CONVERTING FISCHER PROJECTIONS OF "D" MONOSACCHARIDES INTO HAWORTH STRUCTURES

Fisher projection

In the Fischer projection:

- 1. Carbon-#1 is carbon-#1, the hemiacetal carbon (with a \ast), in the Haworth structure
- 2. All of the atoms on the $\underline{\textbf{right}}$ are pointed $\underline{\textbf{down}}$ in the Haworth structure.

Haworth structure

- 3. All of the atoms on the <u>left</u> are pointed <u>up</u> in the Haworth structure.
- 4. The CH_2OH (the carbon-#6 in D-glucose) is pointed $\underline{\bf up}$ in the Haworth structure
- 5. The OH attached to carbon-#5 (box around it) becomes part of the ring.
- 6. The linear Fischer projection becomes a cyclic hemiacetal in the Haworth structure.

In the Haworth Stucture:

- 1. Carbon-1 "*" is the anomeric carbon
- 2. The anomeric carbon is derived from the C=O in the Fischer projection.
- 3. Notice there are no carbonyls in the Haworth projection.
- 4. The carbonyl has become the hemiacetal group.

Drawing Haworth Projections of D-aldohexoses

Drawing Haworth Projections of D-aldohexose	es e	
1. Draw the Fischer projection and number	₁ CHO	
the carbon atoms.	H 2 OH	
	HO 3 H	
D-Galactose	HO 4 H	
	H 5 OH	
	₆ CH ₂ OH	
	6C112O11	
2. For an <u>aldohexose</u> draw the pyranose	6 CH OH	
template for the Haworth projection and number the carbon atom.	⁶ CH ₂ OH	
number the carbon atom.	5)—O	
	4 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	
D-galactose is an aldohexose, so	'	
	3 2	
3. Add hydroxyl groups to $C_2 - C_4$ of the	⁶ CH₂OH	
Haworth template.	5 <u> </u>	
A. In the Fisher projection the hydroxyl groups on the right (only C ₂) are placed	4 \langle 1	
on a downward bond (a bond below the		
ring).	$\stackrel{3}{\longrightarrow} \stackrel{ 2}{\cap}$ OH	
	011	
	⁶ CH₂OH	
B. In the Fisher projection, the hydroxyl	\HO5O	
groups on the left (only C_3 and C_4) are placed on an <u>upward</u> bond (a bond	4 OH 1	
above the ring).		
acove the ring).	3 2	
	OH	
4. Add a hydroxyl group to C_1 :	⁶ ÇH₂OH	
downward for an alista (c) 1 1 1	HO5	
downward for an alpha (α) hydroxyl (opposite side of ring as the CH ₂ OH)	\/	
(opposite side of fing as the C112O11)	4 (OH) 1	
	3 20H	
	OH 6 ÇH ₂ OH	
	HO ₅ OH	
upward for a beta (β) hydroxyl		
(same side of ring as the CH ₂ OH)	4 (OH) 1	
	3 2	
	\ о́н /	
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Drawing Haworth Projections of D-aldopentoses

Drawing Haworth Projections of D-aldopentoses	
1. Draw the Fischer projection and number	₁ CHO
the carbon atoms.	H 2 OH
	HO-3-H
D-xylose	H 4 OH
	₅ CH ₂ OH
2. For an aldopentose draw the furanose	
template for the Haworth projection and	
number the carbon atoms.	5 CH ₂ OH
	4 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
D-xylose is an aldopentose, so	3 2
3. Add hydroxyl groups to $C_2 - C_3$ of the	5 ÇH ₂ OH
Haworth template. A. In the Fisher projection the hydroxyl	0
groups on the right (only C ₂) are placed	4 7 1
on a <u>downward</u> bond (a bond below the	
ring).	$\stackrel{3}{\longrightarrow}$ 2
	OH
	5 CH₂OH
B. In the Fisher projection, the hydroxyl	0
groups on the left (only C_3) are placed on an <u>upward</u> bond (a bond above the	4 OH) 1
ring).	3 2
C,	3 2
A Add a bada and a constant C	ОП
4. Add a hydroxyl group to C ₁ :	5 CH ₂ OH
downward for an alpha (α) hydroxyl	0
(opposite side of ring as the CH ₂ OH)	$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$
	3 2 OH
	OH N 5 CH ₂ OH OH
upward for a beta (β) hydroxyl	4 (00) 1
(same side of ring as the CH ₂ OH)	3 2
	OH
FINISH	IED!
FINISH	IED:

Drawing Haworth Projections of D-ketohexoses

the carbon atoms. D-fructose D-fructose 2. For an ketohexose draw the furanose template for the Haworth projection and number the carbon atoms. Notice that carbon 1 is not present at this point and the OH at carbon 5 has become part of the ring. D-fructose is a ketohexose, so 3. Add hydroxyl groups to C ₃ – C ₄ of the Haworth template. A. In the Fisher projection the hydroxyl groups on the right (only C ₄) are placed on a downward bond (a bond below the ring). B. In the Fisher projection, the hydroxyl groups on the left (only C ₃) are placed on an upward bond (a bond above the ring). B. In the Fisher projection, the hydroxyl groups on the left (only C ₃) are placed on an upward bond (a bond above the ring). 4. Add a hydroxyl group to C ₂ : downward for an alpha (α) hydroxyl (opposite side of ring as the CH ₂ OH) upward for a beta (β) hydroxyl	1. Draw the Fischer projection and number	1CH2OH
D-fructose D-fructose D-fructose D-fructose D-fructose 1 H	- ¥	
D-fructose H OH H OH H OH H OH H OH H OH OH		
2. For an ketohexose draw the furanose template for the Haworth projection and number the carbon atoms. Notice that carbon 1 is not present at this point and the OH at carbon 5 has become part of the ring. 3. Add hydroxyl groups to C ₃ – C ₄ of the Haworth template. A. In the Fisher projection the hydroxyl groups on the right (only C ₄) are placed on a downward bond (a bond below the ring). B. In the Fisher projection, the hydroxyl groups on the left (only C ₃) are placed on an upward bond (a bond above the ring). B. In the Fisher projection, the hydroxyl groups on the left (only C ₃) are placed on an upward bond (a bond above the ring). A. Add a hydroxyl group to C ₂ : downward for an alpha (α) hydroxyl (opposite side of ring as the CH ₂ OH) Location and the CH ₂ OH of the placed opposite the OH at C ₂		
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B. In the Fisher projection, the hydroxyl groups on the left (only C ₃) are placed on an <u>upward</u> bond (a bond above the ring). 4. Add a hydroxyl group to C ₂ : downward for an alpha (α) hydroxyl (opposite side of ring as the CH ₂ OH) upward for a beta (β) hydroxyl (same side of ring as the CH ₂ OH) Notice that the carbon-1 CH ₂ OH is placed opposite the OH at C ₂	Haworth template. A. In the Fisher projection the hydroxyl groups on the right (only C ₄) are placed on a <u>downward</u> bond (a bond below the	5 0 2
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Notice that the carbon-1 CH ₂ OH is placed opposite the OH at C ₂		0H 5 HO 2 4 3 CH ₂ OH
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