CHEMISTRY – CLASS 10

BIOCHEMISTRY SLO's

1. Is sucrose di saccharide or tri saccharide? Argue

   Ans: Sucrose is a disaccharide, not a trisaccharide. It is made up of two monosaccharides: glucose and fructose, which are linked by a glycosidic bond. In contrast, a trisaccharide would consist of three monosaccharide units. The bond between glucose and fructose in sucrose is formed when a glucose molecule's hydroxyl group reacts with fructose's hydroxyl group, resulting in the release of a water molecule. This structure and composition confirm that sucrose is a disaccharide.

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2. What is rectified spirit?

Ans: Rectified spirit is highly concentrated ethanol, typically around 95% alcohol by volume. It is produced by distilling ethanol multiple times to remove impurities and water. This purification process results in a nearly pure form of alcohol, which is colorless and odorless. Rectified spirit is commonly used in industrial applications, as a solvent, or as an ingredient in the production of alcoholic beverages. Due to its high alcohol content, it is not suitable for direct consumption without further processing.

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3. Differentiate between polysaccharides & oligosaccharides.

   Ans:

Feature	Polysaccharides	Oligosaccharides
Definition	Long chains of monosaccharide units (more than 10).	Short chains of 2-10 monosaccharides.
Examples	Starch, cellulose, glycogen.	Raffinose, maltotriose.
Size	Large, polymeric molecules.	Small, shorter chains.
Function	Energy storage, structural support.	Serve as intermediate energy sources, cell recognition.
Solubility	Often insoluble in water.	Soluble in water.
Bond Type	Connected by glycosidic bonds.	Connected by glycosidic bonds.

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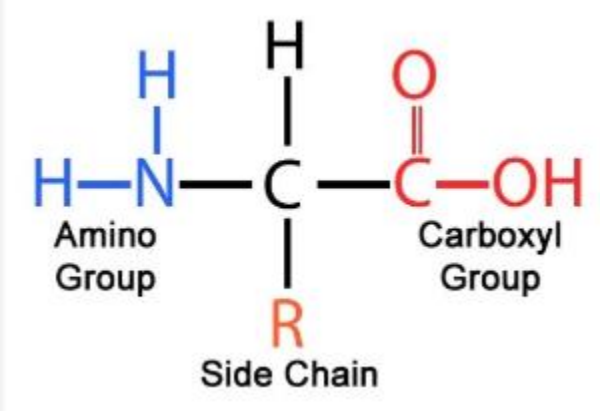
4. What is the structure of amino acids? Also, identify its functional group.

Ans:



The **functional groups** are:

- **Amino group (-NH_2)**
- **Carboxyl group (-COOH)**

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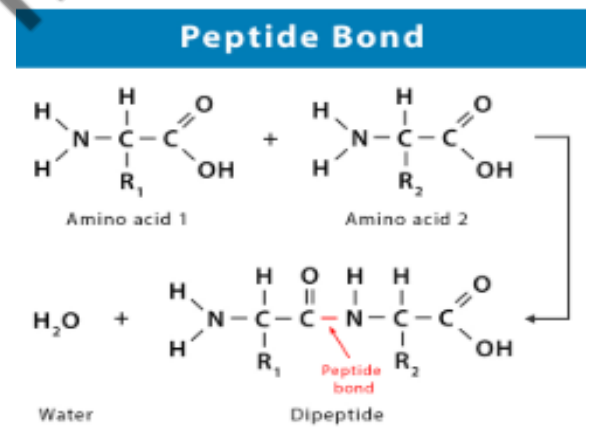
5. How dipeptide bond is formed? / show linkage of amino acid. / write formation of dipeptide bond.

Ans: A **dipeptide bond** is formed through a **condensation reaction** between two amino acids. Here's the process:

1. **Amino group (-NH_2)** of one amino acid reacts with the **carboxyl group (-COOH)** of another amino acid.
2. This reaction releases a molecule of **water (H_2O)**.
3. A **peptide bond (-CO-NH-)** is formed between the carbon of the carboxyl group and the nitrogen of the amino group, linking the two amino acids.

The resulting molecule is called a **dipeptide** because it consists of two amino acids joined by the peptide bond.



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6. What do you know about dextro rotatory sugar?

Ans: **Dextrorotatory sugar** refers to a sugar that rotates the plane of polarized light **to the right**. The term "dextro" comes from "dexter," meaning right, indicating the direction of light rotation. This property occurs due to the specific arrangement of atoms in the sugar molecule, which interacts with polarized light in a way that causes the light to rotate clockwise.

For example, **d-glucose** is a dextrorotatory sugar. The ability to rotate light is a characteristic of optical activity, which is common in many chiral compounds, like sugars and amino acids.

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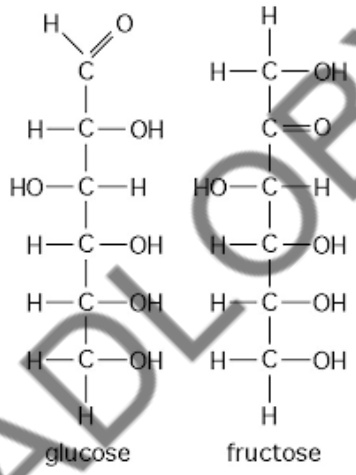
7. Draw the structure of glucose and fructose.

Ans:



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8. Glucose and fructose are isomers of each other. Argue

Ans: Glucose and fructose are indeed **isomers** because they have the same molecular formula ($C_6H_{12}O_6$) but different structural arrangements.

- **Glucose** is an **aldose** (an aldehyde sugar) with a six-membered ring structure, where the carbonyl group (C=O) is at the end of the molecule.
- **Fructose** is a **ketose** (a ketone sugar) with a five-membered ring structure, where the carbonyl group is at the second carbon atom.

While they have the same chemical formula, their different functional groups (aldehyde vs. ketone) and structural forms (aldose vs. ketose) make them **structural isomers**.

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9. Butyric acid is fat or oil?

Ans: **Butyric acid** is neither a fat nor an oil itself, but it is a **short-chain fatty acid** ($C_4H_8O_2$). It is found in some fats and oils, particularly in **butter**, where it contributes to its characteristic smell.

While **fats** and **oils** are triglycerides (glycerol bound to three fatty acids), butyric acid is a **free fatty acid**. It's a saturated fatty acid, often present in small amounts in animal fats and dairy products. Fats and oils, on the other hand, are typically long-chain fatty acids combined with glycerol.

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10. Differentiate between DNA & RNA.

Ans:

Feature	DNA	RNA
Full Form	Deoxyribonucleic acid	Ribonucleic acid
Sugar	Deoxyribose (lacks one oxygen atom)	Ribose (has one more oxygen atom)
Strands	Double-stranded	Single-stranded
Nitrogenous Bases	Adenine (A), Thymine (T), Cytosine (C), Guanine (G)	Adenine (A), Uracil (U), Cytosine (C), Guanine (G)
Function	Stores genetic information	Involved in protein synthesis (mRNA, tRNA, rRNA)
Location	Mostly in the nucleus	Found in the nucleus and cytoplasm
Stability	More stable	Less stable and more transient

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11. Define optical activity and how it helps us identify dextro and levo rotatory sugars.

Ans: **Optical activity** refers to the ability of a substance to rotate the plane of polarized light. This property is exhibited by chiral (optically active) compounds, which lack symmetry and can exist in two mirror-image forms, known as **enantiomers**.

- **Dextrorotatory (d or +)** compounds rotate the plane of polarized light to the **right** (clockwise).
- **Levorotatory (l or −)** compounds rotate the plane of polarized light to the **left** (counterclockwise).

By measuring the angle of rotation of polarized light, we can determine if a sugar is **dextrorotatory** or **levorotatory**. For example, **d-glucose** is dextro-rotatory, while **l-fructose** is levorotatory. This optical activity helps in distinguishing between different isomers of sugars.

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12. What are optically active and inactive compounds?

Ans: **Optically Active Compounds** are substances that can rotate the plane of polarized light. These compounds are **chiral**, meaning they lack symmetry and exist as non-superimposable mirror images called **enantiomers**. Due to their asymmetric structure, they can rotate light in either a **clockwise (dextrorotatory)** or **counterclockwise (levorotatory)** direction. Examples include sugars like **glucose** and amino acids.

Optically Inactive Compounds do not rotate the plane of polarized light. These include **achiral molecules**, which are symmetrical and do not have distinct mirror images, or mixtures of equal amounts of enantiomers (racemates), which cancel out each other's rotation. An example is **racemic mixtures** of enantiomers.

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13. Differentiate between essential and non-essential amino acids.

Ans:

Feature	Essential Amino Acids	Non-Essential Amino Acids
Definition	Amino acids that must be obtained from the diet.	Amino acids that the body can synthesize on its own.
Synthesis	Cannot be synthesized by the body.	Can be synthesized by the body from other compounds.
Examples	Leucine, Lysine, Tryptophan, Methionine, etc.	Alanine, Glutamine, Aspartic acid, Serine, etc.
Dietary Source	Must be consumed through food (e.g., meat, eggs, beans).	Can be produced by the body using other amino acids.
Role in Metabolism	Critical for protein synthesis and various bodily functions.	Support cellular function, repair, and energy metabolism.

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14. Differentiate between addition and substitution reactions.

Ans:

Feature	Addition Reactions	Substitution Reactions
Definition	A reaction where two or more reactants combine to form a single product.	A reaction where one atom or group is replaced by another in a molecule.
Type of Compounds Involved	Typically involves unsaturated compounds (like alkenes or alkynes).	Typically involves saturated compounds (like alkanes or aromatic compounds).
Example	Ethene + H_2 → Ethane (Hydrogenation)	Chloromethane + OH^- → Methanol + Cl^- (Substitution in haloalkanes)
Mechanism	New atoms or groups are added to the molecule.	One atom or group is substituted for another.
Product	One product is formed, usually with no byproducts.	Two products are formed, usually one is the substituted compound.
Bond Change	New bonds are formed between atoms.	A bond is broken, and a new one is formed.

15. Differentiate between addition and elimination reactions.

Ans:

Feature	Addition Reactions	Elimination Reactions
Definition	A reaction where two or more reactants combine to form a single product.	A reaction where a single reactant splits to form two or more products.
Type of Compounds Involved	Typically involves unsaturated compounds (like alkenes or alkynes).	Typically involves saturated compounds, often alcohols or haloalkanes.
Example	Ethene + H_2 → Ethane (Hydrogenation)	Ethanol → Ethene + H_2O (Dehydration of alcohol)
Reaction Process	Two atoms/groups are added to a molecule, breaking a multiple bond.	A small molecule (like H_2O or HX) is removed from a molecule, forming a double bond.
Product	One product is formed, usually a single compound.	Two or more products are formed, often including a double bond.
Bond Change	New bonds are formed, usually between atoms.	Bonds are broken, leading to the formation of a double bond or multiple products.

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16. Define condensation reaction.

Ans: A **condensation reaction** is a type of chemical reaction where two molecules combine to form a larger molecule, with the **elimination of a small molecule**, typically **water** or **methanol**.

In this reaction, a functional group of one molecule reacts with a functional group of another molecule, resulting in the formation of a new bond, and the release of a small molecule as a byproduct. Condensation reactions are common in the formation of **polymers**, **esters**, and **amides**.

For example, in the formation of an **ester** from an alcohol and a carboxylic acid:

- Alcohol + Carboxylic acid → Ester + Water.

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17. Differentiate between saturated and unsaturated fatty acids.

Ans:

Feature	Saturated Fatty Acids	Unsaturated Fatty Acids
Structure	Contain no double bonds between carbon atoms (single bonds only).	Contain one or more double bonds between carbon atoms.
State at Room Temperature	Solid (e.g., butter, lard).	Liquid (e.g., olive oil, fish oil).
Source	Typically found in animal fats and some plant oils (e.g., coconut oil, palm oil).	Found mostly in plant oils, nuts, seeds, and fish.
Effect on Health	Can raise LDL (bad) cholesterol levels, increasing the risk of heart disease.	Can lower LDL cholesterol and may provide health benefits.
Examples	Stearic acid, palmitic acid.	Oleic acid, linoleic acid.
Chemical Bonding	No carbon-carbon double bonds, all carbons are fully saturated with hydrogen.	One or more carbon-carbon double bonds create "kinks" in the chain.

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18. Differentiate between fat and oil.

Ans:

Property	Fat	Oil
State at Room Temp	Solid	Liquid
Source	Mainly animal (e.g., butter, lard)	Mainly plant-based (e.g., olive oil, sunflower oil)
Fatty Acid Composition	More saturated fatty acids	More unsaturated fatty acids
Example	Butter, Lard	Olive oil, Sunflower oil

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19. Differentiate between fat-soluble and water-soluble vitamins.

Ans:

Property	Fat-Soluble Vitamins	Water-Soluble Vitamins
Solubility	Dissolve in fats and oils	Dissolve in water
Storage in Body	Stored in the liver and fat tissues	Not stored; excess is excreted in urine
Examples	Vitamin A, D, E, K	Vitamin C, B-complex vitamins (e.g., B1, B2, B12)
Absorption	Requires bile for absorption	Absorbed directly into the bloodstream
Risk of Toxicity	Higher risk of toxicity due to storage in body	Lower risk of toxicity (excess is excreted)

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20. Write the saponification reaction / esterification reaction / write formation of lipid.

Ans: The saponification reaction is the process of making soap from fats or oils and an alkali. The general reaction is:

Fat (or oil) + Alkali → Glycerol (glycerin) + Soap

A common example with sodium hydroxide (NaOH) as the alkali:

Triglyceride (fat/oil) + 3NaOH → Glycerol + 3 Sodium salts of fatty acids (Soap)

In chemical terms:

$C_{55}H_{11}COOCH_2CH_2CH_2 + 3NaOH \rightarrow C_3H_8O_3 + 3\ C_{17}H_{35}COONa$

This reaction produces glycerol (a byproduct) and soap (sodium salts of fatty acids).

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21. Prove how lipids are ester of ester of fatty acids with alcohol.

Ans: Lipids, such as fats and oils, are esters of fatty acids and alcohols. The formation of lipids involves a reaction between fatty acids (carboxylic acids) and alcohols (typically glycerol). Here's how the esterification process works:

1. **Fatty acid structure**: Fatty acids consist of a long hydrocarbon chain (R-COOH), where "R" is a hydrocarbon group and "COOH" is the carboxyl group.
2. **Alcohol structure**: The alcohol typically involved is glycerol ($C_3H_8O_3$), which has three hydroxyl groups (-OH).
3. **Esterification process**: During esterification, the hydroxyl group of the alcohol reacts with the carboxyl group of the fatty acid. This reaction releases water and forms an ester bond.

For example, when glycerol reacts with three molecules of fatty acid (e.g., oleic acid), it forms a triglyceride:

Glycerol + 3 Fatty Acids → Triglyceride + 3 Water molecules

This proves that lipids are esters, as they result from the esterification of fatty acids with alcohol (glycerol).

Example reaction:

$C_3H_8O_3$ (glycerol) + 3 $C_{17}H_{33}COOH$ (fatty acid) → $C_{55}H_{104}O_6$ (triglyceride) + 3 H_2O (water)