UNIT 1 - CHEMISTRY OF CARBOHYDRATES

B.SC. I SEMESTER II
2021-2022

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GLUCOSE/SUCROSE

STARCH

SUCROSE

CELLULOSE

GALACTOSE/LACTOSE

STARCH

FRUCTOSE

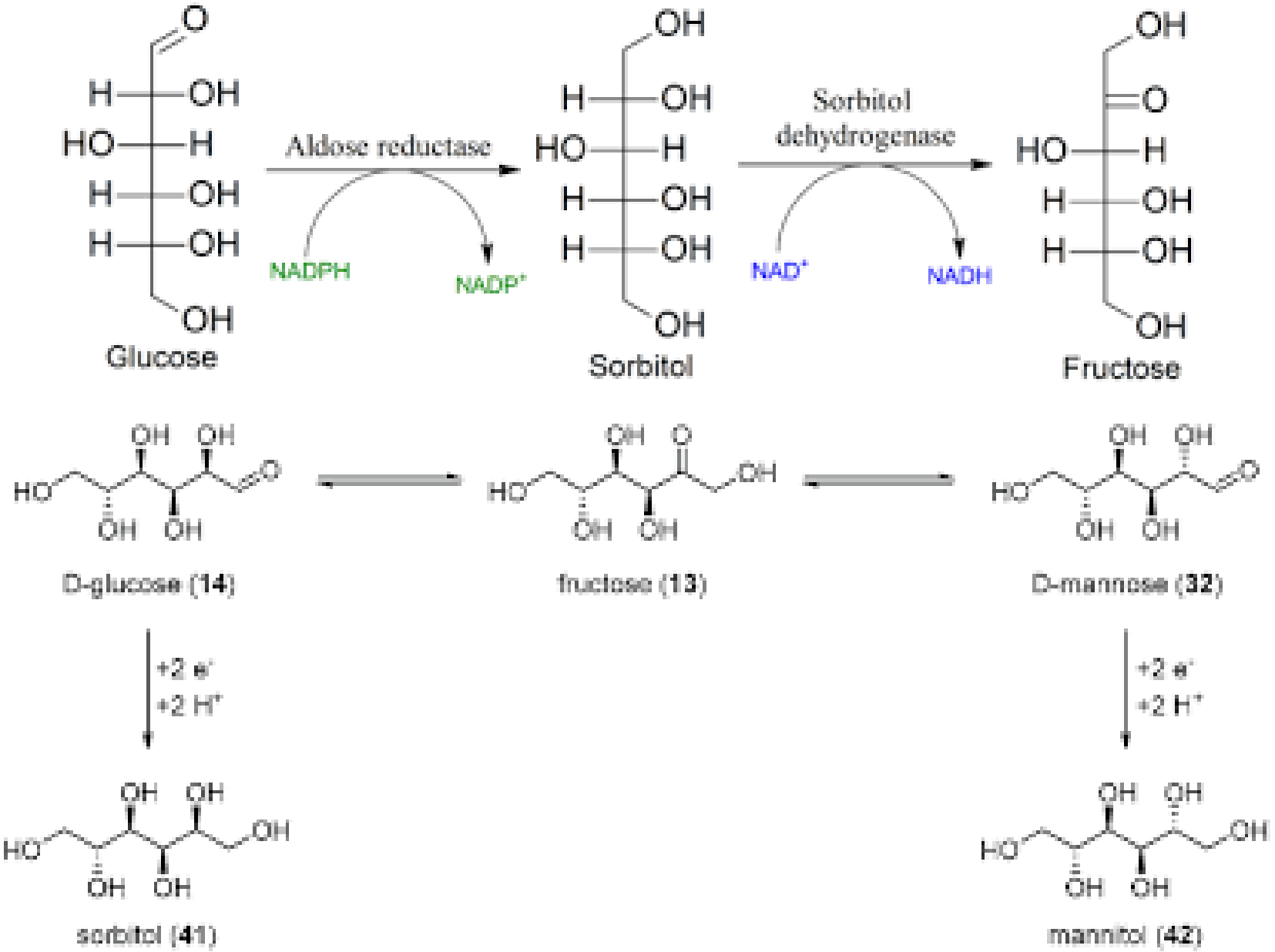
CARBOHYDRATES OR SACCHARIDES

Carbohydrates are the most abundant organic substances in nature.

Carbohydrates can be broadly divided into two main groups
(1) Simple carbohydrates (*reducing sugars*)
(2) Complex carbohydrates (*non reducing starches*)

Examples of simple carbohydrates include glucose, fructose, galactose, sucrose, lactose, and maltose.
Examples of complex carbohydrates include starch, glycogen, and cellulose.

REDUCTION OF CARBONYL GROUP OF GLUCOSE AND FRUCTOSE



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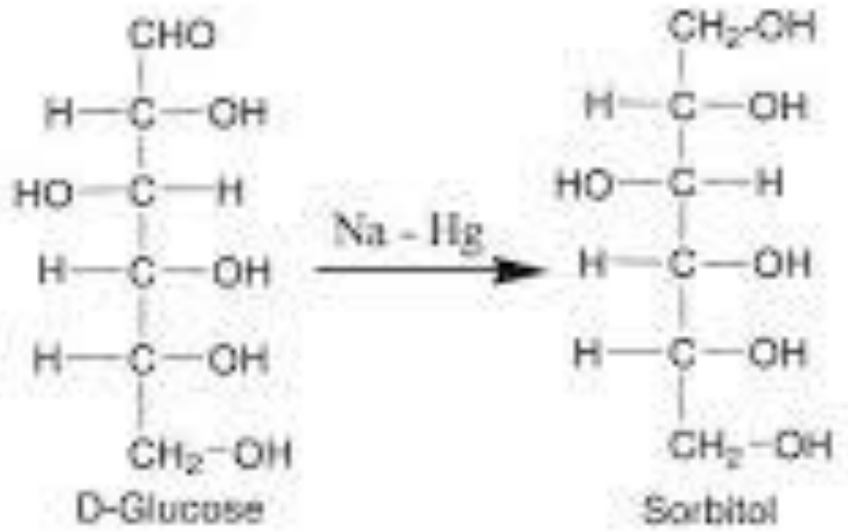
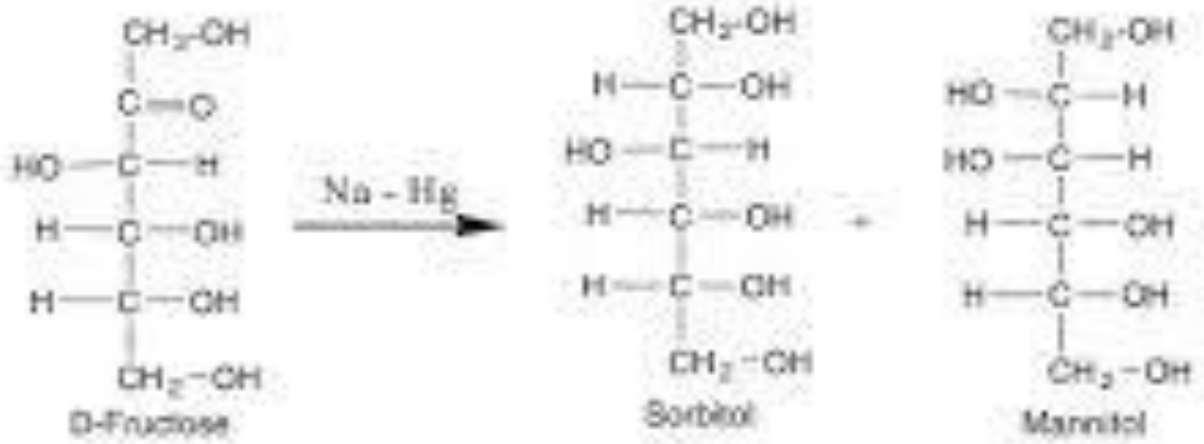
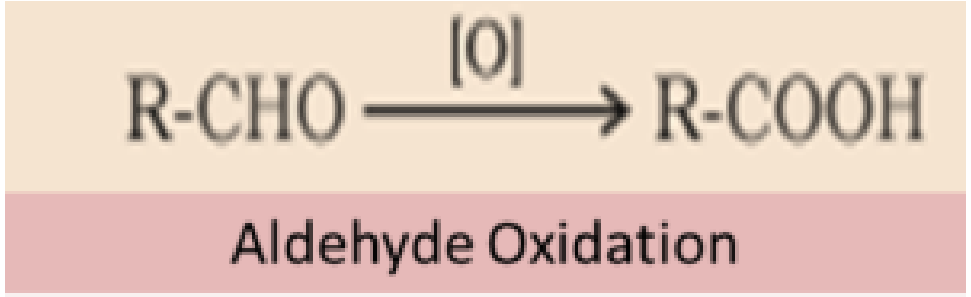


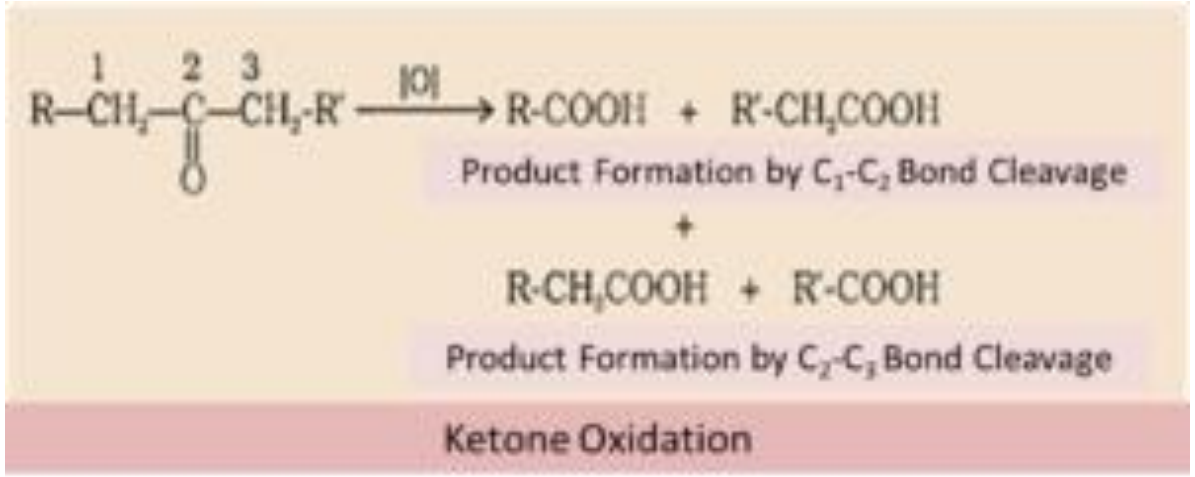


OXIDATION OF GLUCOSE AND FRUCTOSE – REDUCING NATURE

A reducing sugar is any sugar that is capable of acting as a reducing agent.
The common dietary monosaccharides galactose, glucose and fructose are all reducing sugars.
Mild oxidizing agents like Tollen's reagent and Fehling's reagent can oxidize Glucose and Fructose.
Ketoses must first tautomerize to aldoses before they can act as reducing sugars.
Oxidation of ketones requires carbon-carbon bond cleavage so that the reaction can produce carboxylic acid containing a lesser number of bonds with respect to the parent ketone.



GLUCOSE OXIDATION



FRUCTOSE OXIDATION

GLUCOSE – REACTION WITH PHENYL HYDRAZINE

The sugar having free aldehyde or ketone groups is known as reducing sugars. All monosaccharides are reducing sugar. The formation of osazone is used for the identification of reducing sugars.

The chemical formula of phenyl hydrazine is $C_6H_5NH{-}NH_2$.

Phenyl hydrazine causes the removal of the water molecules.

The reducing sugars react with phenyl hydrazine and form a compound that is known as osazones.

By the reaction of phenyl hydrazine, carbonyl group, and alpha-carbon get oxidized.

When glucose reacts with phenyl hydrazine, the products formed are glucosazone, ammonia, and water.

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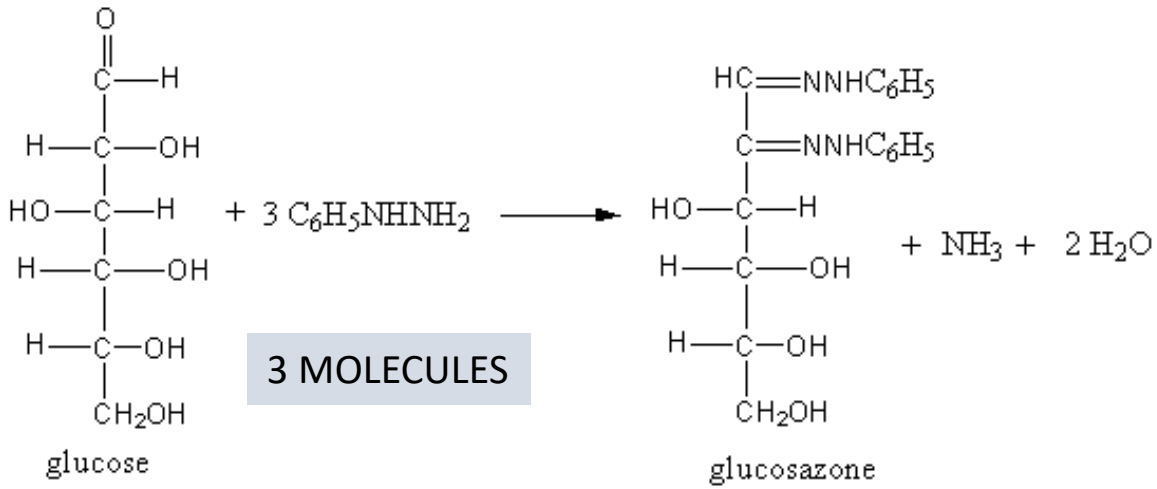


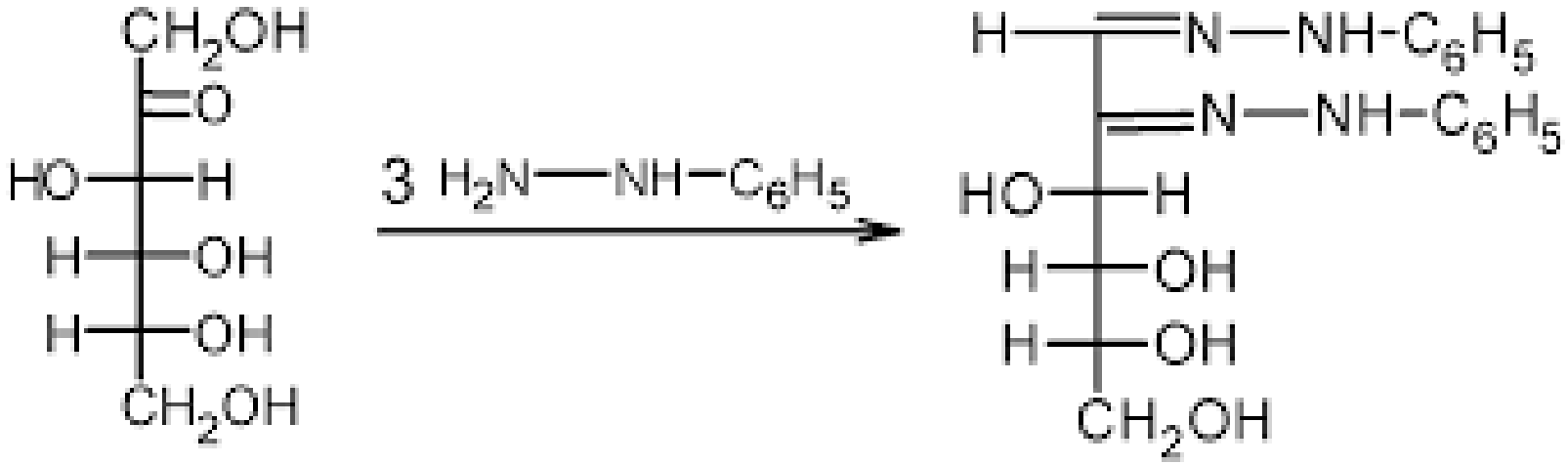
Glucose reacts with an excess of phenyl hydrazine to form glucosazone.

The reaction of glucose with phenyl hydrazine gives glucose phenyl hydrazone whereas the reaction of glucose with excess phenyl hydrazine gives osazone.

Osazone are coloured compounds and osazone of different sugars have different crystal shapes, so they can be identified easily. Glucose and fructose form the same osazone

FRUCTOSE – REACTION WITH PHENYL HYDRAZINE

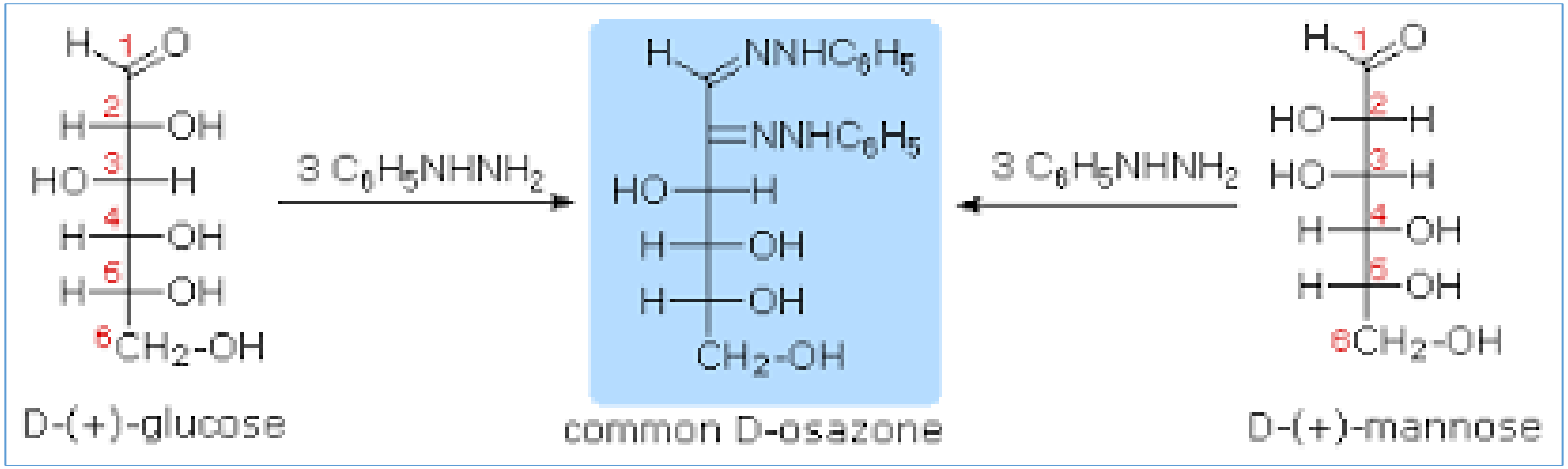
When the ketohexose, D- fructose is treated with phenyl hydrazine it produces an osazone that is identical with the one prepared from either D-(+) glucose or D-(+) mannose.
Sugars forming same osazone have different configuration C1 and C2. These two carbon atoms are involved in osazone formation, the rest four carbon atoms (C3,C4,C5andC6 are same) are identical.
Since all belongs to D-Family hence the configuration of last but one asymmetric carbon atom would be the same.

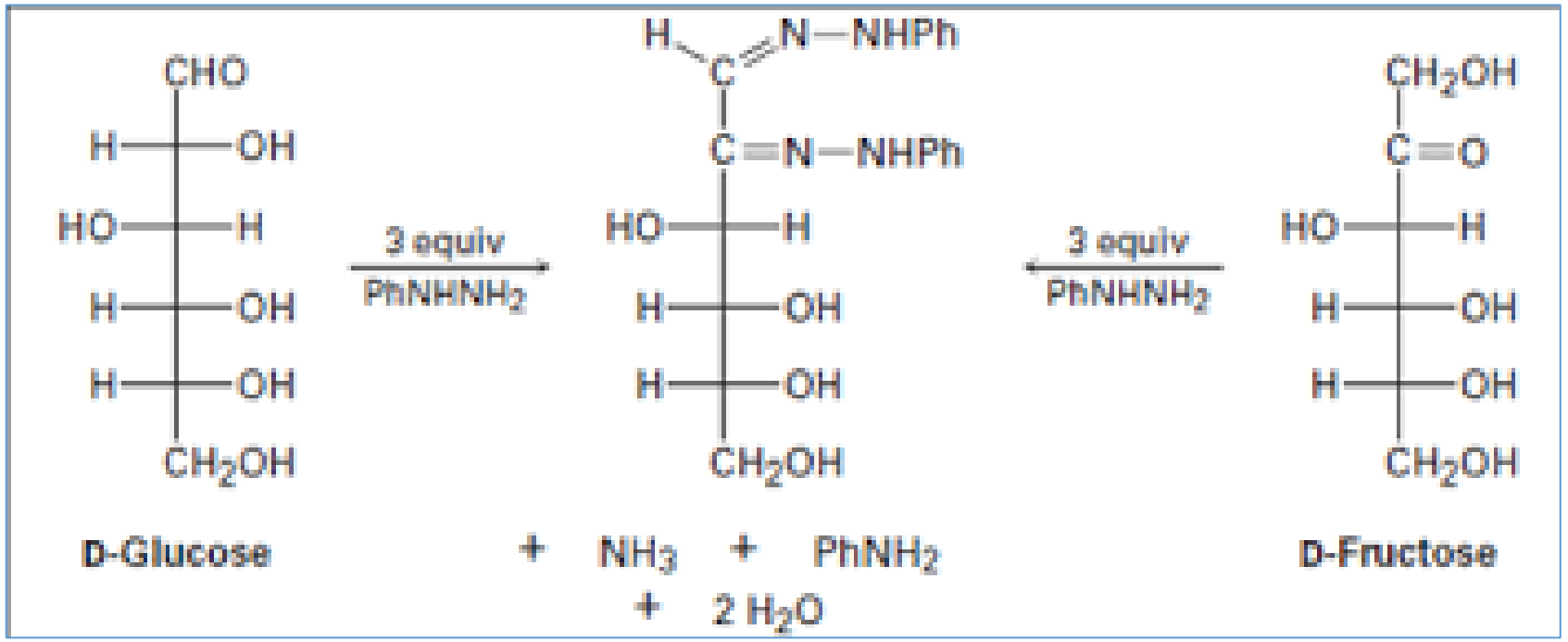


D-Fructose

Fructosazone

GLUCOSE, FRUCTOSE, MANNOSE – REACTION WITH PHENYL HYDRAZINE





MECHANISM OF OSAZONE FORMATION – AMADORI REARRANGEMENT