ORGANIC CHEMISTRY-II

CARBOHYDRATE

STRUCTURE OF GLUCOSE

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B.Sc- Chemistry

Semester-VI Organic Chemistry-II

Unit-I Carbohydrate- Structure of glucose

Aim:

✔ *To understand the classification, structure and properties of carbohydrate*

Objectives:

✔*Explaining the importance of carbohydrates and their classification based on structures and functions.*

✔*Explain the structure of glucose and fructose and their elucidation.* Expected Outcome:

After studying this unit students will be able to

✔ *Describe the classification of carbohydrate*

✔ *Explain the structure of glucose and fructose*

✔ *Understand the optical properties of carbohydrate*

Prerequisites:

✔ *Basics on carbohydrate*

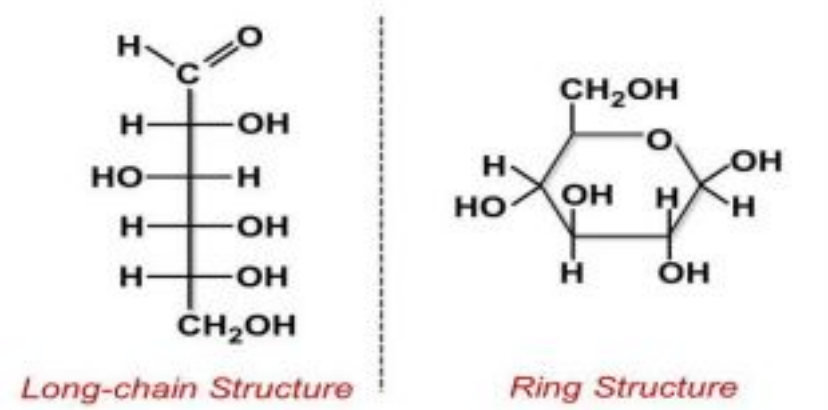
✔ *Optical properties*

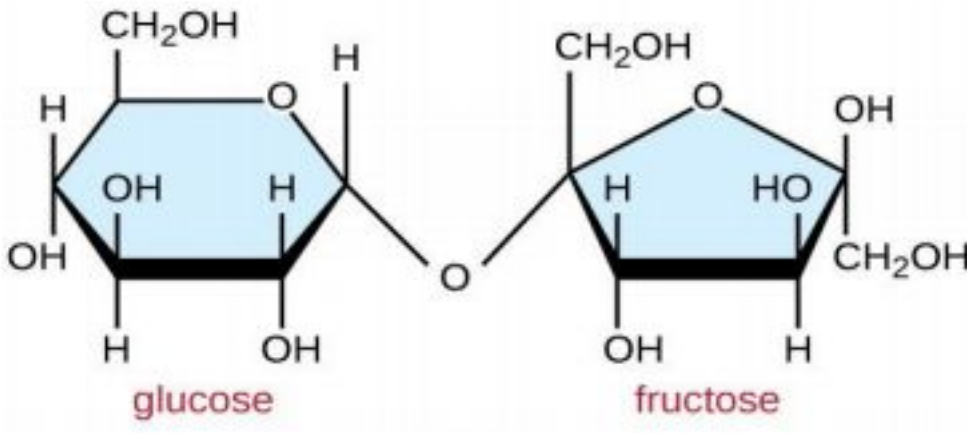
✔*General chemical reactions*

Carbohydrates

 Carbohydrates are the most abundant organic compounds in every living organism. They are also known as saccharides (derived from Greek word ‘sakcharon’ which means sugar) as many of them are sweet. Some examples are glucose (monosaccharide), sucrose (disaccharide) and starch (polysaccharide)

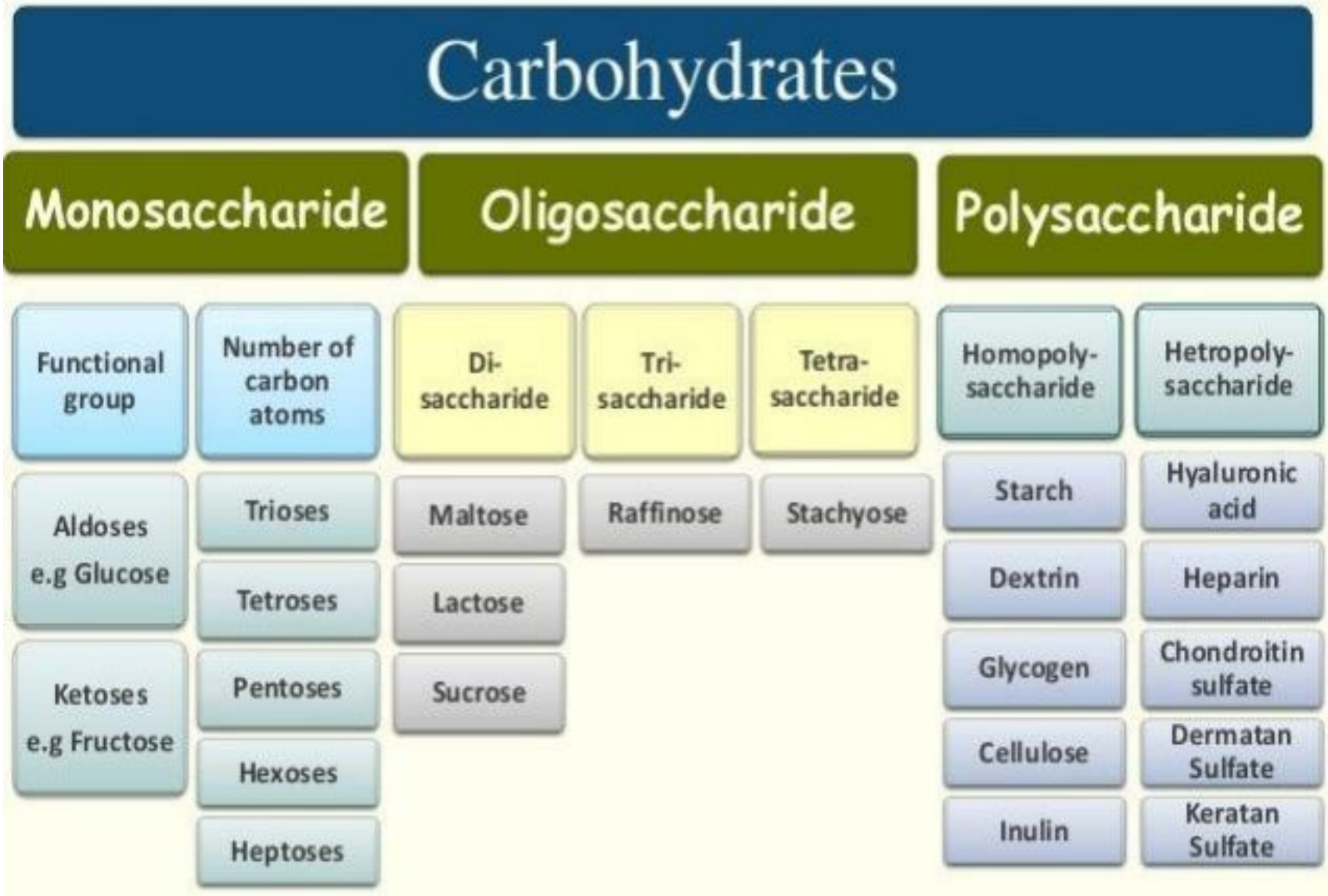
Monosaccharide structure Disaccharide structure





Glucose **Sucrose**

Classification

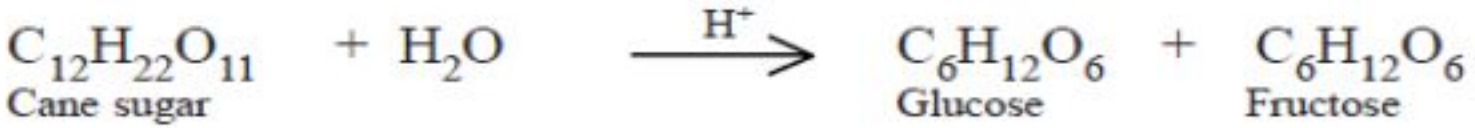


Preparation and structure of Glucose

Glucose is a monosaccharide and belongs to aldohexose. Glucose is known as dextrose because it occurs in nature as the optically active dextro-rotatory isomer. It is also called grape sugar as it is found in most sweet fruits especially grapes. It is present in honey also.

Preparation

It is prepared in laboratory by acid hydrolysis of cane sugar in presence of alcohol.

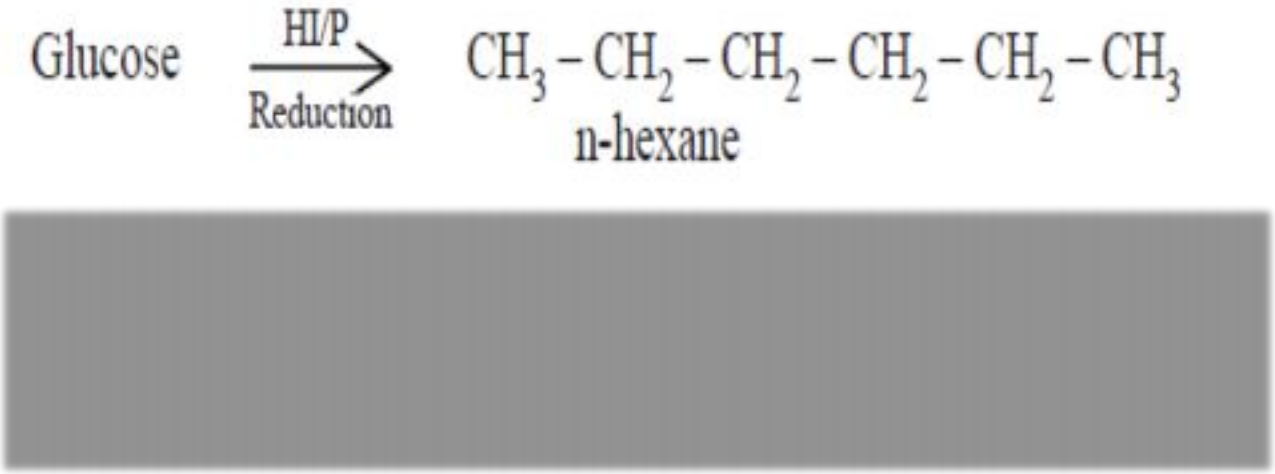


Structure of Glucose

 Elemental analysis (Detection and determination of elements in the compound) and molecular weight determination show that the molecular

formula of glucose is $C_6H_{12}O_6$.

 Complete reduction of glucose with concentrated hydriodic acid in thepresence of red phosphorous produces n-hexane as the major product. This indicates that the six carbon atoms in the glucose molecule form an unbranched chain of six carbon atoms.



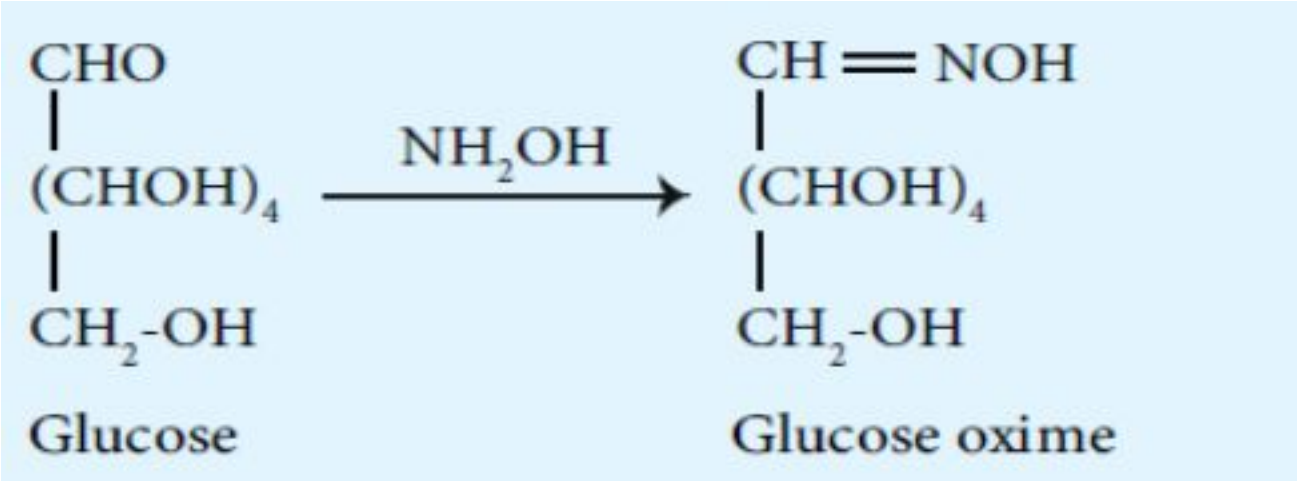
 Glucose reacts with acetic anhydride in the presence of pyridine to form a pentaacetate.

It reacts with $(CH_3)_2SO_4$ in the presence of NaOH give penta methoxyglucose

These reactions indicate that the presence of five hydroxyl groups in a glucose molecule.

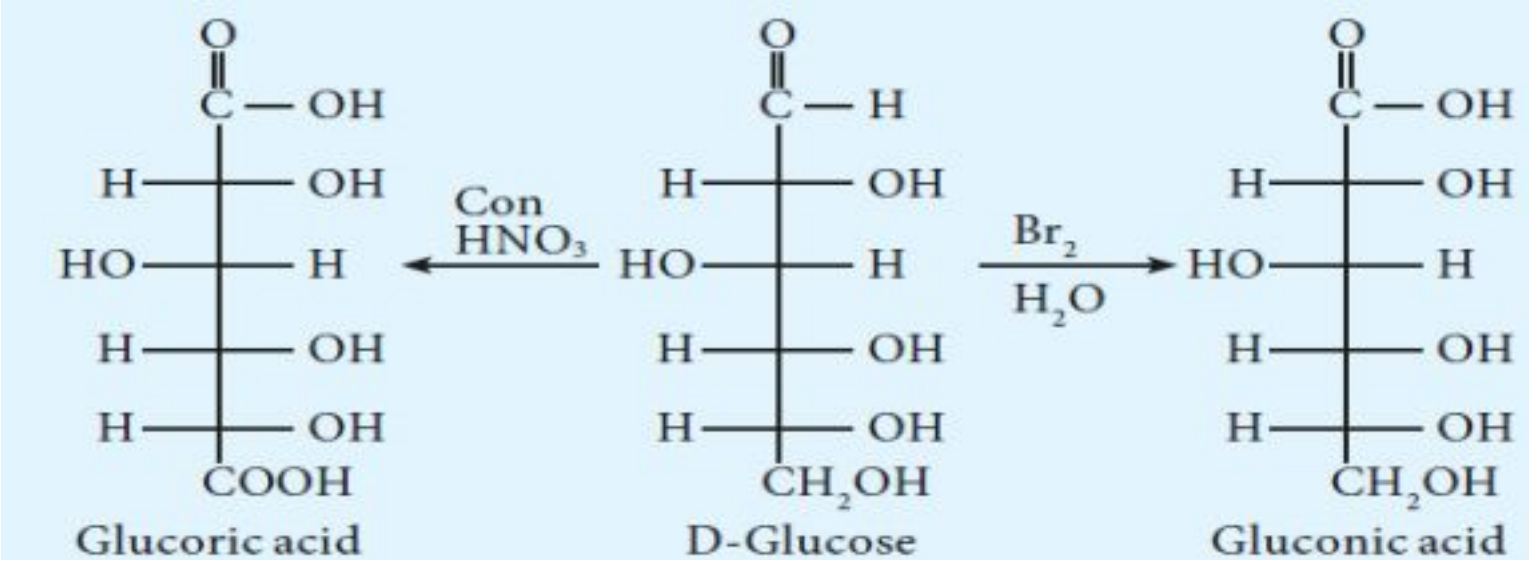
Glucose readily dissolves in water to give a neutral solution. This indicates that the glucose molecule does not contain a carboxyl group. 

Glucose reacts with hydroxylamine to form a monoxime or adds only one mole of HCN to give a cyanohydrin. This reaction indicates the presence of either an aldehyde or a ketone



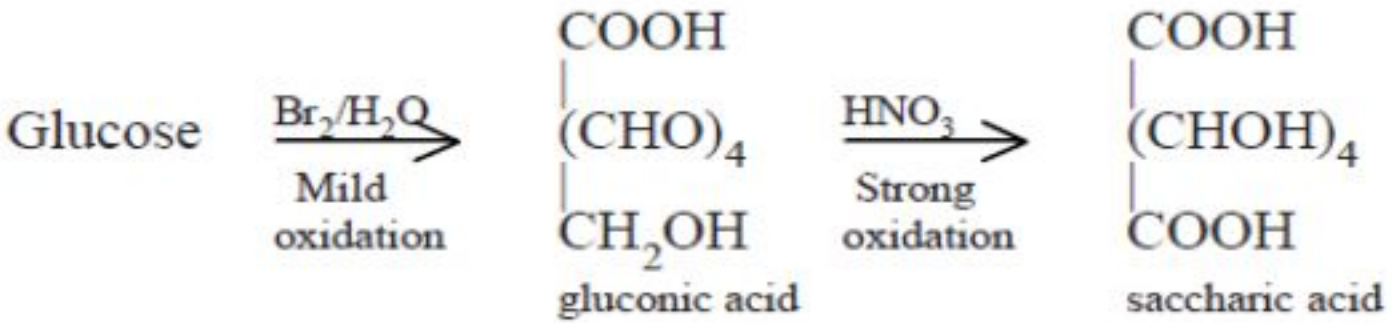
 Mild oxidation of glucose with bromine water gives gluconic acid. This indicates the presence of an aldehyde group since only the aldehyde group can be oxidised to an acid, containing same number of carbon atoms. Since the six carbon atoms in glucose form a consecutive unbranched chain, the

aldehyde group, must occupy one end of this chain.



 Further oxidation of gluconic acid with nitric acid gives saccharic acid.

This indicates the presence of a primary alcoholic group.



- Glucose reduces an ammoniacal solution of silver nitrate (Tollen's reagent) to metallic silver or a basic solution of cupric ion (Fehling's solution) to red cuprous oxide. These reactions further confirm the presence of a aldehyde group.
- based on the above observations the following open chain structure was

d for glucose

C = asymmetric carbon atom

Reference Books

1. Bahl B.S, Arun Bahl,Advanced Organic Chemistry, (12th edition) New Delhi, Sultam Chand and Co., (1986)

2. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd. (1996).

3. Morrison R.T., Boyd R.N., Organic Chemistry, (4th edition) New York, Allyn & Bacon Ltd., (1976)

Online Resources:

1.

https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf

2. http://www.chem.latech.edu/~upali/chem121/Notes-C18-121.pdf