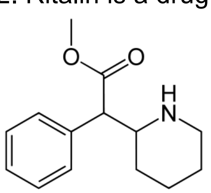
Objective 7: Stereochemistry – identify chirality centers, determine configuration (R/S), identify enantiomers, diastereomers, and meso compounds.
Quiz Practice problems
Key ideas:
Structural (constitutional) isomers have the same chemical formula, different connectivity (bonding).
Stereoisomers have the same chemical formula, same bonding, different orientation in space.
We looked at a specific type of stereoisomer - conformational isomers – in Objective 6.
We will look at other types of stereoisomers – enantiomers and diastereomers.
A compound with enantiomers has different properties. E.g., ibuprofen has two enantiomers – one enantiomer relieves pain but the other does not. Many biomolecules have enantiomers.
Enantiomers are mirror image isomers that are not superimposable on each other. Your right hand and left hand are enantiomers.
Diastereomers are non-mirror image isomers.
Most enantiomers and diastereomers have a chirality center.
A chirality center is a carbon with four different atoms or groups bonded to it.
Each chirality center has a configuration – R or S.
We will look at two ways to draw (represent) compounds with chirality centers – wedge-and-dash and Fischer projection.
In a Fischer projection, the horizontal line are like wedges (point toward you) and the vertical lines are like dashes (point away from you).
See Lab Activity 8.
A compound with "n" chirality centers has a maximum of 2^n stereoisomers.
A compound with one chirality center has enantiomers.
A compound with two or more chirality centers has enantiomers and diastereomers.
If a compound with two or more chirality centers has two stereoisomers that are achiral (has a plane of symmetry), these are meso compounds.

Skills:
Given a Lewis or skeletal structure, identify chirality center(s).
Determine the configuration (R or S) at a chirality center.
Given a Lewis or skeletal structure and configuration, draw a wedge-and-dash representation.
Given a Lewis or skeletal structure and configuration, draw a Fischer projection.
For a compound with two or more chirality centers, identify the enantiomers, diastereomers, and meso compounds (if any).

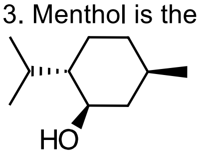
1. Chlorofluorocarbons (CFC) are used in refrigerants, aerosol propellants, and solvents.
a. Compare $CHFClCF_3$ to $CClF_2CCl_3$. Draw the structure of each compound. One of these compounds has a chirality center. Circle the chirality center.
b. For the compound with a chirality center in part a, draw the R enantiomer using a wedge-dash, Fischer projection, and sawhorse representation.

2. Ritalin is a drug used to treat attention deficit disorder (ADD).



a. This compound has 2 chirality centers. Circle each chirality center.
b. How many stereoisomers does Ritalin have?
c. Draw each stereoisomer.
d. Which isomers are enantiomers?
e. Which are diastereomers?

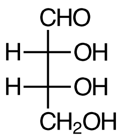
3. Menthol is the chemical that is responsible for a cooling sensation in the neural receptors in our mouth and skin.



a. Menthol has three chirality centers. Circle each chirality center.
b. C-1 is the carbon bonded to the O. The configuration at this C is R. Label the highest priority group as 1, 2nd highest as 2, and so on. Draw in the H bonded to this C with a wedge or dash.

c. C-2 is the carbon bonded to the isopropyl group. The configuration is S. Label the highest priority group as 1, 2nd highest as 2, and so on. Draw in the H bonded to this C with a wedge or dash.
d. Determine the configuration at C-5.
e. The 2^n rule (n = # of chirality centers) tells us the number of possible stereoisomers. How many possible stereoisomers does menthol have?

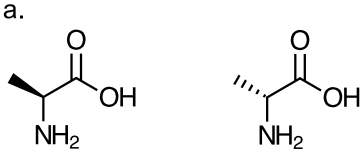
4. Monosaccharides contain between 3 and 6 carbons. The Fischer projection of a tetrose is shown.



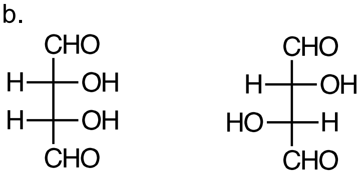
a. Circle the chirality centers. Determine the configuration at each chirality center.
b. This compound has 4 possible stereoisomers. Draw the Fischer projection of each stereoisomer.
c. Which stereoisomers are enantiomers?
d. Which stereoisomers are diastereomers?
e. This compound does not have a plane of symmetry so there is no meso compound. If you change the aldehyde group to a ____ group, the resulting compound has a plane of symmetry and is a meso compound. Fill in the blank. Draw the new compound. Show the plane of symmetry with a dashed line.

5. Compare the pair of compounds. Are the Are the two structures enantiomers, diastereomers, same, or different compounds?

a.



b.



c.