supplement #1 Chem 4524

stereochemical language and assignment with one chiral center

Chemistry 4524 Organic Chemistry II

1.0 What makes a chiral molecule ?

*Any tetrahedral center with 4 different (nonequivalent) groups attached is in principle* ***chiral (pronunciation: ki rel …rhymes with spiral)***

**Ex. CH4 no CH3Cl no CH2ClBr No CHFBrCl yes**

**1.1. Describing Chiral Molecules**

***General ways to describe a chiral molecule:***



*(see pp 288-89 section 7.7 of text)*

***Language specific to sugars: D & L and (+), (-)***

*(see pp 1024-25 section 25.2 of text)*

1) D & L description

Draw Fischer projection of sugar so that HO and H closest to CH2OH are on the horizontal (out-of-plane) and CH2OH is on the bottom of vertical. An `**L**’ sugar has the OH on the left. A `**D**’ sugar has the OH on the right.



**D**=dextrorotatory (right handed) **L**=Levorotatory (left handed)

2) (+) and (-) description

The molecule to the left is D-`arabinose’.

Using a polarimeter, the observed specific rotation is –75o. Hence, it is commonly written as:

# D-(-)-Arabinose

Note that a D sugar can be either (-) or (+). The D or L assignment does not predict the sign of the specific rotation.



**1.2. R & S system of assignment (see also: pg 285-288 section 7.6 of text)**

**R** stands for `rechts’ in German, which means right

**S** stands for `sinister’ in Latin, which means left

An R,S pair are called an **enantiomeric** pair and the separate R and S species are **enantiomers.**

To assign the **R** or **S** character of a chiral molecule, you must assign the values of the 4 non-equivalent groups around the chiral center. The higher the atomic mass of the directly attached elements to the center, the higher the value.

To assign the molecule in example #1, imagine covering the lowest valued atom with your hand and tipping the rest of the molecule so that the three larger groups face you. Starting from the highest valued group, imagine moving in a circle to the next highest valued group and finally to the third highest valued group. If the direction you take is clockwise, this is an `**R**’ molecule; counterclockwise motion means an `**S**’ molecule

example #1



# R or S ?

example #2

When two groups have the same atom connected directly to the stereocenter, (CH3 and CH3CH2) then the mass of the next group connected to it decides the value. Thus, CH3CH2 is higher in value than CH3. What is the R/S assignment of the molecule in example 2, thus ?



**R or S ?**

To assign the R or S character of a Fischer projection, you can build the molecule with your kits, or redraw the projections. (Remember, the horizontals are out; the verticals are in) . Then assign the group values and proceed as in example 1 or 2.

example 3



**R or S ?**

**1.3 Examples Of Chiral Molecules In The World**

**thalidomide**

**good thalidomide is R type**

**bad thalidomide is S type**



**chiral center**

**ibuprofen**

good ibuprofen is S type

useless ibuprofen is R type



**chiral center**

**sugars & Fischer D/L notation**

**anomeric carbons**

**L D**



**penultimate carbons**

(OH on left side) (OH on right side)