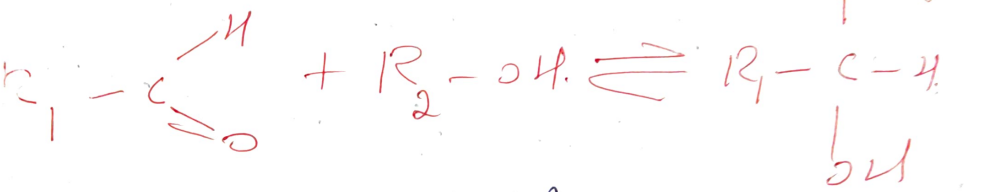
STRUCTURE OF GLUCOSIDE

→ For a better understanding of glucose structure, Let us Consider the formation of hemiacetals and chemiacetals



Aldehyde Alcohol Hemiacetal

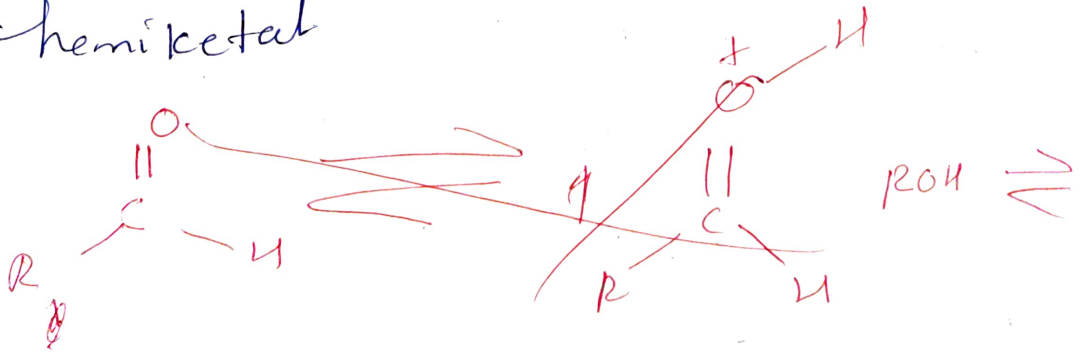
Mechanism:

→ When alcohol oxygen atom adds to the Carbonyl Carbon of an aldehyde or Ketone.

→ There will be a nucleophilic attack of hydroxyl group at the electrophilic Carbonyl group

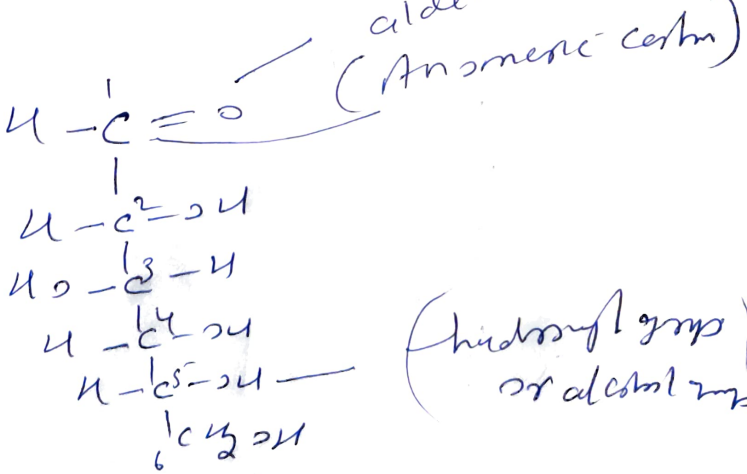
→ Since the alcohols are weak nucleophiles, the attack on the carbonyl carbon is usually promoted by protonation of the carbonyl oxygen

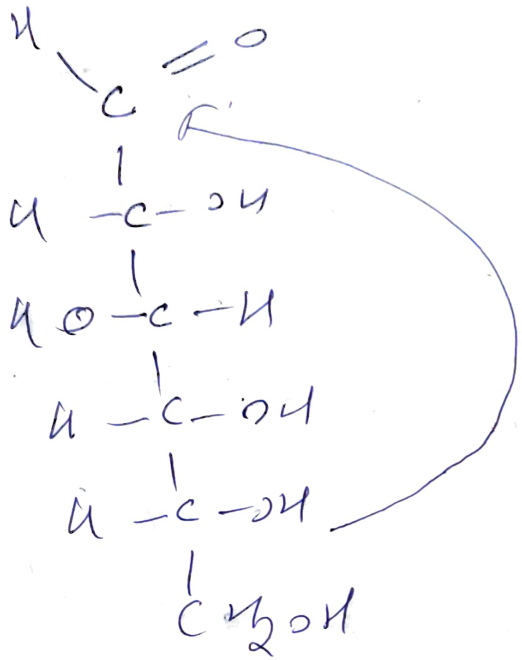
→ When this reaction takes place with an aldehyde, the product is called a hemiacetal and when the reaction takes place with a ketone, the product is referred to as a hemiketal



→ In the case of monosaccharides, the hydroxyl group can react with its own aldehyde or keto functional group to form hemiacetal and hemi ketal.

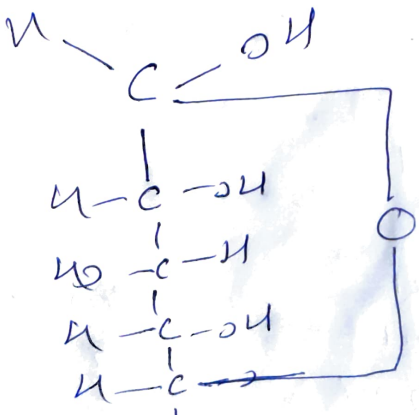
→ Thus, the aldehyde group of glucose at C_1 reacts with alcohol group at C_5 to form two types of cyclic hemiacetals namely α and β D-glucose



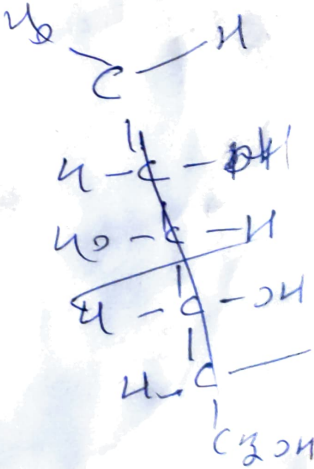


D- Glucose

(Fischer Projection)



α-D-glucose

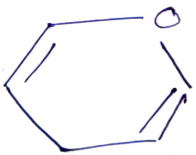


Pyranose and furanose structures

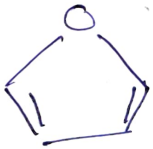
(Haworth projection formulae)

→ Haworth projection formulae are depicted by a six-membered ring pyranose (based on pyran) or a five membered ring ~~&~~ furanose based on furan.

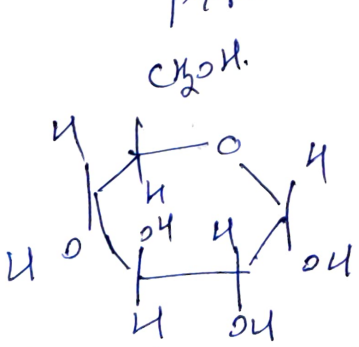
→ The cyclic forms of glucose are known as α-D-glucopyranose and α-D glucofuranose



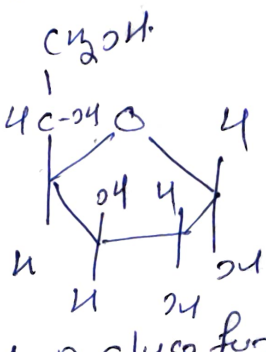
Pyran.



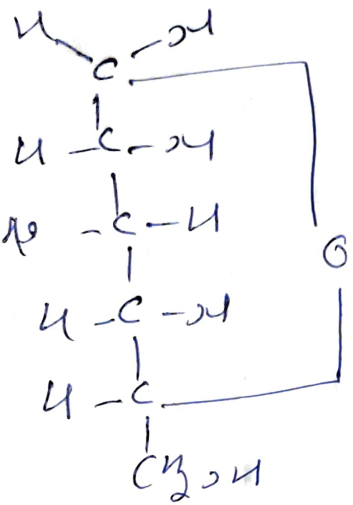
Furan



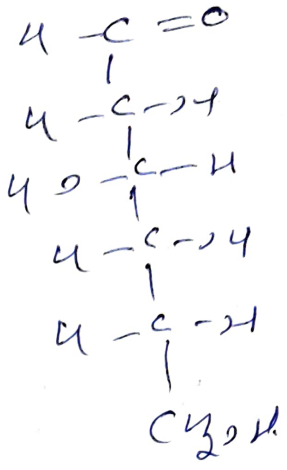
α-D-glucopyranose



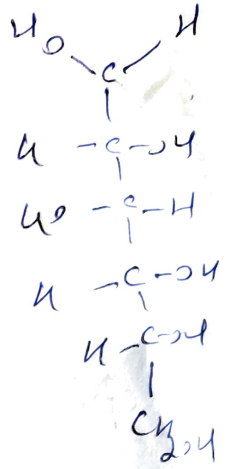
α-D-glucofuranose.



α-D-Glucose

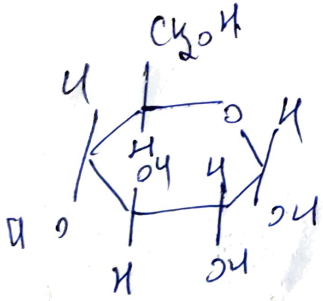


D-glucose

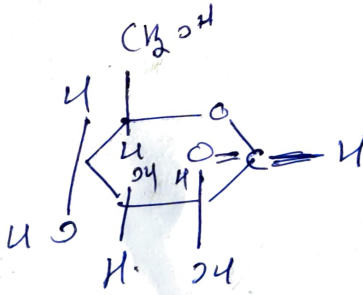


β-D-Glucose

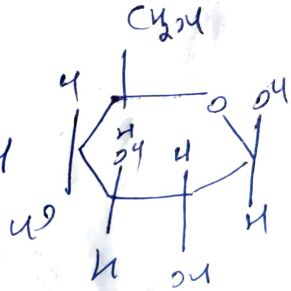
Fischer Projection formulae.



α-D-Glucopyranose.



D-Glucose.



β-D-glucopyranose

(Haworth Projection formulae)

- Anomers : Mutarotation

→ The α and β cyclic forms of D-glucose are known as anomers

→ They differ from each other in the configuration only around C_1 known as anomeric carbon. (hemiacetal carbon).

→ In case α-anomer, the -OH group held by anomeric carbon is on the opposite side of the group -CH$_2$OH of sugar ring

→ The reverse is true for β-anomer

→ The anomers differ in certain physical and chemical property

→ Mutarotation : The α and β anomers of glucose have different optical rotations

→ The specific optical rotation of a freshly prepared glucose (α anomer) solution in water is +112.2° which gradually changes and attain an equilibrium with a constant value of +52.7°.

→ In the presence of alkali, the decrease in optical rotation is rapid

→ The optical rotation of β-glucose is +18.7°.

→ Mutarotation is defined as the change in the specific optical rotation representing the interconversion of α and β forms of D-glucose to an equilibrium mixture

α-D-glucose ⇌ Equilibrium mixture ⇌ β-D-glucose
+112.2° +52.7°C +18.7°C

→ The equilibrium mixture contains 63% β anomer and 36% α anomer of glucose with 1% open chain form

→ β-anomer forms more predominant due to its stable conformation.