, cellulose[cite: 103].
Monosaccharide	[cite_start]A simple sugar with a single carbon ring structure (p. 3)[cite: 46, 47].	3	[cite_start]Glucose and fructose[cite: 47].
Disaccharide	[cite_start]A sugar made of two monosaccharide units joined together (p. 3) [cite: 47].	3	[cite_start]Maltose (glucose + glucose) and sucrose[cite: 38, 48].
Polysaccharide	[cite_start]A complex carbohydrate made of many simple sugar units joined together (p. 2) [cite: 17].	2	[cite_start]Starch, glycogen, and cellulose[cite: 103].
Fat	[cite_start]A molecule made of glycerol and fatty acids that is solid at room temperature; used for energy storage and membranes (p. 5) [cite: 65, 67, 81].	5	[cite_start]Animal fats, waxes[cite: 103].
Oil	[cite_start]A form of fat that is liquid at room temperature (p. 5)[cite: 65].	5	[cite_start]Vegetable oils like olive oil[cite: 103].
Glycerol	[cite_start]A molecule that combines with three fatty acids to form a fat molecule (p. 6)[cite: 67].	6	[cite_start]The 'backbone' of a fat molecule[cite: 78].
Fatty Acid	[cite_start]An organic acid molecule; three are joined to a glycerol molecule to make a fat (p. 6)[cite: 67].	6	[cite_start]The 'tails' of a fat molecule[cite: 76].
Protein	[cite_start]A polymer made of long chains of amino acids, containing C, H, O, and N (p. 7) [cite: 86, 87].	6	[cite_start]Enzymes, muscle, haemoglobin[cite: 103].
Amino Acid	[cite_start]The monomer unit of proteins; there are about 20 different types (p. 7)[cite: 87, 91].	7	[cite_start]Alanine, glycine, valine[cite: 91].
DNA	[cite_start]Deoxyribonucleic acid; a molecule made of two nucleotide strands in a double	9	[cite_start]Found in chromosomes in the nucleus[cite: 83].

Term	One-sentence definition	First appears (page)	Example/application
	helix that carries genetic information (p. 9)[cite: 118, 126].		
Nucleotide	[cite_start]The monomer of DNA, consisting of a deoxyribose sugar, a phosphate group, and an organic base (p. 9)[cite: 119].	9	The building block of DNA. [cite_start]An example is adenosine monophosphate[cite: 132].

4) Core concepts explained

Carbohydrates (p. 2)

- [cite_start]**Elements:** Composed only of Carbon (C), Hydrogen (H), and Oxygen (O)[cite: 25].
- [cite_start]**Monomer:** The basic unit is a simple sugar, or **monosaccharide**, like glucose ($C_6H_{12}O_6$)[cite: 26, 47]. [cite_start]Glucose is soluble and often forms a ring structure[cite: 20, 27].
- **Polymers:** Monomers join to form larger carbohydrates.
  - [cite_start]**Disaccharides:** Two sugar units, e.g., maltose (soluble)[cite: 38, 47].
  - [cite_start]**Polysaccharides:** Many sugar units, e.g., starch, glycogen, and cellulose (generally insoluble)[cite: 17, 54].
- **Functions & Examples:**
  - [cite_start]**Starch:** An energy storage molecule in **plants**, made of long chains of glucose[cite: 51].
  - [cite_start]**Glycogen:** An energy storage molecule in **animals**, made of branched chains of glucose[cite: 49].
  - [cite_start]**Cellulose:** A structural molecule that forms strong fibres to make up plant **cell walls**[cite: 52, 53].

Fats and Oils (p. 5)

- [cite_start]**Elements:** Composed of Carbon (C), Hydrogen (H), and Oxygen (O), but with a much lower proportion of oxygen than carbohydrates[cite: 66, 103].
- **Structure:** Not a simple polymer/monomer structure. [cite_start]Each fat molecule is made from two types of sub-units: **one glycerol** molecule and **three fatty acid** molecules[cite: 67].
- [cite_start]**States:** Fats are solid at room temperature, while oils are liquid[cite: 65, 103].
- [cite_start]**Functions:** Used as a source of energy when stored in cytoplasm and are a key component of cell membranes[cite: 80, 81].

Proteins (p. 6)

- **Elements:** Composed of Carbon (C), Hydrogen (H), Oxygen (O), and **Nitrogen (N)**. [cite_start]Many also contain Sulfur (S) [cite: 86].
- [cite_start]**Monomer:** The basic sub-unit is an **amino acid**[cite: 87]. [cite_start]There are about 20 different types of amino acids[cite: 91].
- [cite_start]**Polymer:** A protein is a long chain of hundreds or thousands of amino acids joined together[cite: 87, 92]. [cite_start]The specific sequence of amino acids determines the protein's unique shape and function[cite: 92].

- **Functions:**
  - [cite_start]**Structural:** Form parts of cell structures like membranes, mitochondria, and chromosomes[cite: 83].
  - [cite_start]**Functional:** Act as **enzymes** to control all the chemical reactions in a cell[cite: 84, 85].

Structure of DNA (p. 9)

- [cite_start]**Structure:** A DNA molecule is a **polymer** made of two long strands of **nucleotides**[cite: 118]. [cite_start]These two strands are twisted to form a **double helix**[cite: 126].
- [cite_start]**Nucleotide:** Each nucleotide (monomer) has three parts: a **phosphate** group, a **deoxyribose sugar**, and an **organic base**[cite: 119].
- [cite_start]**Bases:** There are four different bases: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G)[cite: 120].
- **Base Pairing Rule:** The two strands are held together by chemical bonds between the bases. [cite_start]The pairing is highly specific: **A always pairs with T**, and **C always pairs with G**[cite: 126]. [cite_start]This means the number of A bases equals the number of T bases, and the number of C bases equals the number of G bases[cite: 176].

5) Diagrams and micrographs (figures)

- **Figure 4.1 Glucose molecule (p. 2):** Shows the chemical ring structure of a glucose monomer, both in full detail and as a simple hexagon.
- **Figure 4.2 Formation of maltose (p. 3):** Illustrates two glucose molecules joining to form one molecule of maltose (a disaccharide) and a molecule of water.
- **Figure 4.3 Part of a glycogen molecule (p. 4):** Shows a branched chain made of many glucose units linked together, representing a polysaccharide.
- **Figure 4.4 & 4.5 Cellulose (p. 4-5):** A diagram and an electron micrograph showing how long cellulose molecules group together to form strong cellulose fibres, which make up a plant cell wall.
- **Figure 4.6 Fat molecule (p. 6):** A simple diagram showing the structure of a fat: a glycerol "head" attached to three fatty acid "tails".
- **Figure 4.7 Protein molecule (p. 7):** Represents a protein as a long chain of differently shaped circles (amino acids) joined by chemical bonds.
- **Figure 4.8 A nucleotide (p. 9):** A diagram of a single nucleotide, showing its three components: phosphate, deoxyribose sugar, and an organic base (adenine shown as an example).
- **Figure 4.9 Part of a DNA molecule (p. 10):** Shows four different nucleotides (A, C, G, T) linked together by their phosphate groups to form a single strand.
- **Figure 4.10 & 4.11 DNA double helix (p. 10-11):** A model and diagram showing the double helix structure. Key labels are the **sugar-phosphate chain** (the "backbone" on the outside) and the **base pairs** (the "rungs" on the inside), with A pairing with T and C pairing with G.
- **Figure 4.15 Food test summary (p. 18):** A flowchart diagram summarizing the experimental steps for testing a food sample for fat, reducing sugar, protein, and starch. An excellent revision tool.

6) Processes and cycles

The main processes are the biochemical food tests.

Synthesis of Polymers

Large biological molecules are synthesised (made) from their sub-units.

1. **Carbohydrates:** Glucose molecules are joined together to make polysaccharides.
    - Inputs: Glucose molecules.
    - [cite_start]Outputs: Starch (in plants) or glycogen (in animals), and water[cite: 95, 96].
2. **Fats:** Glycerol and fatty acids are joined.
    - Inputs: 1 glycerol molecule, 3 fatty acid molecules.
    - [cite_start]Output: 1 fat molecule, water[cite: 97].
3. **Proteins:** Amino acids are joined in a specific sequence.
    - Inputs: Various amino acid molecules.
    - [cite_start]Output: A protein molecule, water[cite: 96].

7) Formulae and calculations

This chapter focuses on descriptive biology, not mathematical calculations. The key chemical formula to recognize is for **glucose**:

- [cite_start]$C_6H_12O_6$ (p. 2) [cite: 26]

8) Required practicals / experiments

Food Tests (p. 16-18)

	Test for Starch	**Test for Reducing Sugar**	**Test for Protein (Biuret Test)**	**Test for Fat (Emulsion Test)**	**Test for Vitamin C**
Aim	To detect the presence of starch in a food sample.	To detect the presence of a reducing sugar (e.g., glucose) in a food sample.	To detect the presence of protein in a food sample.	To detect the presence of fats or oils in a food sample.	To compare the concentration of vitamin C in different fruit juices.
Apparatus	Test tube, dropping pipette.	Test tube, beaker for water bath, heat source.	Test tube, measuring cylinder or pipette.	Dry test tube, filter funnel.	Test tube, syringe, pipette.
Method	1. [cite_start]Place a small amount of the food sample (as a suspension in water) in a test tube[cite: 227]. 2. [cite_start]Add 3-4 drops of **iodine**	1. [cite_start]Place 2 cm^3 of the food sample solution in a test tube[cite: 231]. 2. [cite_start]Add an equal volume of **Benedict's solution**[cite: 231].	1. [cite_start]Place 2 cm^3 of the food solution in a test tube[cite: 235]. 2. [cite_start]Add 2 cm^3 of **dilute sodium hydroxide** solution[cite: 236].	1. [cite_start]Crush the food sample and shake with about 5 cm^3 of **ethanol** in a dry test tube until it dissolves[cite: 240, 257]. 2. [cite_start]Pour the	1. [cite_start]Place 2 cm^3 of DCPIP solution (a blue dye) in a test tube[cite: 249]. 2. [cite_start]Add the fruit juice

	Test for Starch	Test for Reducing Sugar	Test for Protein (Biuret Test)	Test for Fat (Emulsion Test)	Test for Vitamin C
	solution[cite: 228]. 3. Observe any colour change.	 3. [cite_start]**Heat** the tube in a boiling water bath for a few minutes[cite: 232]. 4. Observe colour change.	 3. [cite_start]Add 2 cm^3 of **1% copper sulfate solution**[cite: 236]. 4. Observe colour change.	clear ethanol solution into a separate test tube containing a few cm^3 of **water**[cite: 241]. 3. Observe.	drop by drop from a syringe[cite: 250]. 3. [cite_start]Shake and count the number of drops needed for the blue colour to disappear[cite: 250, 251].
Variables	IV: Presence of starch. DV: Colour of iodine. Control: Water instead of food sample.	IV: Presence of reducing sugar. DV: Final colour of precipitate. Control: Water instead of food sample.	IV: Presence of protein. DV: Final colour of solution. Control: Water instead of food sample.	IV: Presence of fat. DV: Formation of an emulsion. Control: Water instead of food sample.	IV: Type of fruit juice. DV: Volume (number of drops) of juice needed. Control: DCPIP solution with water.
Safety	[cite_start]Iodine stains skin and clothes[cite: 223].	Wear eye protection. [cite_start]Take care with hot water/boiling water bath[cite: 222, 224].	[cite_start]Sodium hydroxide is an irritant, wear eye protection[cite: 222, 236].	Ethanol is flammable, keep away from flames.	[cite_start]DCPIP can stain skin and clothes[cite: 245].
Expected Results	[cite_start]**Positive:** Solution turns **blue-black**[cite: 228]. **Negative:** Solution remains brown/yellow.	[cite_start]**Positive:** Colour changes from clear blue → green → yellow → **brick-red precipitate**[cite: 233]. **Negative:** Solution remains blue.	[cite_start]**Positive:** Solution turns **purple or violet**[cite: 237]. **Negative:** Solution remains blue.	[cite_start]**Positive:** A **milky white emulsion** forms[cite: 241]. **Negative:** Solution remains clear.	[cite_start]The blue DCPIP becomes **colourless**[cite: 250]. The fewer drops needed, the higher the vitamin C concentration.

9) Data handling and graphing

This chapter primarily uses tables to summarize information (e.g., Table 4.1, p. 8). The main data handling skill relates to interpreting the results of the Vitamin C test.

- **Example Data Table (from p. 20):**

Fruit Juice	Drops needed to decolourise DCPIP
A	10
B	18
C	7

- **Interpretation:** The dependent variable is the number of drops. The fewer drops required, the more concentrated the vitamin C.
- **Conclusion from data:** Fruit juice C has the highest concentration of vitamin C, and fruit juice B has the lowest.

10) Common misconceptions and exam tips

- **Misconception:** All carbohydrates are sweet and soluble.
  - **Correct Understanding:** Only simple sugars (monosaccharides and disaccharides) are sweet and soluble. [cite_start]Polysaccharides like starch and cellulose are not sweet and are insoluble[cite: 54].
  - **Tip:** Remember glucose is fuel (soluble, easy to transport), but starch is storage (insoluble, stays put).
- **Misconception:** Fats and carbohydrates are made of the same things.
  - [cite_start]**Correct Understanding:** Both contain C, H, and O, but fats have much less oxygen[cite: 103]. Their basic sub-units are also completely different (glucose vs. glycerol/fatty acids).
  - **Tip:** Think "Protein has Nitrogen" (P-N). Fats are C-H-O, but "O-so-little oxygen".
- **Misconception:** There are only a few types of proteins because there are only 20 amino acids.
  - [cite_start]**Correct Understanding:** There are vast numbers of different proteins because the 20 amino acids can be arranged in almost infinite sequences and lengths, creating unique shapes and functions[cite: 92].
  - **Tip:** Think of amino acids like letters of the alphabet. With 26 letters, we can make millions of words and sentences.
- **Misconception:** In DNA, any base can pair with any other base.
  - [cite_start]**Correct Understanding:** Base pairing is specific and complementary: A always pairs with T, and C always pairs with G[cite: 126].
  - **Tip:** Remember "Apple on the Tree" (A-T) and "Car in the Garage" (C-G).

11) Exam-style practice

Multiple Choice Questions (MCQs)

1. Which elements are always present in proteins but not always in carbohydrates?
   A. Carbon and Hydrogen
   B. Oxygen and Carbon
   C. Nitrogen and Sulfur
   D. Hydrogen and Oxygen
   [cite_start]*(Answer: C. Proteins always contain Nitrogen, and often Sulfur, which are not in carbohydrates[cite: 86, 103].)*
2. What are the sub-units of a fat molecule?
   A. Amino acids and glycerol
   B. Glucose and fatty acids

C. Glycerol and fatty acids

D. Nucleotides

[cite_start]*(Answer: C. A fat is made of one glycerol and three fatty acids[cite: 67].)*

3. A food sample is tested. It turns purple with the Biuret test and forms a red precipitate when heated with Benedict's solution. Which nutrients are present?

   A. Starch and protein

   B. Protein and reducing sugar

   C. Fat and starch

   D. Reducing sugar and fat

   [cite_start]*(Answer: B. Purple is a positive Biuret test for protein [cite: 237][cite_start], and a red precipitate is a positive test for reducing sugar[cite: 233].)*

4. Which polysaccharide is the main structural component of plant cell walls?

   A. Starch

   B. Glycogen

   C. Glucose

   D. Cellulose

   [cite_start]*(Answer: D. Cellulose is made of long chains grouped into strong fibres for cell walls[cite: 52, 53].)*

5. The base pairing rule in DNA is:

   A. A-G and C-T

   B. A-C and G-T

   C. A-T and C-G

   D. A-A and C-C

   [cite_start]*(Answer: C. Adenine always pairs with Thymine, and Cytosine always pairs with Guanine[cite: 126].)*

6. Which test requires the sample to be dissolved in ethanol first?

   A. Test for starch

   B. Test for fat

   C. Test for protein

   D. Test for reducing sugar

   [cite_start]*(Answer: B. The emulsion test for fat involves dissolving the sample in ethanol before adding it to water[cite: 240, 257].)*

7. Glycogen is a storage carbohydrate found in:

   A. Plant cells

   B. Animal cells

   C. Bacterial cells

   D. Fungal cells

   [cite_start]*(Answer: B. Glycogen is a food storage substance in many animal cells[cite: 49].)*

8. Which of the following is a monosaccharide?

   A. Starch

   B. Maltose

   C. Glucose

   D. Cellulose

   [cite_start]*(Answer: C. Glucose has a single carbon ring and is a monosaccharide[cite: 47].)*

9. What are the three components of a DNA nucleotide?

   A. Phosphate, ribose sugar, base

   B. Phosphate, glucose, base

   C. Phosphate, deoxyribose sugar, base

   D. Deoxyribose sugar, amino acid, base

[cite_start]*(Answer: C. A DNA nucleotide consists of a phosphate group, a deoxyribose sugar, and an organic base[cite: 119].)*

10. A student needs more drops of orange juice than lemon juice to decolourise DCPIP. What does this show?
    A. Orange juice has more Vitamin C.
    B. Lemon juice has more Vitamin C.
    C. Both juices have the same amount of Vitamin C.
    D. Orange juice contains a reducing sugar.
    [cite_start]*(Answer: B. If more juice is needed, it means the concentration of Vitamin C is lower[cite: 252].)*

Short-Answer Questions

1. **State** two structural differences between a molecule of starch and a molecule of fat.
    - *Marking points:*
        - Starch is a polymer made of glucose monomers, while fat is made of glycerol and fatty acids [1].
        - Starch only contains C, H, and O. Fats also contain C, H, and O but in different proportions (less O) [1].
2. A student wishes to test a peanut for the nutrients it contains. **Describe** the steps they would take to test for the presence of fat.
    - *Marking points:*
        - Crush the peanut with ethanol in a dry test tube [1].
        - Filter the mixture to get a clear solution (filtrate) [1].
        - Pour the clear filtrate into a test tube containing water [1].
        - A positive result is a milky/white emulsion forming [1].
3. **Explain** why there are many more different types of proteins than polysaccharides.
    - *Marking points:*
        - Proteins are made from 20 different types of amino acid monomers [1].
        - Polysaccharides are usually made from only one type of monomer (glucose) [1].
        - The amino acids can be arranged in any sequence and length, creating a huge variety of possible protein molecules [1].
4. **List** the four organic bases found in DNA and **state** how they pair up.
    - *Marking points:*
        - The four bases are Adenine, Thymine, Cytosine, Guanine [1].
        - Adenine (A) pairs with Thymine (T) [1].
        - Cytosine (C) pairs with Guanine (G) [1].
5. **Describe** the positive result for the test for a reducing sugar and name the reagent used.
    - *Marking points:*
        - Reagent: Benedict's solution [1].
        - Positive result (after heating): A precipitate forms that is green, yellow, or brick-red [1].

Structured Questions

1. The table below shows the chemical elements present in three biological molecules, A, B, and C.

Molecule	Carbon	Hydrogen	Oxygen	Nitrogen
A	✓	✓	✓	✗
B	✓	✓	✓	✓
C	✓	✓	✓	✗

a) **Identify** molecule B. [1]

b) Molecule A is a polysaccharide and molecule C is a fat. **State** one other difference in their chemical structure. [1]

c) **Describe** a food test you would carry out to confirm the identity of molecule B. **Include** the expected result. [3]

- *Model Answer & Marking Points:*

  a) Protein [1]. *It is the only one listed containing Nitrogen.*

  b) Molecule A (polysaccharide) is a polymer made of glucose monomers [1]. Molecule C (fat) is made from glycerol and fatty acids [1]. *(Only 1 point needed)*

  c) **Test**: Biuret test [1]. **Method**: Add sodium hydroxide solution, then add copper sulfate solution [1]. **Result**: The solution would turn purple/violet [1].

2. DNA is an important biological molecule found in the nucleus.

a) **Describe** the overall shape of a DNA molecule. [2]

b) A short section of one strand of DNA has the base sequence: **A – G – G – C – T – A**

i) **State** the base sequence of the opposite, complementary strand. [1]

ii) **Name** the three components that make up a single nucleotide. [3]

- *Model Answer & Marking Points:*

  a) It is a double helix [1], which looks like a twisted ladder [1].

  b) i) T – C – C – G – A – T [1].

  b) ii) Phosphate group [1], Deoxyribose sugar [1], and an Organic base [1].

12) Quick revision checklist

- ☐ I can list the chemical elements found in carbohydrates, fats, and proteins.
- ☐ I can define monomer and polymer and give a biological example of each.
- ☐ I know that glucose is a monosaccharide.
- ☐ I can name three polysaccharides: starch, glycogen, and cellulose.
- ☐ I can state the function and location (plant/animal) of starch, glycogen, and cellulose.
- ☐ I can describe the structure of a fat as 1 glycerol and 3 fatty acids.
- ☐ I know that proteins are made from chains of amino acids.
- ☐ I can describe the test for starch (Iodine solution).
- ☐ I can describe the test for reducing sugars (Benedict's solution and heat).
- ☐ I can describe the test for protein (Biuret test).
- ☐ I can describe the test for fat (Ethanol emulsion test).
- ☐ I can describe the structure of DNA as a double helix.
- ☐ I know the four bases in DNA are A, T, C, and G.
- ☐ I can state the complementary base pairing rule (A-T, C-G).

13) Flashcards (ready-to-use)

Question	Answer
Q1: What are the three chemical elements in all carbohydrates?	[cite_start]Carbon, Hydrogen, and Oxygen (C, H, O) (p. 2)[cite: 25].
Q2: What is the monomer of a protein?	[cite_start]Amino acid (p. 7)[cite: 87].

Question	Answer
Q3: What is the monomer of starch?	[cite_start]Glucose (p. 3)[cite: 50].
Q4: What are the sub-units of a fat molecule?	[cite_start]One glycerol and three fatty acids (p. 6)[cite: 67].
Q5: Which biological molecule always contains Nitrogen?	[cite_start]Protein (p. 7)[cite: 86].
Q6: What is the function of cellulose?	[cite_start]To provide structural strength to plant cell walls (p. 3)[cite: 53].
Q7: What is the function of glycogen?	[cite_start]It is the energy storage carbohydrate in animals (p. 3)[cite: 49].
Q8: What reagent is used to test for starch?	[cite_start]Iodine solution (p. 16)[cite: 228].
Q9: What is a positive result for the starch test?	[cite_start]A blue-black colour (p. 16)[cite: 228].
Q10: What reagent is used to test for reducing sugars?	[cite_start]Benedict's solution (p. 16)[cite: 231].
Q11: What is the final colour for a strong positive reducing sugar test?	[cite_start]A brick-red precipitate (p. 16)[cite: 233].
Q12: What two chemicals are needed for the Biuret test for protein?	[cite_start]Sodium hydroxide and copper sulfate solution (p. 16)[cite: 236].
Q13: What is a positive result for the Biuret test?	[cite_start]A purple or violet colour (p. 16)[cite: 237].
Q14: What is the name of the test for fats?	[cite_start]The emulsion test (p. 16)[cite: 241].
Q15: What is the structure of DNA called?	[cite_start]A double helix (p. 9)[cite: 126].
Q16: How do the bases pair up in DNA?	[cite_start]A with T, C with G (p. 9)[cite: 126].
Q17: What three parts make up a nucleotide?	[cite_start]A phosphate, a deoxyribose sugar, and a base (p. 9)[cite: 119].
Q18: What is the difference between a fat and an oil?	[cite_start]Fats are solid at room temperature, oils are liquid (p. 5)[cite: 65].
Q19: What is the chemical formula for glucose?	[cite_start]$C_6H_12O_6$ (p. 2)[cite: 26].
Q20: What is a disaccharide?	[cite_start]A sugar molecule made of two simple sugar units joined together, e.g., maltose (p. 3)[cite: 47].

14) 60-second recap

This chapter covers the four essential biological molecules. **Carbohydrates** (C, H, O) are made from glucose monomers and function for energy (glucose), plant storage (starch), animal storage (glycogen), and plant structure (cellulose). **Fats** (C, H, O) are made from glycerol and fatty acids and are used for energy storage and membranes. **Proteins** (C, H, O, N) are polymers of amino acids and have structural roles and act as enzymes. **DNA** is a double helix polymer of nucleotides, carrying genetic code through its base pairs: A with T, and C with G. You can test for these nutrients: iodine turns blue-black for starch, heating with

Benedict's solution gives a red precipitate for reducing sugar, Biuret reagent turns purple for protein, and ethanol plus water creates a white emulsion for fat.

15) References to pages

- **Amino Acids:** 2, 7, 8, 9
- **Carbohydrates:** 1, 2, 3, 7, 8, 19, 21
- **Cellulose:** 2, 3, 8, 19, 20, 21
- **DNA:** 1, 9, 10, 11, 12, 19
- **Fats/Oils:** 1, 5, 6, 7, 8, 19, 21
- **Fatty Acids:** 6, 8, 12, 19, 21
- **Food Tests:** 1, 16, 17, 18, 19, 20
- **Glucose:** 2, 3, 7, 8, 12, 19, 21
- **Glycerol:** 6, 8, 19, 21
- **Glycogen:** 3, 8, 19, 20, 21
- **Monomers & Polymers:** 1, 2, 21
- **Nucleotides:** 9, 10, 12, 19
- **Proteins:** 1, 2, 6, 7, 8, 19, 21
- **Starch:** 2, 3, 7, 8, 19, 20, 21
- **Vitamin C:** 1, 17, 20

16) Excluded "Going further" sections (not summarized)

Section title	Pages
(Untitled, about glucose vs cellulose properties)	2
Synthesis and conversion in cells	7, 8
(Untitled, about different proteins vs carbohydrates)	9
DNA (history of discovery)	13, 14, 15
Total excluded: 4	