SCHOLAR EYE

10TH CLASS • CHEMISTRY

CHAPTER 13

Biochemistry

Complete Exercise Solutions

Short & Long Questions • Solved with Explanations

20	8	✓
Short Answer Questions	Long Answer Questions	Explained Step by Step

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Chapter 13 – Biochemistry

This chapter exercise contains **20 Short Answer Questions** and **8 Long Answer Questions**. Every question is solved completely, with the answer highlighted and an explanation to build understanding.

✎ SHORT ANSWER QUESTIONS

1 How plants synthesize carbohydrates?

✔ ANSWER

Plants synthesize carbohydrates through a process called **photosynthesis**.

★ EXPLANATION

During photosynthesis, plants use sunlight, water (H_2O), and carbon dioxide (CO_2) in the presence of **chlorophyll** (the green pigment in leaves) to produce glucose (a carbohydrate) and oxygen.

Equation:

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

(in the presence of Sunlight and Chlorophyll)

2 Give the characteristics of monosaccharides.

✔ ANSWER

- They are the simplest form of carbohydrates and cannot be hydrolyzed further.
- They are sweet in taste and soluble in water.
- They are crystalline solids.
- They have the general formula $(CH_2O)_n$, where n ranges from 3 to 7.

★ EXPLANATION

Monosaccharides are single sugar molecules (like glucose and fructose). Because their molecules are small, they dissolve easily in water and taste sweet.

3 What is the difference between glucose and fructose?

✔ ANSWER

- **Glucose** is an **aldohexose** (contains an aldehyde group, –CHO) and is found in grapes, honey, and human blood.
- **Fructose** is a **ketohexose** (contains a ketone group, –C=O) and is found in fruits and honey. Fructose is sweeter than glucose.

★ EXPLANATION

Although both have the same chemical formula ($C_6H_{12}O_6$), the arrangement of atoms is different, making them structural isomers.

4 Give an example of a disaccharide. How is it hydrolyzed into monosaccharides?

✔ ANSWER

Sucrose (table sugar) is a common disaccharide. It is hydrolyzed by boiling with dilute acid or by the enzyme **sucrase** (invertase), breaking the glycosidic bond to yield one molecule of glucose and one molecule of fructose.

★ **EXPLANATION**

Hydrolysis means “breaking with water.” Water molecules break the bond linking the two sugars together.

5 Give the characteristics of polysaccharides.

✔ **ANSWER**

- They are complex carbohydrates made of thousands of monosaccharide units.
- They are tasteless and mostly insoluble in water (or form colloids).
- They have a very high molecular weight.
- Examples include starch, cellulose, and glycogen.

★ **EXPLANATION**

Because polysaccharides are massive macromolecules, they do not dissolve easily, and their size prevents them from binding to sweet-taste receptors on our tongues.

6 Where are the proteins found?

✔ ANSWER

Proteins are found in every living cell. In the human body, they make up muscles, skin, hair, nails, enzymes, hormones, and hemoglobin. Dietary sources include meat, eggs, dairy, beans, and nuts.

★ EXPLANATION

Proteins are the “building blocks” of life; they are essential for the structure and function of all biological tissues.

7 Describe the uses of carbohydrates.

✔ ANSWER

- **Energy Source:** Glucose is the primary immediate energy source for cells.

- **Energy Storage:** Excess glucose is stored as starch in plants and glycogen in animals.
- **Structure:** Cellulose provides structural support in plant cell walls.
- **Cellular components:** Ribose and deoxyribose are part of RNA and DNA.

★ **EXPLANATION**

Carbohydrates are primarily used for quick energy, but they also play crucial structural roles in biology.

8 Lactose is a disaccharide; which monosaccharides are present in it?

✔ **ANSWER**

Lactose (milk sugar) is composed of **glucose** and **galactose**.

★ **EXPLANATION**

When lactose is digested by the enzyme lactase, it breaks down into these two simple sugars.

9 Why are the ten amino acids essential for us?

✔ ANSWER

They are called “essential” because the human body **cannot synthesize** them on its own. They must be obtained through our diet.

★ EXPLANATION

Out of the 20 standard amino acids, our bodies can make 10 (non-essential). The other 10 must come from protein-rich foods to maintain proper health.

10 How are proteins formed?

✔ ANSWER

Proteins are formed by the **condensation polymerization** of amino acids.

★ EXPLANATION

Amino acids link together when the carboxyl group (–COOH) of one reacts with the amino group ($–NH_2$) of another, releasing a water molecule and forming a **peptide bond**. A long chain of these is a polypeptide, which folds into a functional protein.

11 How is gelatin obtained?

✔ ANSWER

Gelatin is obtained by boiling animal bones, skin, and connective tissues in water.

★ EXPLANATION

This process denatures (breaks down) the collagen protein found in connective tissues, extracting the soluble gelatin.

12 Give the general formula of the lipids.

✔ ANSWER

Lipids are a diverse group, so they don’t have a single simple formula. However, the most common lipids (fats and oils/triglycerides) are formed from glycerol and three fatty acids. The general formula for a **fatty acid** is **R–COOH** (where R is a long hydrocarbon chain).

★ EXPLANATION

Because lipids are defined by their solubility (insoluble in water, soluble in organic solvents) rather than a single formula, we represent them by their components.

13 Name two fatty acids with their formulae.

✔ ANSWER

- **Palmitic acid** (Saturated): $C_{15}H_{31}COOH$
- **Oleic acid** (Unsaturated): $C_{17}H_{33}COOH$

★ EXPLANATION

Saturated fatty acids have only single bonds in their carbon chain, while unsaturated ones have one or more double bonds.

14 Give the types of vitamins.

✔ ANSWER

- **Fat-soluble vitamins:** A, D, E, and K.
- **Water-soluble vitamins:** B-complex (B1, B2, B3, etc.) and Vitamin C.

★ EXPLANATION

The solubility determines how the body absorbs, transports, and stores them.

15 What is the significance of vitamins?

✔ ANSWER

Vitamins are essential for normal growth, metabolism, and preventing diseases. They act as coenzymes (B-vitamins), antioxidants (C & E), and are crucial for vision (A), bone health (D), and blood clotting (K).

★ EXPLANATION

The body needs vitamins in tiny amounts, but they are vital for regulating chemical reactions within cells.

16 Describe the sources and uses of vitamin A.

✔ ANSWER

- **Sources:** Carrots, sweet potatoes, spinach, liver, eggs, and dairy.

- **Uses:** Essential for vision (forms rhodopsin in the retina), supports the immune system, and maintains healthy skin.

★ **EXPLANATION**

Vitamin A deficiency can lead to night blindness.

17 Justify that water soluble vitamins are not injurious to health.

✔ **ANSWER**

Water-soluble vitamins are not injurious in excess because they are not stored in the body's fat tissues. Any excess amount is simply dissolved in water and excreted through the urine.

★ **EXPLANATION**

Unlike fat-soluble vitamins (A, D, E, K) which can accumulate and cause toxicity (hypervitaminosis), water-soluble vitamins are flushed out daily, making overdose highly unlikely.

18 What do you mean by genetic code of life?

✔ ANSWER

The genetic code is the specific sequence of nucleotides (A, T, C, G) in DNA molecules that determines the sequence of amino acids during protein synthesis.

★ EXPLANATION

Think of DNA as a recipe book. The genetic code is the language (the specific order of letters) that tells the cell exactly how to build proteins.

19 What is the function of DNA?

✔ ANSWER

DNA stores genetic information necessary for the growth, development, and functioning of an organism. It is responsible for passing traits from one generation to the next (heredity).

★ EXPLANATION

DNA acts as the long-term storage of biological instructions.

20 How do you justify that RNA works like a messenger?

✔ ANSWER

RNA works like a messenger because a specific type called **mRNA (messenger RNA)** carries the genetic instructions transcribed from DNA in the nucleus to the ribosomes in the cytoplasm, where proteins are synthesized.

★ EXPLANATION

DNA is too large to leave the nucleus. RNA acts as the copy that travels to the protein factories (ribosomes) to deliver the blueprint.

✎ LONG ANSWER QUESTIONS

1 What are carbohydrates? How monosaccharides are prepared? Give their characteristics.

✔ COMPLETE ANSWER

Definition:

Carbohydrates are organic compounds containing carbon, hydrogen, and oxygen, usually with a hydrogen-to-oxygen ratio of 2:1 (like water). They are polyhydroxy aldehydes or ketones.

Preparation of Monosaccharides:

They are prepared industrially or biologically by the **hydrolysis** of disaccharides or polysaccharides. For example, boiling sucrose with dilute acid or using the enzyme invertase yields glucose and fructose.

Characteristics:

1. They are the simplest sugars (e.g., glucose, fructose).
2. They cannot be hydrolyzed into smaller sugar units.

3. They are sweet in taste.
4. They are highly soluble in water.
5. They act as reducing agents (they can reduce Tollens' and Fehling's reagents).
6. They exist mostly as crystalline solids.

2 Explain oligosaccharides.

✔ **COMPLETE ANSWER**

Explanation:

Oligosaccharides are carbohydrates that yield **2 to 10** monosaccharide units upon hydrolysis. They are formed by the condensation of a few monosaccharides linked by glycosidic bonds.

Types:

- **Disaccharides (2 units):** Sucrose (glucose + fructose), Lactose (glucose + galactose), Maltose (glucose + glucose).
- **Trisaccharides (3 units):** Raffinose.

Properties:

They are crystalline solids, sweet in taste, and soluble in water. They are important in cell recognition and signaling.

3 What are polysaccharides? Give their properties.

✔ COMPLETE ANSWER

Definition:

Polysaccharides are complex, high-molecular-weight carbohydrates composed of long chains of hundreds to thousands of monosaccharide units linked by glycosidic bonds.

Properties:

1. They are macromolecules (very large molecules).
2. They are tasteless and generally not sweet.
3. They are insoluble in water, but some form colloidal solutions or absorb water to swell up.
4. They are non-reducing (they do not react with Fehling's solution).
5. **Examples:** Starch (energy storage in plants), Glycogen (energy storage in animals), Cellulose (structural component in plant cell walls).

4 Explain the sources and uses of proteins.

✔ COMPLETE ANSWER

Sources:

- *Animal sources:* Meat, poultry, fish, eggs, milk, and cheese (complete proteins).
- *Plant sources:* Lentils, beans, soybeans, peanuts, and whole grains (incomplete proteins).

Uses:

1. **Growth and Repair:** Proteins are the building blocks of muscles, skin, hair, and nails.
2. **Enzymes:** They act as biological catalysts to speed up chemical reactions.
3. **Hormones:** Some proteins (like insulin) regulate body functions.
4. **Transport:** Hemoglobin transports oxygen in the blood.
5. **Defense:** Antibodies fight infections.
6. **Energy:** Proteins can be broken down for energy if carbohydrates and fats are depleted.

5 Explain that amino acids are building blocks of proteins.

✔ COMPLETE ANSWER

Explanation:

Amino acids are organic molecules containing an amino group ($–NH_2$) and a carboxyl group (–COOH) attached to the same carbon atom (the alpha-carbon).

Peptide Bond:

When the carboxyl group of one amino acid reacts with the amino group of another, a water molecule is removed (dehydration synthesis), and a **peptide bond** is formed.

Chain Formation:

Two amino acids form a dipeptide, three form a tripeptide, and a long chain forms a polypeptide. These polypeptides fold into specific three-dimensional shapes to become functional proteins. Since thousands of amino acids link up to create proteins, they are called the “building blocks” of proteins.

6 Explain the sources and uses of lipids.

✔ COMPLETE ANSWER

Sources:

- *Animal fats:* Butter, ghee, lard, and fatty meats.
- *Plant oils:* Olive oil, sunflower oil, coconut oil, and nuts.

Uses:

1. **Energy Storage:** Lipids store more than twice the energy per gram compared to carbohydrates.
2. **Insulation:** Fat layers under the skin help maintain body temperature.
3. **Protection:** They act as shock absorbers, protecting vital organs like the heart and kidneys.
4. **Cell Membranes:** Phospholipids are the main structural component of cell membranes.
5. **Hormones:** Steroid hormones (like testosterone and estrogen) are lipids.
6. **Vitamin Absorption:** They help in absorbing fat-soluble vitamins (A, D, E, K).

7 Give the importance of vitamins.

✔ COMPLETE ANSWER

Importance:

Vitamins are essential organic micronutrients required in small amounts for normal metabolism and health.

1. **Coenzymes:** B-complex vitamins act as coenzymes to help enzymes release energy from food.
2. **Vision:** Vitamin A is crucial for the retina’s ability to process light.
3. **Bone Health:** Vitamin D aids in the absorption of calcium and phosphorus for strong bones.
4. **Antioxidants:** Vitamins C and E protect cells from damage by free radicals.
5. **Blood Clotting:** Vitamin K is essential for the synthesis of clotting proteins.
6. **Prevention of Deficiency Diseases:** They prevent conditions like scurvy, rickets, beriberi, and night blindness.

8 Describe the sources, uses and deficiency symptoms of water soluble vitamins.

✔ **COMPLETE ANSWER**

Vitamin B-Complex (e.g., B1, B2, B3, B12):

- *Sources:* Whole grains, legumes, meat, eggs, leafy greens.
- *Uses:* Essential for energy metabolism, red blood cell formation, and nervous system health.
- *Deficiency:* B1 (Beriberi – nerve damage), B3 (Pellagra – dermatitis/dementia), B12 (Anemia).

Vitamin C (Ascorbic Acid):

- *Sources:* Citrus fruits (oranges, lemons), tomatoes, bell peppers, spinach.
- *Uses:* Required for collagen synthesis (wound healing), acts as an antioxidant, and boosts immune function.
- *Deficiency:* Scurvy (bleeding gums, slow wound healing, bruising).

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