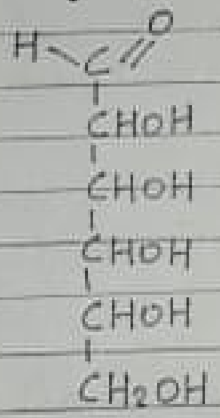
Establish the Structure of Glucose

1. By elemental analysis and molecular weight determination its molecular formula is $C_6H_{12}O_6$.
2. After reduction of glucose in presence of red phosphorous and HI to give normal hexane. Which indicates that glucose molecule contains a straight chain of six C-atoms.
3. Glucose reacts with 5-mols. of acetyl chloride or acetic anhydride to give glucose penta acetate. Which indicates that 5-hydroxy group present in a glucose molecule. Glucose mol. is a stable compound. So five hydroxy group are placed five different C-atoms.

4. Glucose combine with hydroxylamine to give glucose oxime it also combined with 1-mol. of HCN to give cyanohydrine indicating that one carbonyl group present in glucose mol.

5. When glucose oxidised with Br_2/H_2O to give gluconic acid indicating that carbonyl group is the aldehyde.

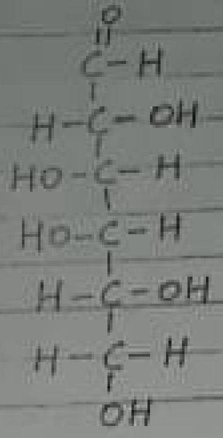
On the basis of fore going facts the structure may be given as below:



Glucose (2,3,4,5,6-pentahydroxyhexanal)

There are four asymmetric C-atom in glucose mol. This representation of glucose is incomplete, because it doesnot give us any idea about the spacial arrangement of the hydroxy groups and the H-atoms around these four asymmetric centres.

The configuration of D-Glucose proved by Emil Fischer.
The structure of D-Glucose is illustrated by Emil Fischer



★ Evidence against openchain structure :

The open chain formula of glucose most of the reactions are satisfactory but fails to explain the following reactions:

1. We know that glucose mol. have aldehydic group but glucose doesnot react with ammonia and $NaHSO_3$.

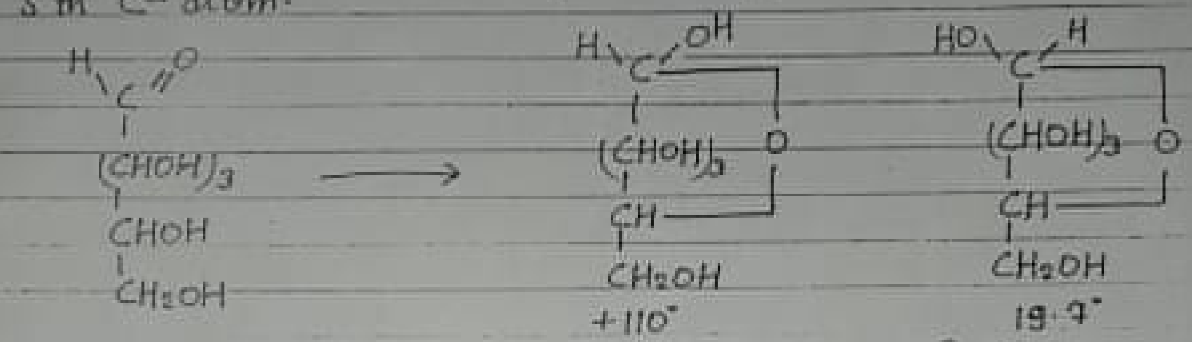
2. Glucose doesnot react with schiff's base for aldehyde.
3. Glucose doesnot react with grignard reagent
4. Glucose penta acetate doesnot react with hydroxyl amine.
5. Two isomeric methyl glucosides α and β are obtained by heating glucose with methyl alcohol in presence of dry. HCl gas.

6. In aq. solution of glucose shows mutarotation.

All these observations indicates that free aldehydic group is not present in the glucose molecule.

∴ Cyclic structure of Glucose

D-Glucose exists into two optically active forms known as α-D-Glucose and β-D-Glucose. α-D-Glucose has specific rotation +110° while β-D-Glucose has specific rotation +19.7°. The two isomeric forms are interconvertiable in aq. solution. The equilibrium rotation is 50+52°. The equilibrium mixture has 36% α-glucose and 64% β-glucose. Glucose forms a stable hemiacetal according to Fischer between aldehydic gr. and hydroxy group of the 5th C-atom.



Openchain sts. of D-Glucose 36%

α-Glucose β-Glucose

Ring chain str of glucose 64%

Ring chain structure explain all the reaction of glucose the objection against the open chain sts. of glucose have been also satisfactory.

1. No reaction with ammonia and $NaHSO_3$. The glucose ring is not very stable it is easily broken upon strong reagents like HCN, NH_2OH, $NH_2NHC_6H_5$ etc. but weak reagents like ammonia and $NaHSO_3$ cannot react with HCN and $NaHSO_3$.

2. α- and β-Glucose on treatment with CH_3OH in presence of HCl to give α- and β- methyl glucosides.