Dept. of Biochemistry

Introductory Biochemistry

Biomolecules_Carbohydrate _Lecture_5

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Dehydration Reaction

- A dehydration reaction is a chemical reaction between two compounds where one of the products is water. For example, two monomers may react where a hydrogen (H) from one monomer binds to a hydroxyl group (OH) from the other monomer to form a dimer and a water molecule (H_2O). The hydroxyl group is a poor leaving group, so Bronsted acid catalysts may be used to help to protonate the hydroxyl to form $-OH_2^+$. The reverse reaction, where water combines with hydroxyl groups, is termed hydrolysis or a hydration reaction.

A dehydration reaction is the same as a dehydration synthesis. A dehydration reaction may also be known as a condensation reaction , but more properly, a dehydration reaction is a specific type of condensation reaction.

Dehydration Reaction Examples:

Reactions that produce acid anhydrides are dehydration reactions. For example acetic acid (CH_3COOH) forms acetic anhydride ($(CH_3CO)_2O$) and water by the dehydration reaction

$$CH_3COOH \rightarrow (CH_3CO)_2O + H_2O$$

Dehydration reactions are also involved in the production of many polymers.

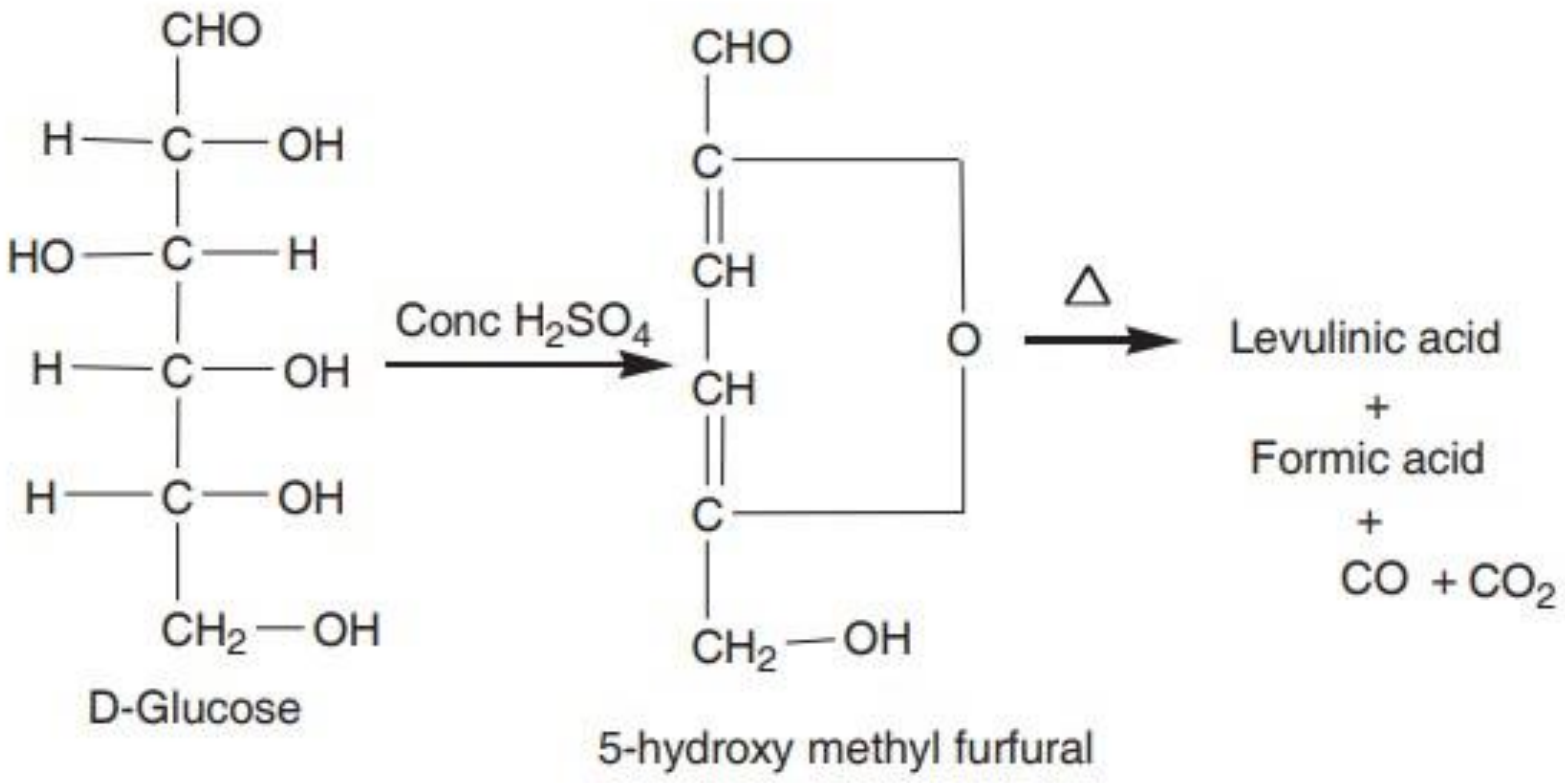
- Other examples include:
- Conversion of alcohols to ethers

  (2 R-OH $\rightarrow$ R-O-R + H_2O)
- Conversion of alcohols to alkenes

  (R-CH_2-CHOH-R $\rightarrow$ R-CH=CH-R + H_2O)
- Conversion of amides to nitriles

  ($RCONH_2$ $\rightarrow$ R-CN + H_2O)
- Dienol benzene rearrangement
- the reaction of sucrose with concentrated sulfuric acid

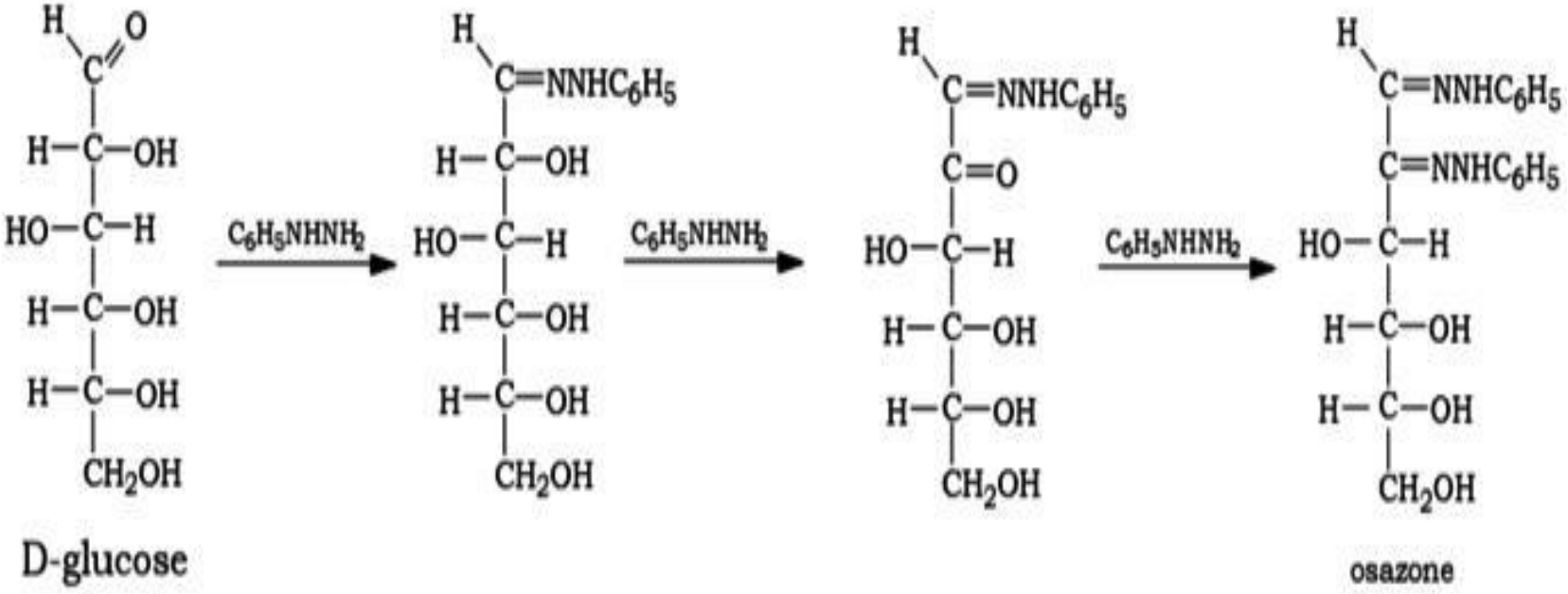
Dehydration of Momosaccharides

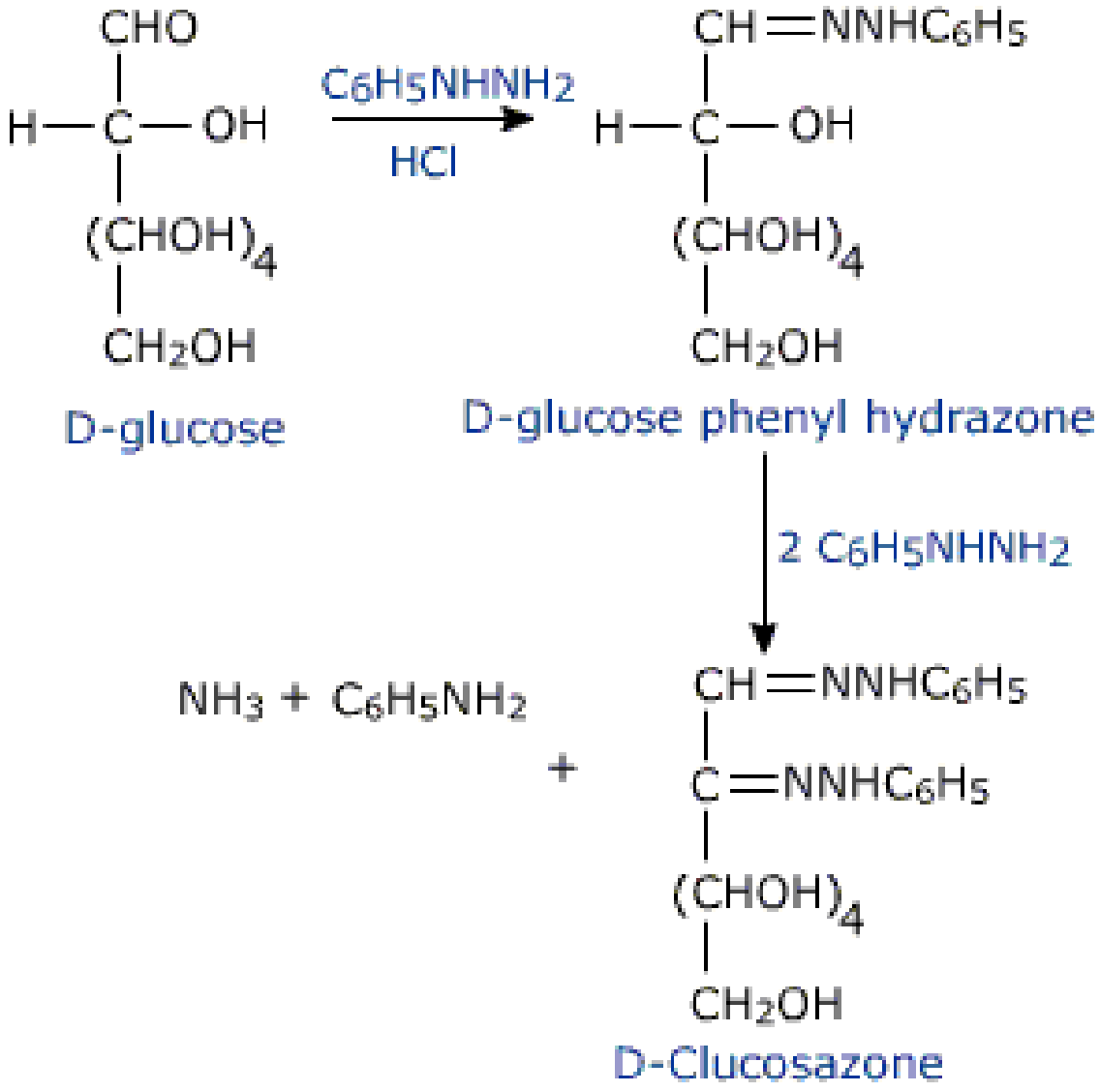


Osazones

Osazones are a class of carbohydrate derivatives found in organic chemistry formed when reducing sugars are reacted with excess of phenylhydrazine at boiling temperatures.

Osazone formation




CHO
H—C—OH
(CHOH)4
CH2OH
D-glucose
C6H5NHNH2
HCl
CH=NNHC6H5
H—C—OH
(CHOH)4
CH2OH
D-glucose phenyl hydrazone
2 C6H5NHNH2
NH3 + C6H5NH2
+
CH=NNHC6H5
C=NNHC6H5
(CHOH)4
CH2OH
D-Clucosazone

Glycoside

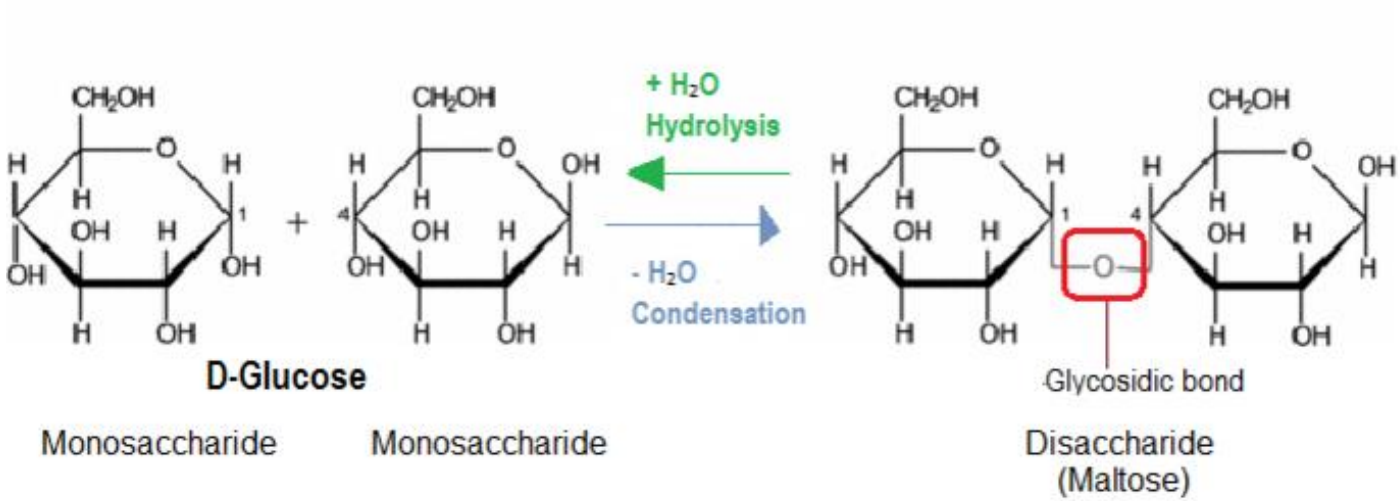
Glycoside, any of a wide variety of naturally occurring substances in which a carbohydrate portion, consisting of one or more sugars or a uronic acid (*i.e.*, a sugar acid), is combined with a hydroxy compound. The hydroxy compound, usually a non-sugar entity (aglycon), such as a derivative of phenol or an alcohol, may also be another carbohydrate, as in cellulose, glycogen, or starch, which consist of many glucose units.

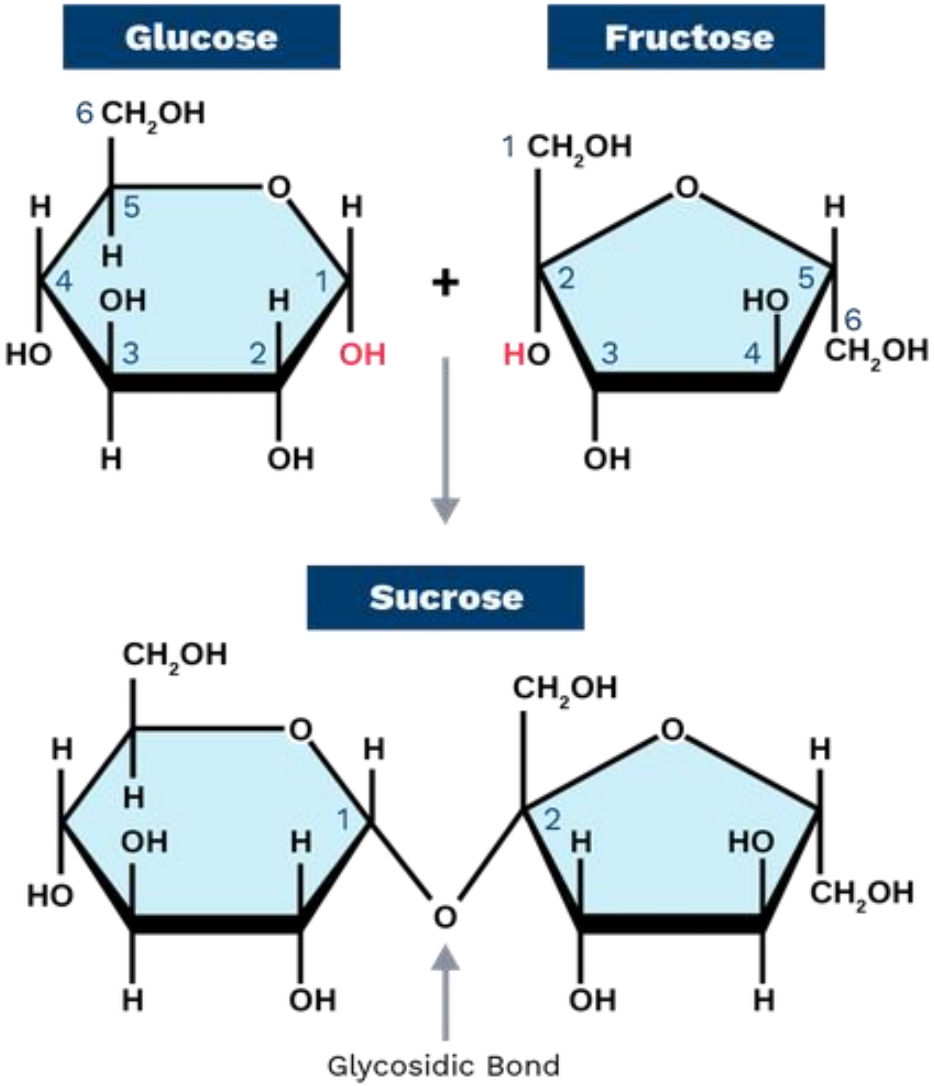
Glycosidic Bond

- A glycosidic bond is a covalent bond formed between a carbohydrate molecule and another molecule. In this reaction, the hydroxyl group of the carbohydrate combines with the hydrogen of another organic molecule, releasing a molecule of water and forming a covalent bond. Glycosidic bonds can be of the alpha or the beta type.
- An alpha-glycosidic bond is formed when both carbons have the same stereochemistry, whereas a beta-glycosidic bond occurs when the two carbons have different stereochemistry.

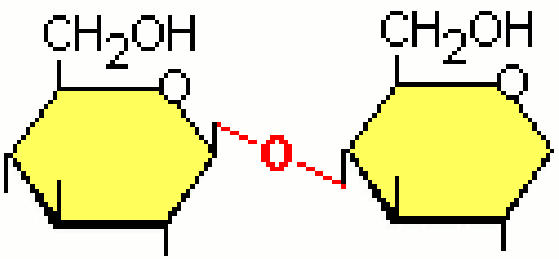
- Glycosides are the molecules in which a sugar part is bound to some other non-sugar part.
- Glycosides play numerous important roles in living organisms.
- Plants store important chemicals in the form of inactive glycosides; if these chemicals are needed, the glycosides are brought in contact with water and an enzyme and the sugar part is broken off, making the chemical available for use.
- Many such plant glycosides are used as medications.

- Formally, a glycoside is any molecule in which a sugar group is bonded through its anomeric carbon to another group via a glycosidic bond.
- The sugar group is known as the Glycone and the non-sugar group as the Aglycone or Genin part of the glycoside.
- The glycone can consist of : Single sugar group (Monosaccharide) or Several sugar groups (Oligosaccharide).

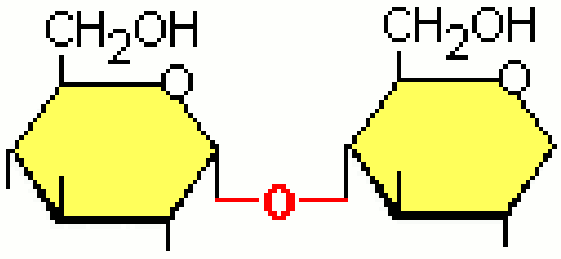

+ H2O
Hydrolysis
- H2O
Condensation
Glycosidic bond
D-Glucose
Monosaccharide
Monosaccharide
Disaccharide
(Maltose)


Glucose
Fructose
6 CH2OH
1 CH2OH
Sucrose
Glycosidic Bond

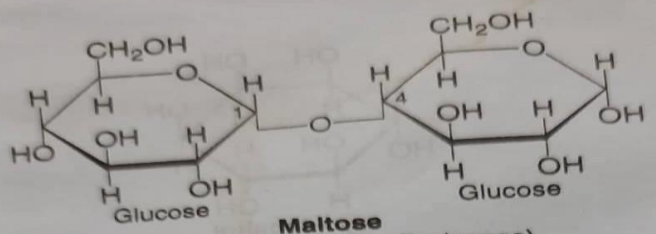
Alpha & Beta Glycosides



beta (1 → 4) bond
cellulose

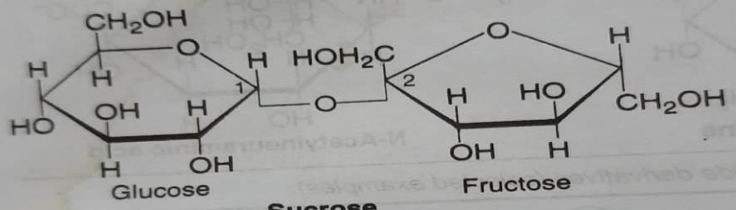


alpha (1 → 4) bond
starch, glycogen



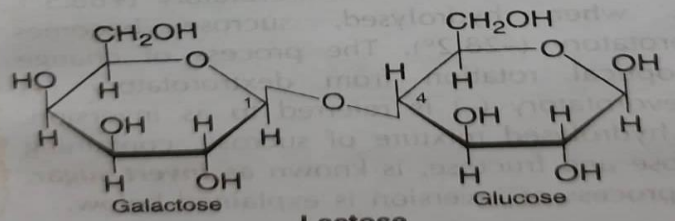
Maltose

(α-D-glucosyl (1 → 4) α-D-glucose)



Sucrose

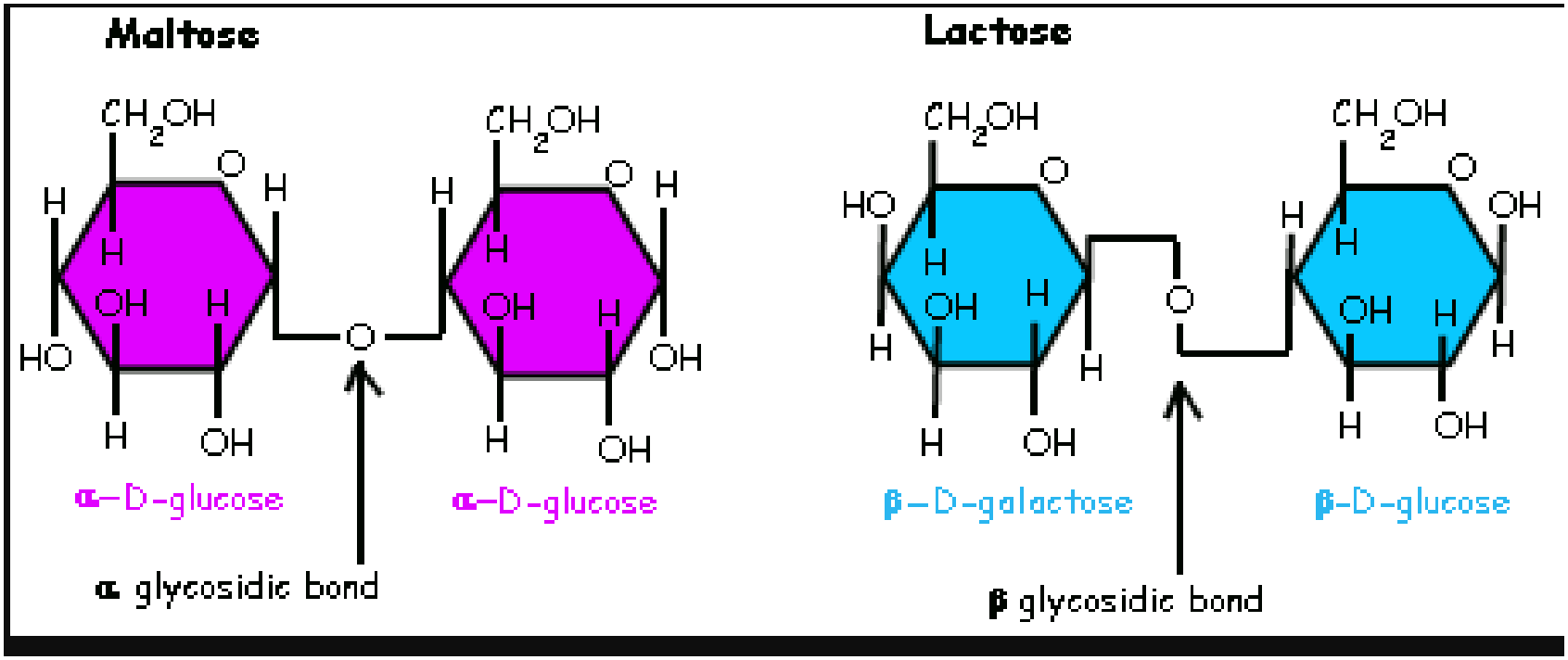
(α-D-glucosyl (1 → 2) β-D-fructose)

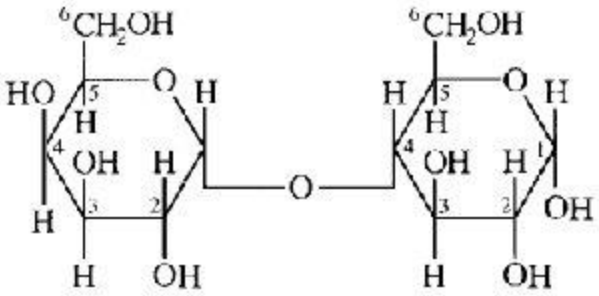


Lactose

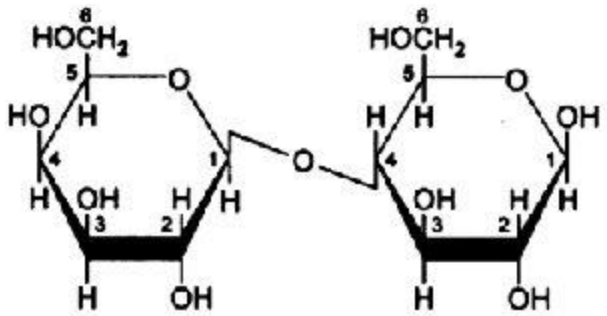
(β-D-galactosyl (1 → 4) β-D-glucose)

Fig. 2.12 : Structures of disaccharides —maltose, sucrose and lactose.

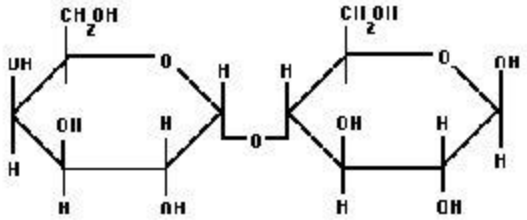

Maltose
Lactose
α–D-glucose
α–D-glucose
β–D-galactose
β–D-glucose
α glycosidic bond
β glycosidic bond



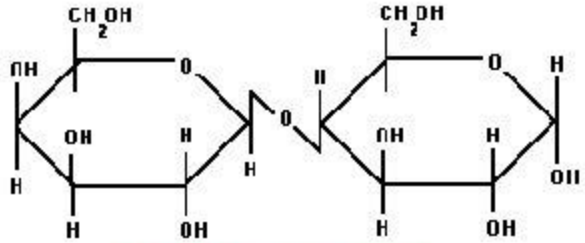
1. alpha-galactose
   + alpha-glucose



2. beta-galactose
   + beta-glucose



3. alpha-galactose
   + beta-glucose



4. beta-galactose
   + alpha-glucose