Biological Molecules | Solved Exercise

Multiple Choice Questions (MCQs)

i. Polyhydroxy compounds of aldehyde and ketones are called:

Answer: I. Carbohydrates

ii. Wheat, Rice and honey are sources of:

Answer: III. Carbohydrates

iii. _____ is a basic component of paper industry:

Answer: I. Cellulose

iv. Polymers of amino acids are:

Answer: II. Proteins

v. Nucleic acids are of _____ types:

Answer: I. Two (DNA and RNA)

vi. Vitamin _____ is called ascorbic acid:

Answer: III. C

vii. Fats and oils are called:

Answer: II. Lipids

viii. _____ is a factor related to blood clotting:

Answer: iv. Vitamin K

Short Answers

i. Describe some sources and uses of carbohydrates.

Sources: Wheat, rice, maize, potato, sugar cane, honey, fruits and vegetables.

Uses:

- They are the main source of energy for the body (1g gives 4 kcal)
- Glucose is the primary fuel for brain cells
- Cellulose is used in paper and textile industries
- Starch is used as food and in making glue
- Glycogen is stored in liver and muscles as an energy reserve

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ii. Explain bonding in protein molecules.

Proteins are made of amino acids joined by peptide bonds. When two amino acids combine, the —COOH (carboxyl) group of one amino acid reacts with the —NH_2 (amino) group of another amino acid. A water molecule (H_2O) is released in this reaction. The resulting bond is called a peptide bond (–CO–NH–). When many amino acids join together in this way, a long chain called a polypeptide is formed, which is the basic structure of a protein.

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iii. What is meant by denaturing proteins?

Denaturation is the process in which a protein loses its natural 3D shape due to external factors such as heat, acid, alkali or UV radiation. The bonds that hold the protein's structure together (hydrogen bonds, disulfide bonds) break, causing the protein to unfold. As a result, the protein loses its biological activity. For example, when an egg is boiled, the egg white (albumin protein) turns solid — this is denaturation. The process is usually irreversible.

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iv. Describe the difference between fats and oils.

Fats	Oils
Solid at room temperature	Liquid at room temperature
From animal sources (butter, ghee, lard)	From plant sources (sunflower, olive)
Contain saturated fatty acids	Contain unsaturated fatty acids
Higher melting point	Lower melting point

Note: Both fats and oils are esters of glycerol and fatty acids and belong to the lipid family.

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v. Write a brief composition of nucleic acid.

A nucleic acid is made up of repeating units called nucleotides. Each nucleotide has three parts:

- Phosphate group (H_3PO_4)
- Pentose sugar — ribose (in RNA) or deoxyribose (in DNA)
- Nitrogenous base — Adenine (A), Guanine (G), Cytosine (C), Thymine (T) in DNA; Uracil (U) replaces Thymine in RNA

Nucleotides are joined together by phosphodiester bonds to form a long nucleic acid chain.

Comprehensive Questions

i. What are carbohydrates? Explain classification of carbohydrates.

Definition: Carbohydrates are polyhydroxy compounds of aldehydes and ketones. They are organic compounds containing Carbon (C), Hydrogen (H) and Oxygen (O) with the general formula $(CH_2O)n$.

Classification:

1. Monosaccharides — The simplest carbohydrates that cannot be broken down further by hydrolysis.

- Examples: Glucose, Fructose, Galactose (all have formula $C_6H_{12}O_6$)

2. Disaccharides — Formed by joining two monosaccharide units with loss of water.

- Sucrose = Glucose + Fructose
- Maltose = Glucose + Glucose
- Lactose = Glucose + Galactose

3. Polysaccharides — Large polymers made of many monosaccharide units joined together.

- Starch — stored in plants, food source for humans
- Glycogen — stored in animal liver and muscles
- Cellulose — makes up plant cell walls, used in paper industry

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ii. Describe proteins, the nature of bonding in protein and their uses.

Definition: Proteins are large biological molecules (polymers) made up of long chains of amino acids. They contain C, H, O, N and sometimes S and P.

Nature of Bonding: Amino acids are joined by peptide bonds. This bond forms between the —COOH group of one amino acid and the $—NH_2$ group of the next, releasing a water molecule. The structure of protein has four levels:

- Primary — sequence of amino acids in the chain
- Secondary — chain folds into alpha helix or beta-pleated sheet
- Tertiary — 3D folding of the polypeptide chain
- Quaternary — multiple polypeptide chains combine together

Uses of Proteins:

- Enzymes (biological catalysts) control all metabolic reactions

- Antibodies provide immunity against diseases
- Hemoglobin transports oxygen in blood
- Keratin forms hair, nails and skin
- Hormones like insulin regulate body functions
- Essential for growth and repair of body tissues

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iii. Explain lipids with classification, sources and uses.

Definition: Lipids are organic compounds insoluble in water but soluble in organic solvents like ether and chloroform. They are esters of fatty acids and glycerol.

Classification:

- Fats — solid at room temperature, from animal sources, contain saturated fatty acids
- Oils — liquid at room temperature, from plant sources, contain unsaturated fatty acids
- Waxes — hard solid lipids (beeswax, carnauba wax)
- Phospholipids — major component of cell membranes
- Steroids — Example: cholesterol, sex hormones

Sources:

- Animal sources: meat, fish, eggs, butter, milk
- Plant sources: nuts, seeds, olive, coconut, soybean

Uses:

- Major energy reserve (1g gives 9 kcal)
- Protect and insulate body organs
- Help absorb fat-soluble vitamins (A, D, E, K)
- Phospholipids form cell membranes
- Used in making soap and cosmetics

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iv. What are nucleic acids? Describe types, composition and functions.

Definition: Nucleic acids are large biomolecules that store and transmit genetic information. They are polymers of nucleotides. The name comes from the nucleus of the cell where they were first discovered.

Types:

1. DNA (Deoxyribonucleic Acid)

- Double-stranded helix structure
- Contains deoxyribose sugar
- Bases: Adenine, Guanine, Cytosine, Thymine
- Found mainly in the nucleus

2. RNA (Ribonucleic Acid)

- Usually single-stranded
- Contains ribose sugar
- Bases: Adenine, Guanine, Cytosine, Uracil (no Thymine)
- Found in nucleus and cytoplasm

Composition — each nucleotide has:

- A phosphate group
- A pentose sugar (ribose or deoxyribose)
- A nitrogenous base

Functions:

- DNA stores genetic information and passes it from parent to offspring
- RNA carries instructions from DNA to ribosomes for protein synthesis
- Both control all cellular activities through protein synthesis

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v. What are vitamins and how are they classified?

Definition: Vitamins are organic compounds required in small amounts for normal growth, health and metabolism. The body cannot make most vitamins on its own so they must be obtained from food. Their deficiency causes specific diseases.

Classification:

1. Fat-Soluble Vitamins — dissolve in fats and oils, stored in body fat and liver.

Vitamin	Chemical Name	Deficiency Disease
A	Retinol	Night blindness
D	Calciferol	Rickets
E	Tocopherol	Infertility, muscle weakness
K	Phylloquinone	Poor blood clotting

2. Water-Soluble Vitamins — dissolve in water, not stored in body, must be taken daily.

Vitamin	Chemical Name	Deficiency Disease
B_1	Thiamine	Beri-beri
B_{12}	Cobalamin	Anemia
C	Ascorbic Acid	Scurvy