Traditionally, in carbohydrate chemistry, the furanose rings and the pyranose rings in carbohydrate molecules are shown in the planar conformation, placed on the plane perpendicular to the plane of the paper.

![Furanose ring](image1)

![Pyranose ring](image2)

This representation of rings is known as the Haworth formula.

eg: cyclic forms of D-glucose

To generate the Haworth formulas of the cyclic forms of a monosaccharide, use the following procedure, explained using the pyranoses of D-glucose.

Step 1: Draw the Fischer projection of the acyclic form of D-glucose. (See D,L convention)

![Fischer projection](image3)

Step 2: Number the carbon chain in 1 starting at the top.

![Numbered carbon chain](image4)
Step 3: To generate the pyranose ring, the oxygen atom on C-5 in 1 needs to be attached to C-1 by a single bond.

In 1, C-1 is behind the plane of the paper and the hydroxy group on C-5 is in front. For the pyranose ring to be planar, both C-1 and the hydroxy group on C-5 have to be either behind or in front of the plane of the paper. C-5 is a chiral center. In order to bring the hydroxy group on C-5 to the site occupied by the CH\textsubscript{2}OH group without changing the absolute configuration at C-5, rotate the three ligands H, OH, and CH\textsubscript{2}OH on C-5 in 1 clockwise without moving the fourth ligand. (See Fischer projection)
1 and 2 both represent D-glucose, but, in 2, unlike in 1, C-1 and the hydroxy group on C-5 are on the same side of the plane of the paper.

Step 4: Ignore that 2 is a Fischer projection and rotate it clockwise by 90º.

Step 5: Redraw the atom chain along the horizontal axis as follows.

Step 6: Add the ligands on C-2 through C-5 in 4. The ligands pointing up in 3 are pointing up in 4; those pointing down in 3 are pointing down in 4.
Step 7: Remove the hydrogen atom and the oxygen atom on C-1 and the hydrogen atom in the hydroxy group on C-5 in 5 and connect the two atoms by a single bond.

Step 8: Add the two remaining bonds to C-1 in 6.

Step 9: Attach a hydrogen atom to the bond pointing up and a hydroxy group to the bond pointing down on C-1 in 7.

Step 10: Interchange the hydrogen atom and the hydroxy group on C-1 in 8.
8 and 9 are the Haworth formulas of the pyranoses of D-glucose.

If, in the acyclic form of a monosaccharide, the hydroxy group that reacts with the carbonyl carbon is not on a chiral carbon (e.g., D-fructose → pyranoses), skip step 3.

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