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Biochemistry

Sem-II

Important Questions & Solutions

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UNIT- I

10/15 MARKS

Q.1. Introduction, classification and biological role of carbohydrate.

→ **ANSWER:** **INTRODUCTION**

- Carbohydrates are organic compounds made up of carbon, hydrogen and oxygen, usually in the ratio of 1 : 2 : 1.
- They are also known as saccharides and are one of the main types of nutrients in our food.
- Carbohydrates are the primary and immediate source of energy for the body.

- **CLASSIFICATION**
- Carbohydrates are classified based on the number of sugar (saccharide) units they contain :

	Type	No. of Sugar units	Examples.
1.	Monosaccharides	1	Glucose, Fructose, Galactose.
2.	Disaccharides	2	Sucrose, Lactose, Maltose

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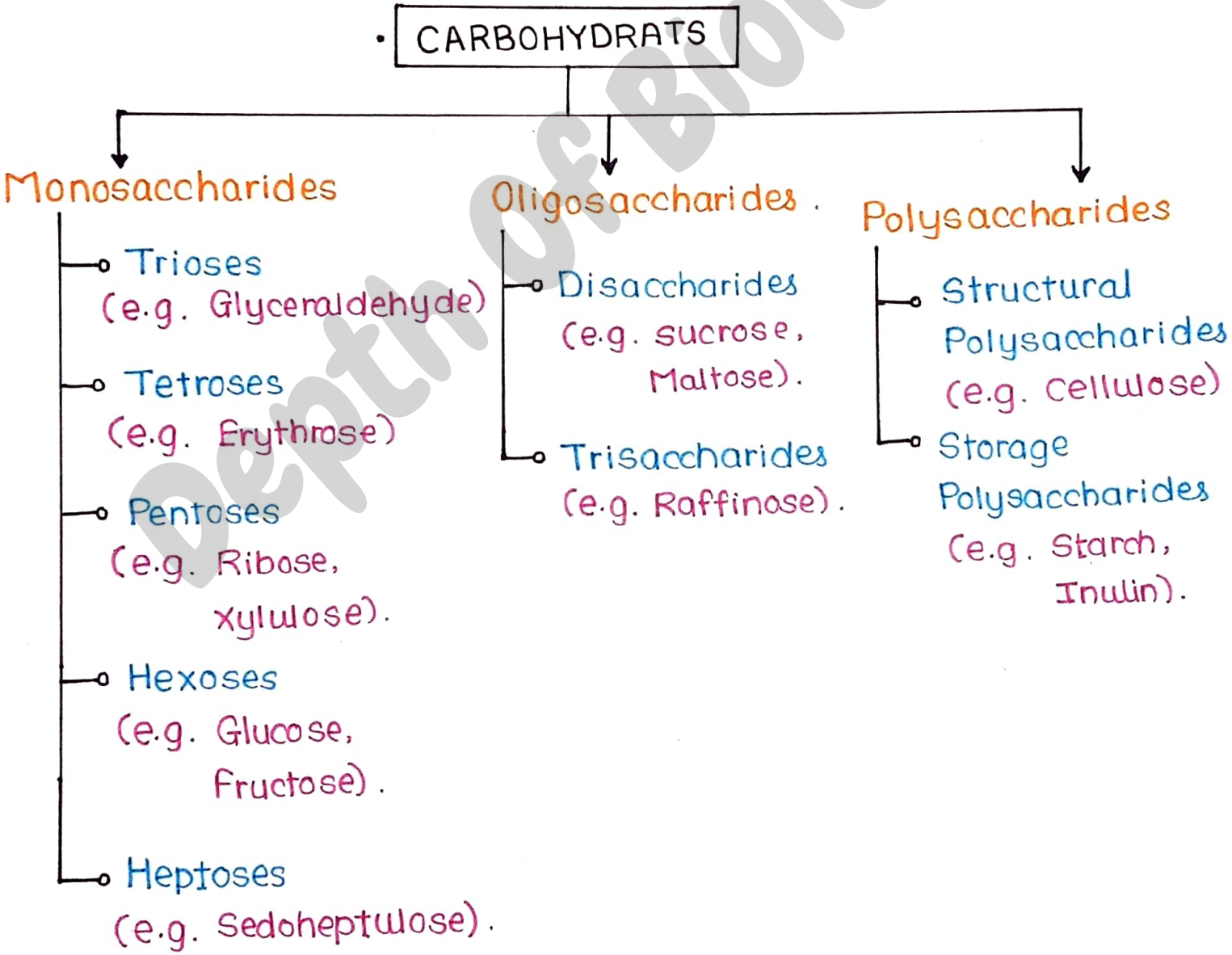
3.	Oligosaccharides	3-10	Raffinose, Stachyose.
4.	Polysaccharides	>10	Starch, Glycogen, Cellulose, Chitin.



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1. Monosaccharides

- These are the simplest form of carbohydrates, containing a single sugar unit.
- They cannot be hydrolyzed into simpler carbohydrates.
- TYPES :

Name	No. of Carbon	Examples.
Triose	3	Glyceraldehyde
Tetrose	4	Erythrose
Pentose	5	Ribose, Deoxyribose
Hexose	6	Glucose, Fructose, Galactose.
Heptose	7	Sedoheptulose

2. DISACCHARIDES

- Formed by the condensation of two monosaccharide units linked by a glycosidic bond.
- Examples :
- Sucrose $\xrightarrow{\text{Hydrolysis}}$ Glucose + Fructose [Table sugar]

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- Lactose = Glucose + Galactose
  on hydrolysis gives 1 unit of Glucose and 1 unit of Galactose.

- Maltose $\xrightarrow[\text{Hydrolysis}]{\text{On}}$ Glucose + Glucose
  [formed during starch digestion].

3. Oligosaccharides

- Contains 3 to 10 monosaccharide units.
- They are commonly found in glycoproteins and cell membranes.
- Examples : ·Raffinose $\xrightarrow[\text{Hydrolysis}]{\text{On}}$ Galactose + Glucose + Fructose
- Stachyose $\xrightarrow[\text{Hydrolysis}]{\text{On}}$ 2 Galactose + Glucose + Fructose.

4. Polysaccharides

- Large and complex carbohydrates made up of more than 10 monosaccharide units
- They can be branched or unbranched, and are insoluble in water.

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- TYPES :

A) Storage Polysaccharides:

- Starch (plants) : mixture of amylose and amylopectin.
- Glycogen (animals): stored in liver and muscles.

B) Structural Polysaccharides :

- Cellulose : plant cell wall; indigestable in humans.
- Chitin: exoskeleton of insects and crustaceans.

- **BIOLOGICAL ROLE OF CARBOHYDRATES**

- Carbohydrates play vital role in the structure and function of all living organisms.
- Their biological importance includes:

1. Primary Source of Energy

- Carbohydrates like glucose provide immediate energy through glycolysis and the TCA cycle.
- Each gram of carbohydrate provides 4 Kcal of energy

2. Energy Storage

- Starch in plants and glycogen in animals act as storage forms of glucose.

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- These can be broken down when the body needs energy.

3. Structural Component

- Cellulose provides structural strength to plant cell walls.
- Chitin forms the exoskeleton of insects and crustaceans.

4. Sparing Protein Function

- When carbohydrates are available, they prevent proteins from being used as an energy source.
- This helps proteins focus on growth and repair.

5. Fat metabolism Regulation

- Carbohydrates help in the complete oxidation of fats.
- Lack of carbs can lead to ketone body production (ketosis).

6. Component of Genetic Material

- The sugars ribose and deoxyribose are part of RNA and DNA, respectively.

7. Formation of Coenzymes

- Carbohydrates form part of important coenzymes

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like NAD^+, FAD and ATP.

8. Cell Recognition and communication

- Glycoproteins and glycolipids on cell membranes are involved in cell signaling, recognition and immunity.

9. Digestive Health (Dietary fiber)

- Cellulose and other fibers aid in digestion and prevent constipation.
- Help maintain healthy gut flora.

10. Detoxification

- Some carbohydrate derivatives participate in detoxifying harmful substances in the liver (e.g. glucoronic acid).

- Carbohydrates are not just energy-giving nutrients; they also support cell structure, metabolism, DNA formation, and overall health.

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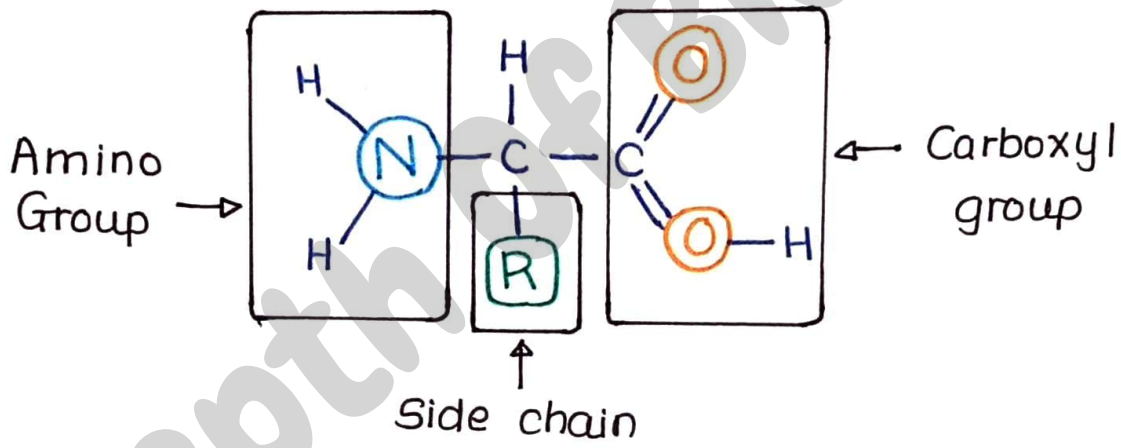
- **2 marks / 3 marks / MCQ**

Q.1 Explain proteins.

ANSWER: PROTEIN

- **Definition:** Proteins are large, complex biomolecules made up of long chains of amino acids linked by peptide bonds.



- Proteins are essential for growth, repair, and maintenance of body tissues.
- They act as enzymes, hormones, antibodies, and structural components of cells.
- **Examples:** Hemoglobin (carries oxygen), Insulin (controls blood sugar).

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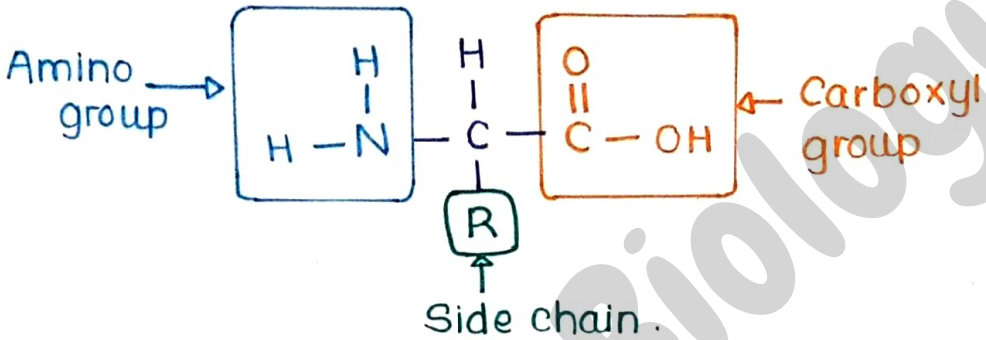
Q.2 Explain amino acid.

ANSWER: AMINO ACID

Definition : • Amino acids are organic compounds that serve as the building blocks of proteins.



• General structure of Amino acids.

- Each amino acid contains an amino group ($-NH_2$), a carboxyl group ($-COOH$) and a unique side chain (R- group).
- There are 20 different amino acids, and some must be obtained from the diet (essential amino acids).
- **Examples**: Glycine, valine, Leucine.

Q.3 Explain Lipid.

ANSWER: LIPID

Definition : Lipids are a group of naturally occurring hydrophobic (water-insoluble) molecules, including fats, oils, waxes and steroids.

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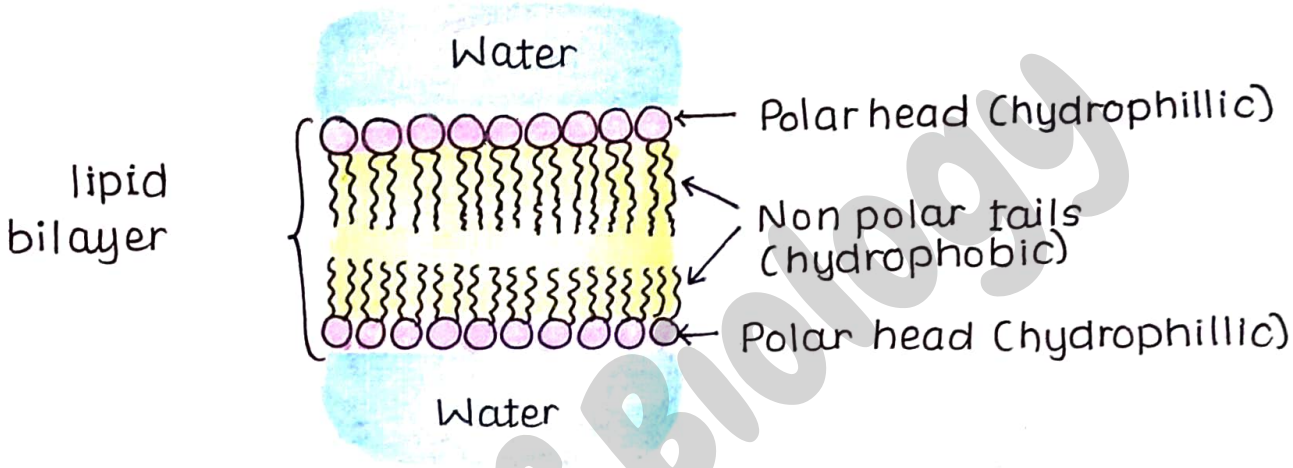
- Lipids are important for energy storage, forming cell membranes (phospholipids) and insulation.

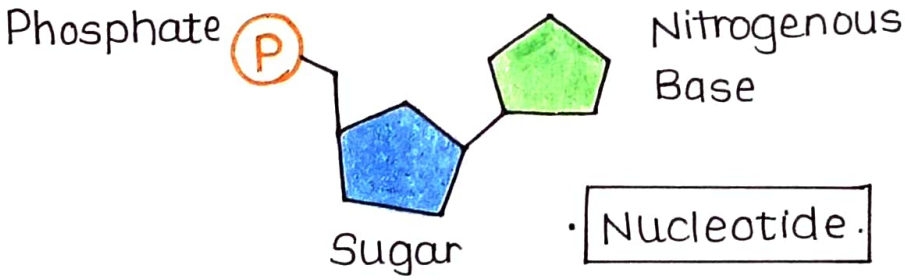
- **Examples** : Triglycerides (stored fat), cholesterol (important for hormones and membranes).



Q.4. Explain Nucleic Acid

⇨ **ANSWER** : Nucleic Acid

Definition : Nucleic acids are large biomolecules that store and transfer genetic information in cells.



- **Nucleotide**.

- There are two main types:
  - DNA (Deoxyribonucleic acid): carries the genetic blueprint.

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- RNA (Ribonucleic acid): helps in protein synthesis
- They are made up of units called nucleotides. (sugar + phosphate + Nitrogen base).
- They control heredity and protein synthesis in body.

Q.5 Explain endergonic & exergonic reactions

⇨ **ANSWER**: ENDERGONIC REACTION

Definition: An endergonic reaction is a chemical reaction that requires energy input to proceed.

- In endergonic reactions, the products have more energy than the reactants. Since energy is absorbed, these reactions do not happen on their own. (non-spontaneous).
- They usually occur with the help of energy sources like sunlight or ATP.

Example: Photosynthesis - Plants use sunlight (energy) to convert carbon dioxide and water into glucose.

- EXERGONIC REACTION
- Definition: An exergonic reaction is a chemical reaction that releases energy.
- In exergonic reactions, the products have less energy than the reactants.

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- Energy is released in the form of heat or ATP and these reactions are usually spontaneous (happen on their own).
- **Example**: Cellular respiration - Glucose is broken down to release energy in the form of ATP.

Q.6 Explain redox potential.

⇨ **ANSWER** : REDOX POTENTIAL

- **Definition**: Redox potential (also called oxidation-reduction potential potential or E°) is a measure of the ability of a chemical species to gain or lose electrons in a redox (reduction-oxidation) reaction.
- If a substance gains electrons, it get reduced.
- If it loses electrons, it gets oxidized.
- Redox potential tells us how easily a molecule can accept or donate electrons.
- A higher redox potential means the substance easily gains electrons (strong oxidizing agent).
- A lower redox potential means it easily loses electrons (strong reducing agent).

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Q.7 Write down the biological significance of ATP.

ANSWER : BIOLOGICAL SIGNIFICANCE OF ATP

1. ATP is the main energy carrier in all living cells.
2. It provides energy for cellular processes like metabolism and biosynthesis.
3. ATP powers muscle contraction, enabling movement.
4. It supplies energy for active transport, moving substances across cell membranes.
5. ATP is essential for DNA and RNA synthesis during cell division and protein production.
6. It plays a role in cell signaling and communication.
7. Without ATP, cells cannot perform vital functions and would die.
8. ATP is continuously regenerated to meet the energy needs of the cell.

.This makes ATP essential for Life.

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Q.8 Define cyclic AMP

⇨ **ANSWER** : CYCLIC AMP

- **Definition**: · Cyclic AMP (cAMP) is a cyclic form of adenosine monophosphate that acts as a second messenger in cells.
- cAMP is produced from ATP by the enzyme adenylate cyclase when a hormone or signal binds to a receptor on the cell surface.
- It helps carry the signal inside the cell to activate specific proteins, such as protein kinase A (PKA).
- This activation leads to changes in cell functions like metabolism, gene expression and cell growth.
- Thus, cAMP plays an important role in transmitting and amplifying signals within the cell.

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