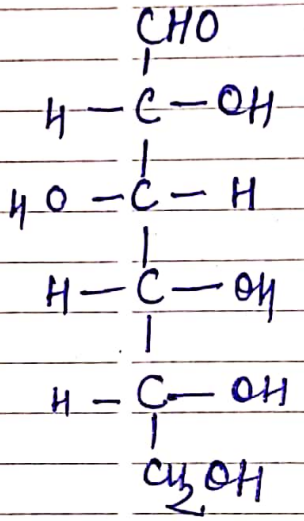
Cyclic structure of glucose

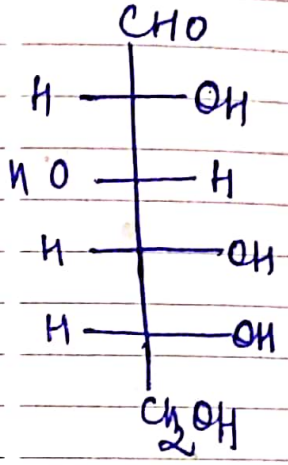
Give the evidences in favour of ring structure / What are peculirities of the properties of glucose which include to the ring structure of glucose. What do you mean by Epimer and anomer. Discuss the ring structure of glucose. Write the chemical name of sucrose.

The open chain structure of glucose is given by



Common formula of D-glucose.

or



Cross formula of D-glucose

Altho the open chain structure of glucose explain most of the reactions, however it suffers from the following limitation and drawback.

① Glucose does not give Schiff's test for aldehyde (i.e it does not restore the pink colour of Schiff's reagent)

② Glucose does not forms addition

product with $NaHSO_3$, it means that the aldehydic group of glucose is not free to give these reaction

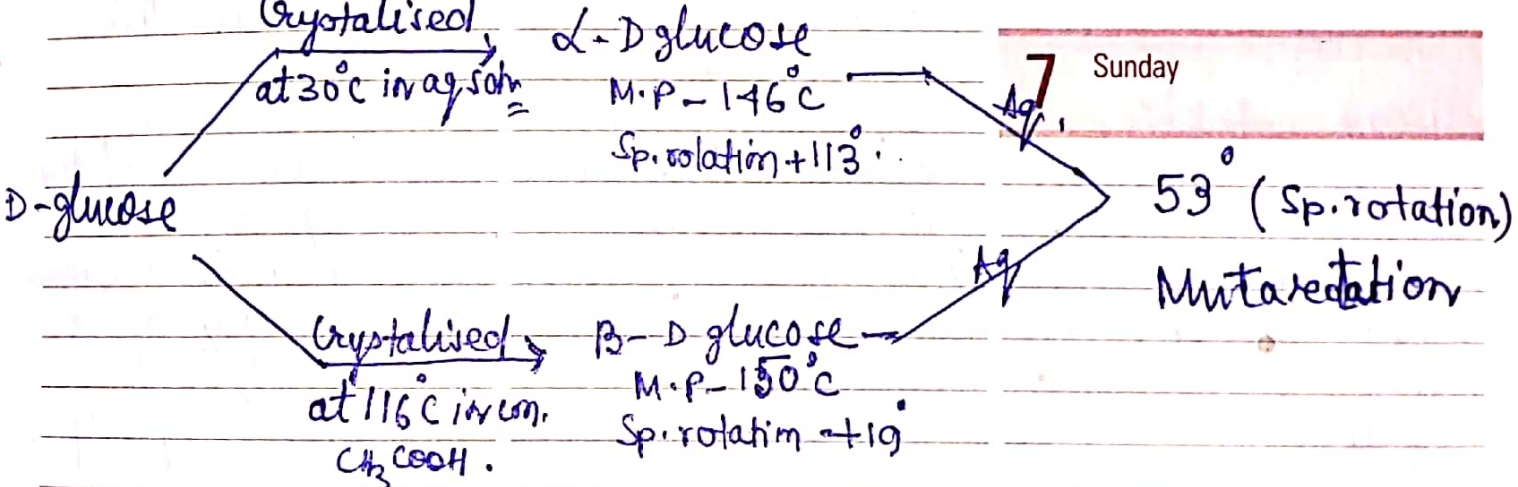
③ Glucose does not react with Grignard reagent (as does aldehyde)

④ Glucose does not show Carbonyl absorption in I.R Spectroscopy.

⑤ Glucose penta acetate / Penta acetyl glucose does not react with NH_2OH

All these five observation is suggested that the ~~free~~ Absence of free aldehyde group.

⑥ Isolation of two different Crystalline form of D glucose

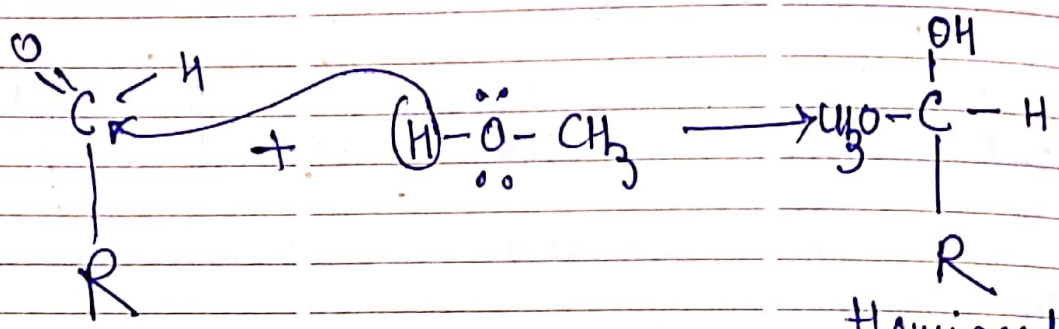


The open chain structure of glucose does not explain this type of behaviour / peculariety

⑦ Treatment of glucose with CH_3OH

in presence of dry HCl does not give dimethyl acetal, as it might be expected, if glucose were a open chain structure. Instead two isomeri mono methyl derivatives are obtained, there are methyl α-D glucoside and methyl β-D glucoside, practically these glucoses does not exhibit mularotation and does not reduced Fehling Solution and Tollen's reagent.

The elemental composition of methyl glucoside is suggested that they are hemiacetals.



Hemiacetal.

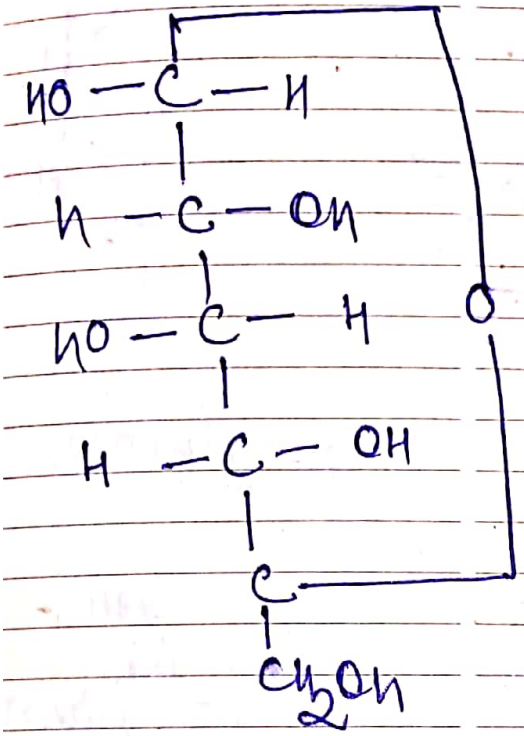
Ring structure — In order to explain the above facts cyclic structure of D-glucose involving formation of an intramolecular hemiacetal by reaction between -CHO group and -OH group on C-5 was proposed as the result of cyclisation, C-1 (hemi acetal carbon) become assymetric this simply means that when the hydrogen of -OH group at C-5 added to oxygen of the planar aldehyde group, the -OH group may move either to the left or right and thus resulting in the formation of two isomer, The isomer having the -OH group

11 Thursday

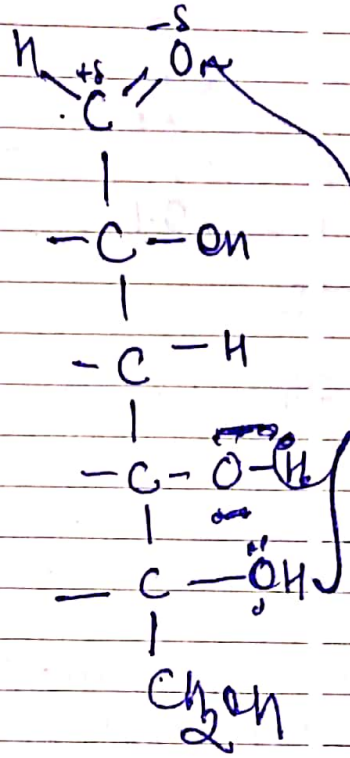
12 Friday

13 Saturday

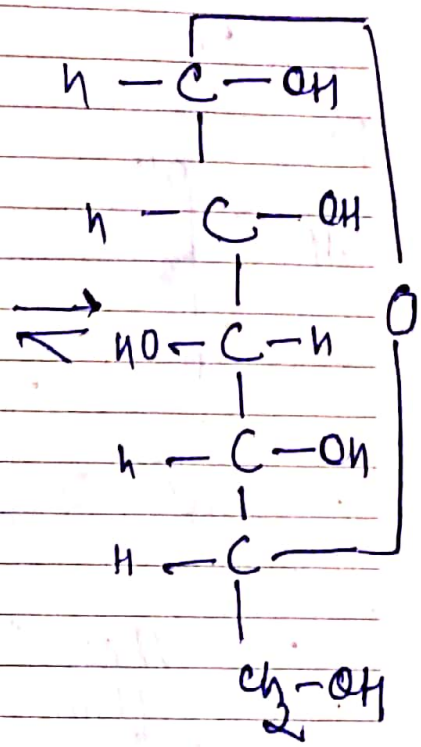
to the left of C-1 is deginated / called β-D glucose and the one having -OH group on the right is known as α-D glucose. which are shown below.



β-D glucose
(+19°)



Open chain structure
(+52°)

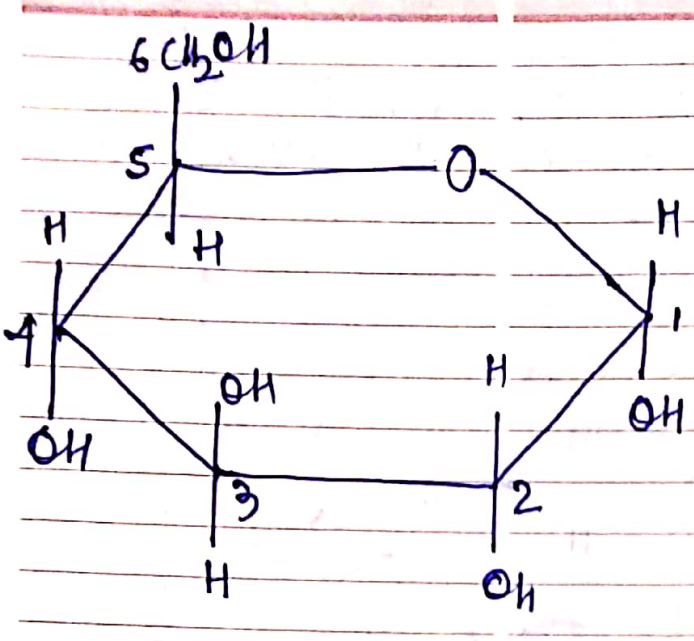


α-D glucose
(+113°)

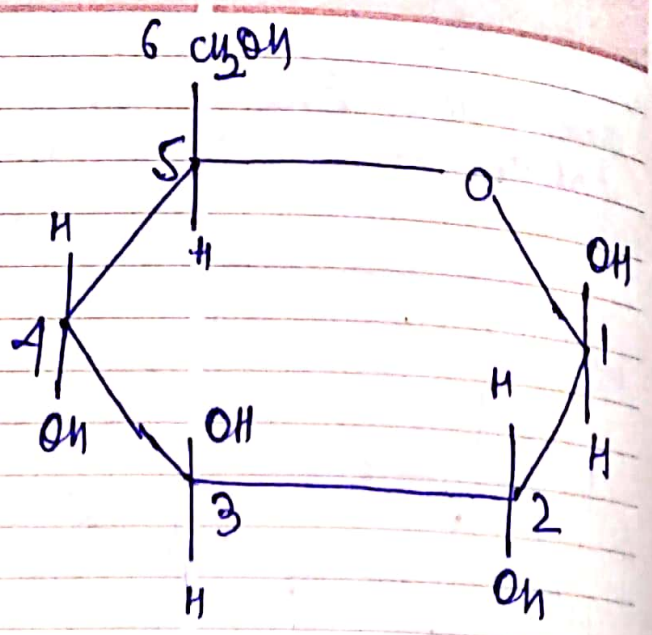
14 Sunday

A better shape was suggested by a English chemist W. H. Haworth, Fischer, & Tanret, in which ring structure is written as flat hexagon, which is more correct thus α-D glucose and β-D glucose may be represented as.

15 Monday | 16 Tuesday | 17 Wednesday

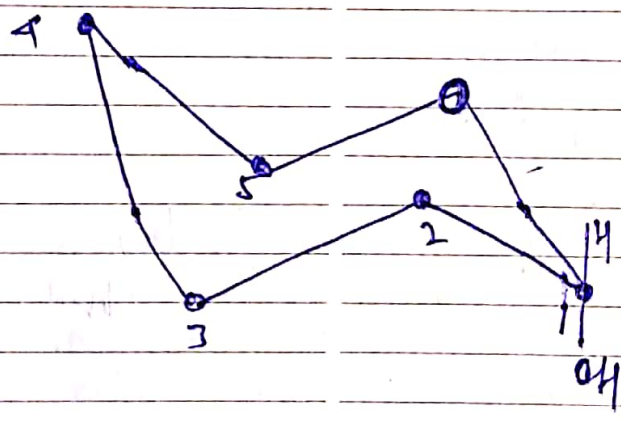


α-D glucose

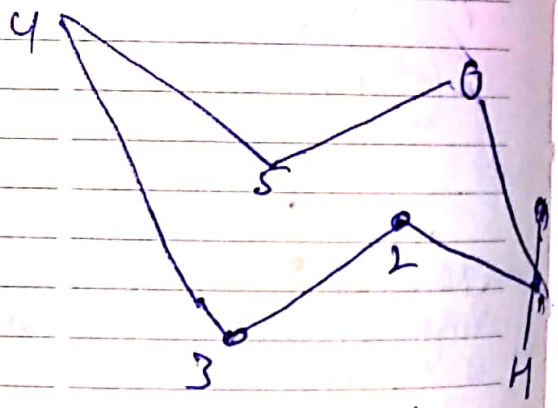


β-D-glucose

These are confirmed by x-ray analysis.
Now a days, it is suggested that the better way to represent them in the non planar in chair conformation (similar to cyclohexane)



α-D-glucose



β-D-glucose.