Glucose can easily be prepared by hydrolyzing sucrose with hydrochloric acid in ethanolic medium.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose D-(+)-Glucose D-(-)Fructose

Since glucose is less soluble in ethanol, it separate out on cooling the reaction mixture. Commercially, it is obtained by the hydrolysis of starch which is avilable from relatively inexpensive sources such as maize, potatoes and rice.

GLUCOSE IS AN ALDOHEXOSE, i.e. IT CONTAINS AN ALDEHYDIC GROUP AND A CHAIN OF SIX CARBON ATOMS. WE SHOULD THEREFORE, EXPECT IT TO UNDERGO TYPICAL REACTIONS OF ALDEHYDES AND THOSE OF ALCOHOLS.

A tentative structure for glucose may be established on the basis of the following observations :

(1) The molecular formula of glucose has been fixed as $C_6H_{12}O_6$ on the basis of elemental analysis and molecular weight determination.

(2) Reduction of glucose with phosphorus and HI gives n-hexane establishing thereby that all the six carbon atoms are present in a straight chain.

(3) Formation of a penta-acetate on treatment with acetic anhydride indicates the presence of five hydroxyl groups.

(4) That presence of a carbonyl group in glucose is indicated by the formation of an oxime and cyanohydrin.

(5) That the carbonyl group is aldhydic is demonstrated by the observvation that mild oxidation of glucose yields a monocarboxylic acid containing the same number of carbon atoms.

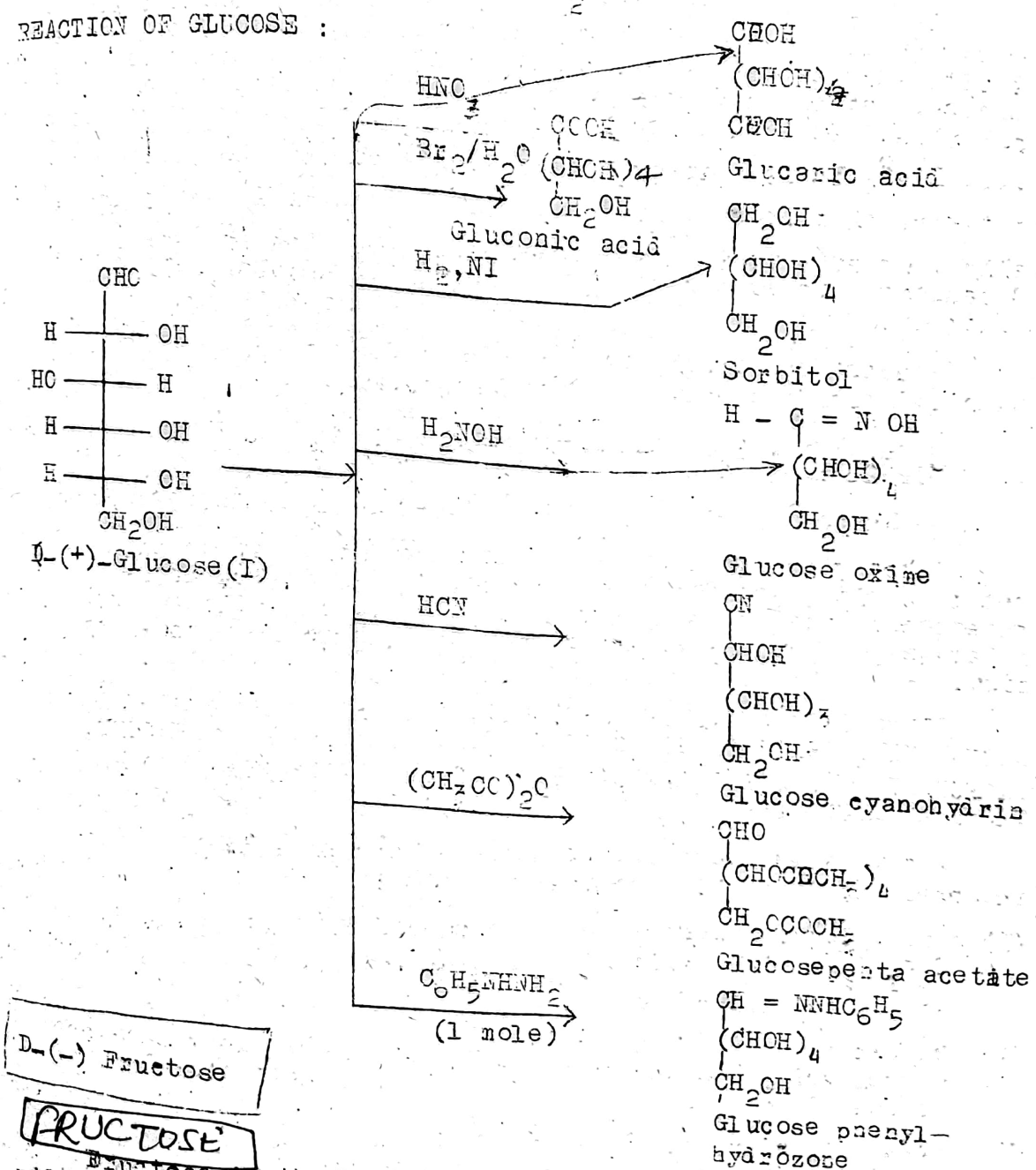
(6) Oxidation with nitric acid yields a dicarboxylic acid (also with the same number of carbon atom), the second carboxylic function is, therefore, generated as a result of oxidation of the primary alcoholic function.

(7) Glucose is a stable compound and does not undergo dehydration. This fact may be taken as an indication that not more than one hydroxyl group is bonded to a single carbon atom.

On the basis of the foregoing evidence, a tentative structure of glucose may be written as follows :

CHO CHOH CHOH CHOH CHOH CH_2OH

REACTION OF GLUCOSE :



D-(-) Fructose

FRUCTOSE

Fructose is the most important ketohexose. It occurs widely in fruits and combined with glucose in sucrose. Fructose, m.p. 102°, is laevorotatory substance and is also known as laevulose. It may be prepared by hydrolysis of sucrose followed by fractional crystallization. It is commercially obtained by acid - catalysed hydrolysis of Inulin (a polysaccharide which occurs in dahlia tubers).

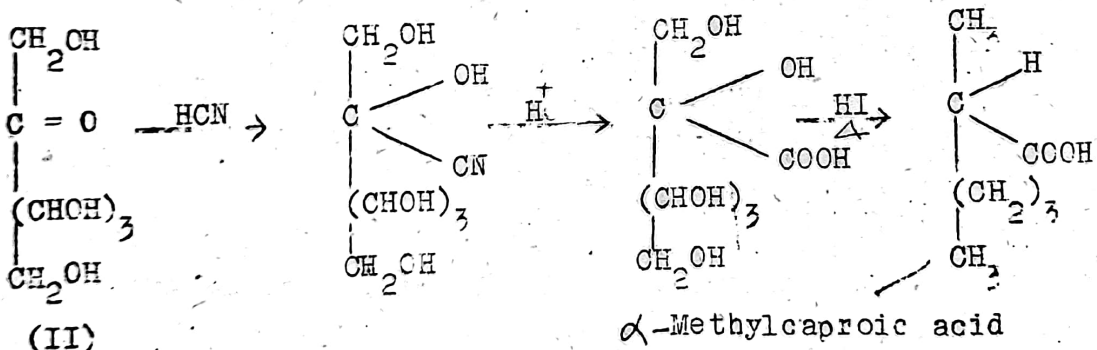
$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{H^+} nC_6H_{12}O_6$$

Inulin — Fructose

The chemical reaction of fructose bear close similarity to those of glucose. Since it is a ketohexose, it will show chemical reactions of a keto group rather than that of an aldehydic function.

A tentative structure for fructose may be established on the basis of the following observations :

1. The molecular formula of fructose has been fixed as $C_6H_{12}O_6$ on the basis of elemental analysis and molecular weight determination.
2. The presence of a carbonyl group in fructose is established by the formation of oxime and cyanohydrin derivatives.
3. On oxidation with nitric acid, a mixture of trihydroxyglutaric, tartaric and glycolic acid is obtained. Since all these acids contains fewer carbon atoms than fructose, the caroonyl group must be present as keto group.
4. That fructose is a 2-ketohexose is shown by the following sequence of reactions :



(II) Fructose

α-Methylcaproic acid

5. Formation of a penta acetate on treatment with acetic anhyiride indicates the presence of five hydroxyl groups.

On the basis of the foregoing reactions, a tentative structure for fructose may be written as follows :

$$CH_2OHCCCHCHCHCHCHCH_2OH$$