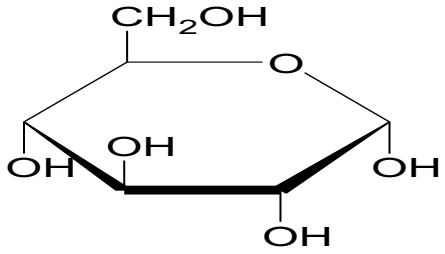
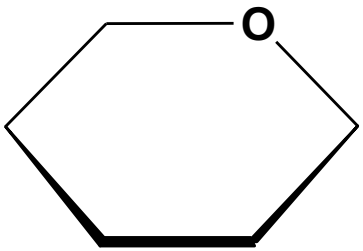
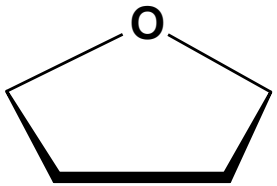
Cyclic Structures of monosaccharides



Cyclic structures

- Are the prevalent form of monosaccharides with 5 or 6 carbon atoms.



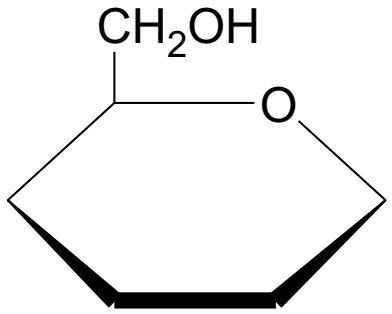


- Form when the hydroxyl group on C-5 reacts with the aldehyde group or ketone group.

Cyclic Haworth Structures

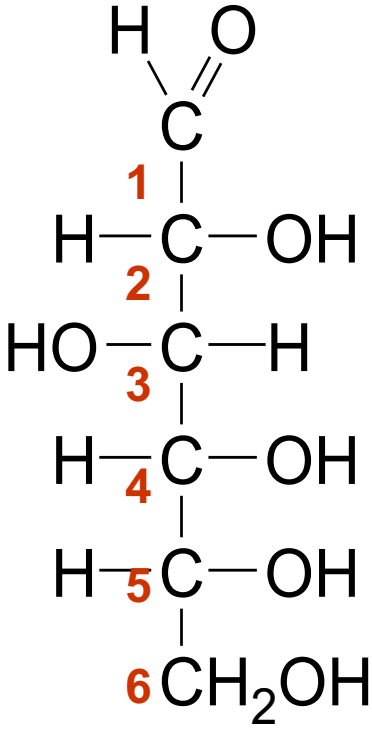
Stable cyclic hemiacetals form

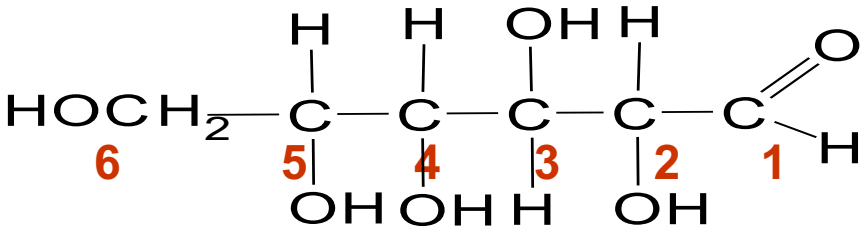
- When the C=O group and the —OH are part of the same molecule.
- For hexoses, the hydroxyl group on C-5 reacts with the aldehyde group or ketone group.
- The cyclic structure of a D-isomer has the last CH_2OH group located above the ring.



Drawing the Cyclic Structure for Glucose

STEP 1 Number the carbon chain and turn clockwise to form a linear open chain.

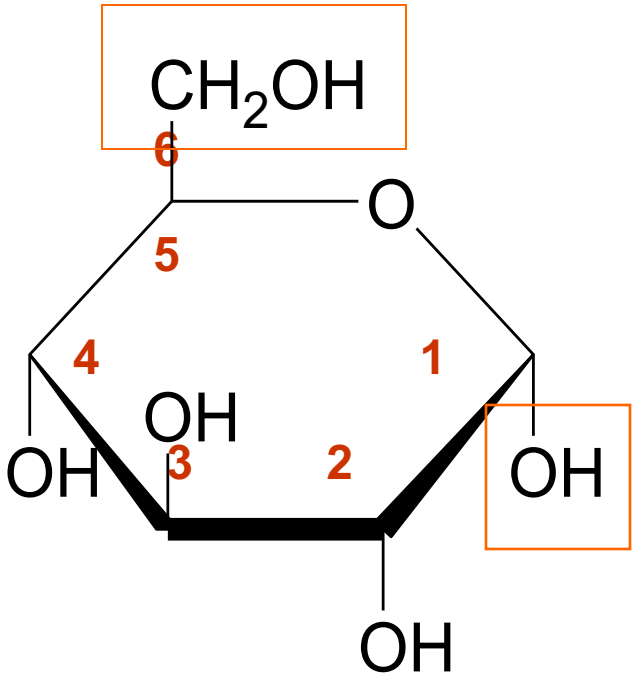




Cyclic Structure for Glucose

STEP 2 Bend the chain to make a hexagon

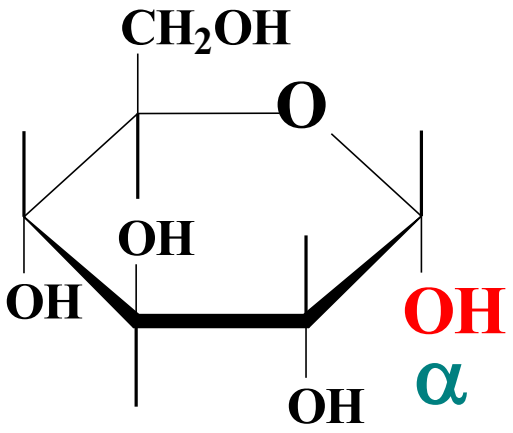
- Bond the C5 –O– to C1.
- Place the C6 group above the ring.
- Write the –OH groups on C2 and C4 below the ring.
- Write the –OH group on C3 above the ring.
- Write a new –OH on C1.



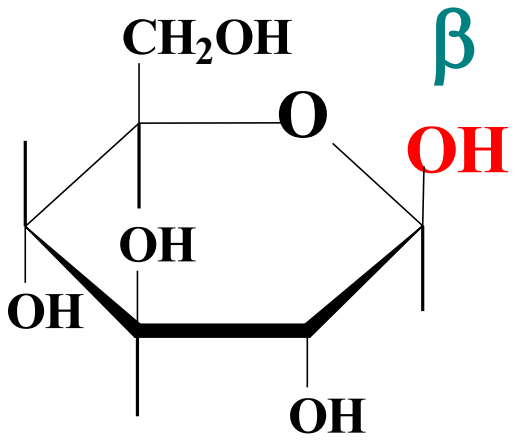
Cyclic Structure for Glucose (cont)

STEP 3 The new –OH on C1 is drawn

- Down for the α anomer.
- Up for the β anomer.

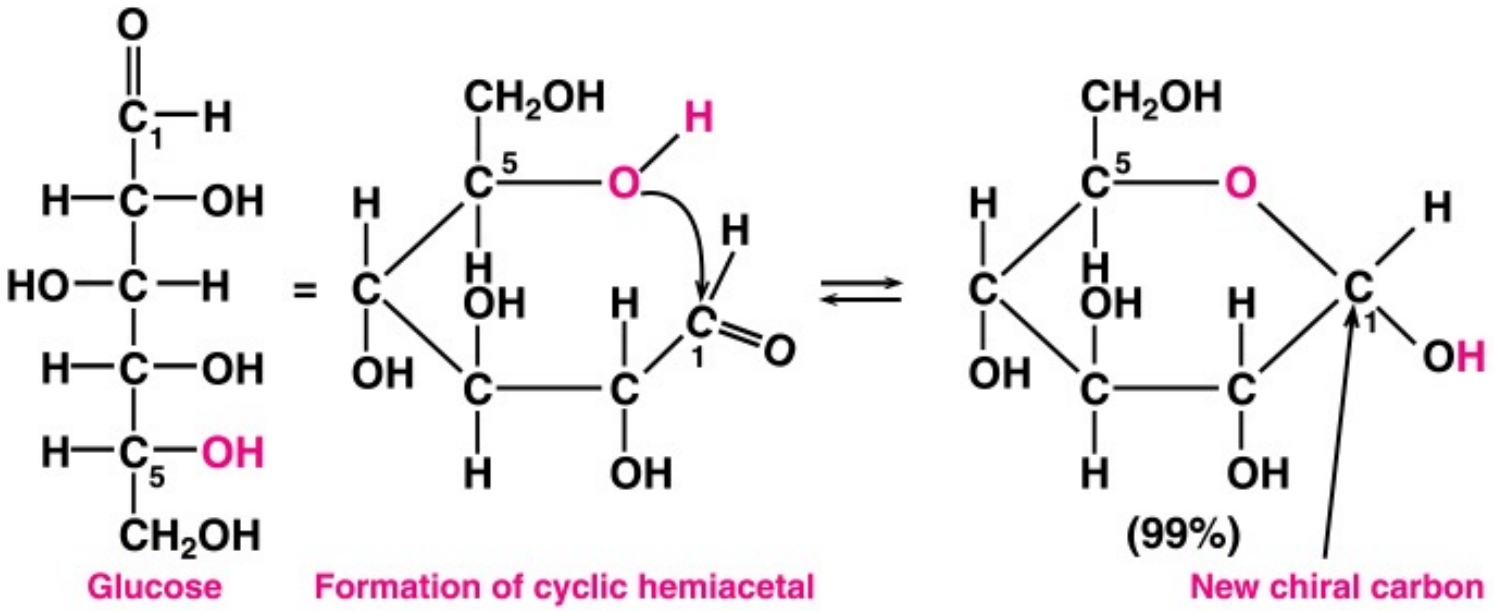


α-D-glucose



β-D-glucose

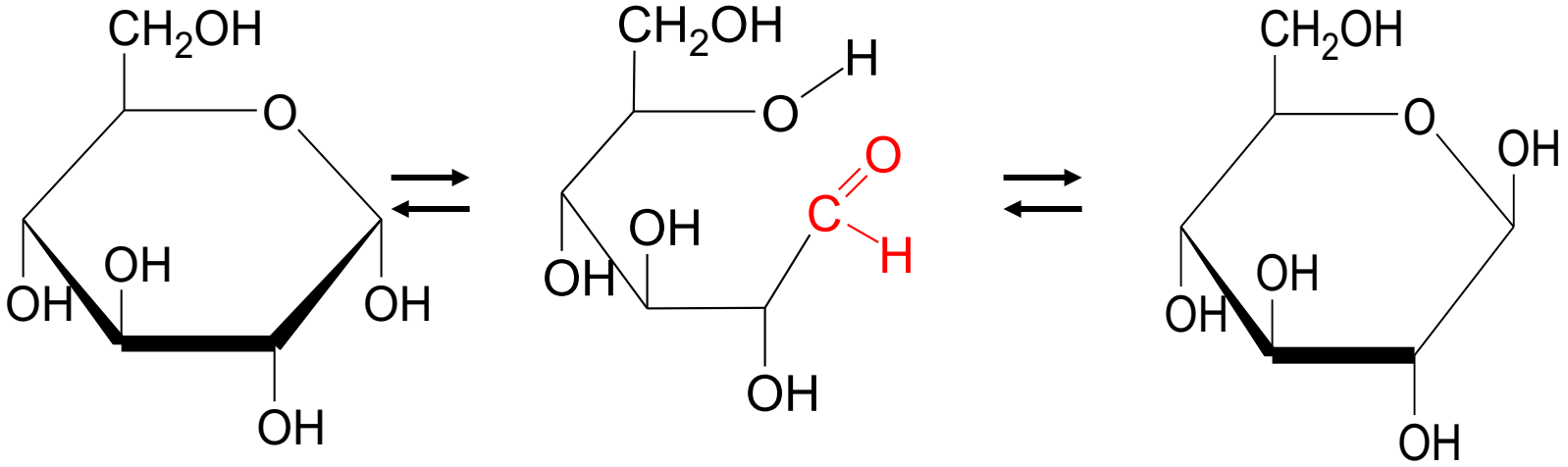
Summary of the Formation of Cyclic Glucose (Anomeric carbon)



α-D-Glucose and β-D-Glucose in Solution

When placed in solution,

- Cyclic structures open and close.
- α-D-glucose converts to *β*-D-glucose and back.
- There is only a small amount of open chain. In water each mutarotates to an equilibrium with [α] = +52.7
- (63.6% β / 36.4% α)



α-D-glucose (36%)

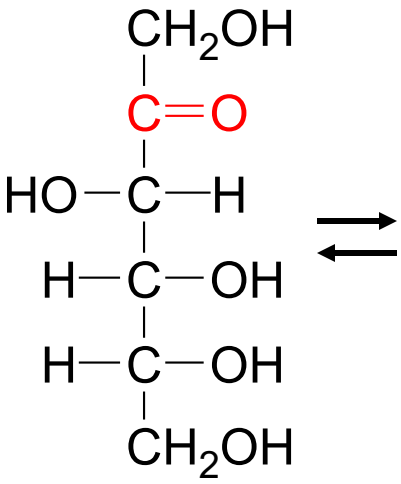
D-glucose (open) (trace)

β-D-glucose (64%)

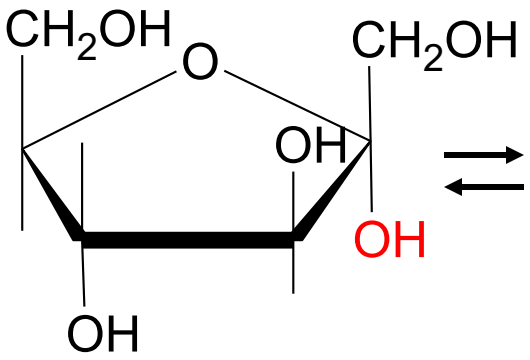
Cyclic Structure of Fructose

Fructose

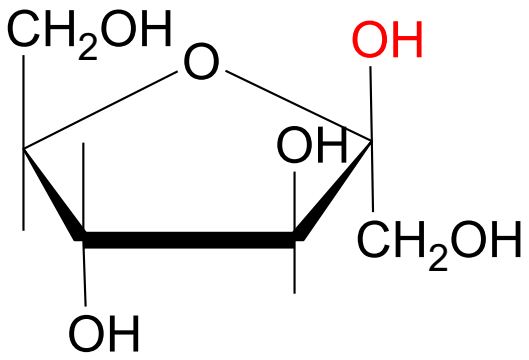
- Is a ketohexose.
- Forms a cyclic structure.
- Reacts the —OH on C-5 with the C=O on C-2.



D-fructose



α-D-fructose



β-D-fructose

Learning Check

Write the cyclic form of α-D-galactose