

CHEMISTRY 10.1 • BIOMOLECULES

Classification of Carbohydrates

Structural analysis, hydrolysis behavior, and chemical properties of saccharides.

[Exam Review]

[Organic Chemistry]

[Class 12]

10.1.1 OVERVIEW



Classification by Hydrolysis Behavior

Carbohydrates: Defined chemically as optically active polyhydroxy aldehydes or ketones, or compounds that produce them on hydrolysis.

General formula $C_x(H_2O)_y$
(also known as saccharides).

Monosaccharides

Yield: Cannot be hydrolysed further.

Units: 1 basic unit.

Glucose, Fructose, Ribose

Oligosaccharides

Yield: Yields 2 to 10 monosaccharide units on hydrolysis.

Sub-types: Disaccharides (most common), Trisaccharides, etc.

Sucrose, Maltose

Polysaccharides

Yield: Yields a large number of monosaccharide units.

Taste: Non-sugars (not sweet).

Starch, Cellulose, Glycogen

Hydrolysis—cleavage by water—is the primary diagnostic tool for classifying carbohydrate complexity.

Monosaccharides: The Base Monomers

Aldose

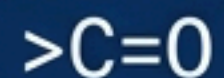
Contains an aldehyde group.



Example: Glucose

Ketose

Contains a keto group.



Example: Fructose

Carbon Atoms	General Term	Aldehyde	Ketone
3	Triose	Aldotriose	Ketotriose
4	Tetrose	Aldotetrose	Ketotetrose
5	Pentose	Aldopentose	Ketopentose
6	Hexose	Aldohexose	Ketohexose
7	Heptose	Aldoheptose	Ketoheptose

Approximately 20 monosaccharides naturally occur in nature. They act as the single, indivisible building blocks for all complex carbohydrates.



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Key Highlights

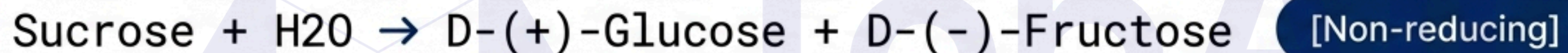
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Disaccharides & Glycosidic Linkages

The Glycosidic Linkage

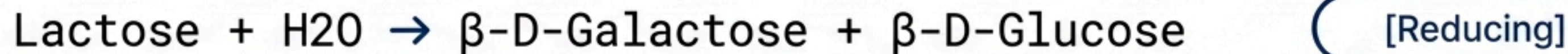
An oxide linkage formed between two monosaccharides (**-H₂O**) by the loss of a water molecule.



Note: Known as 'Invert Sugar' after hydrolysis.



Note: C1 of one glucose linked to C4 of another.



Note: Found in milk ('Milk sugar'). Linkage between C1 of galactose and C4 of glucose.

Polysaccharides: Storage & Structure

Starch

Function: Main storage in plants; crucial dietary source.

Monomer: α -D-glucose

Structure Breakdown:

Amylose (15-20%): Water-soluble, unbranched.

Linkage: [C1-C4]

Amylopectin (80-85%): Insoluble, branched.

Linkages: [C1-C4] and [C1-C6]

Cellulose

Function: Structural constituent of plant cell walls. Most abundant organic substance in the plant kingdom.

Monomer: β -D-glucose

Structure Breakdown:

Straight-chain polysaccharide. Joined by [C1-C4] glycosidic linkages.

Glycogen

Function: Carbohydrate storage in animals ('animal starch'). Found in liver, muscles, brain.

Monomer: Glucose

Structure Breakdown:

Highly branched, structurally similar to amylopectin. Broken down by enzymes when body needs glucose.

Reducing vs. Non-Reducing Sugars

Reducing Sugars

Definition: Carbohydrates that reduce Fehling's solution and Tollens' reagent.

Structural Cause: Functional groups (aldehydic or ketonic) are **FREE** and not involved in bond formation.

Examples: All monosaccharides (aldose or ketose), Maltose, Lactose.

Non-Reducing Sugars

Definition: Carbohydrates that do not reduce Fehling's or Tollens' reagents.

Structural Cause: Reducing groups of the monosaccharides are **BONDED** (involved in the glycosidic linkage).

Examples: Sucrose.

Key Takeaway Panel: The presence of a FREE aldehyde or ketone group is the sole chemical determinant for a sugar's reducing property.



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