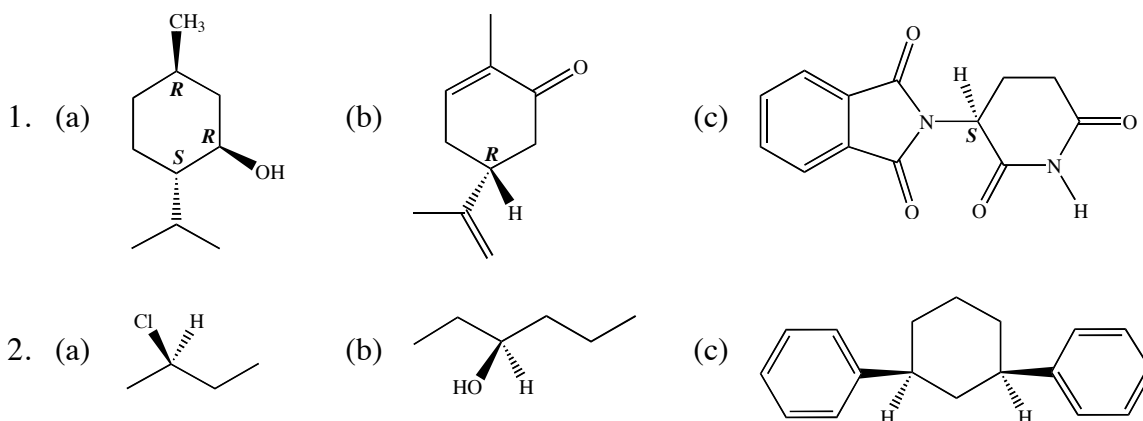
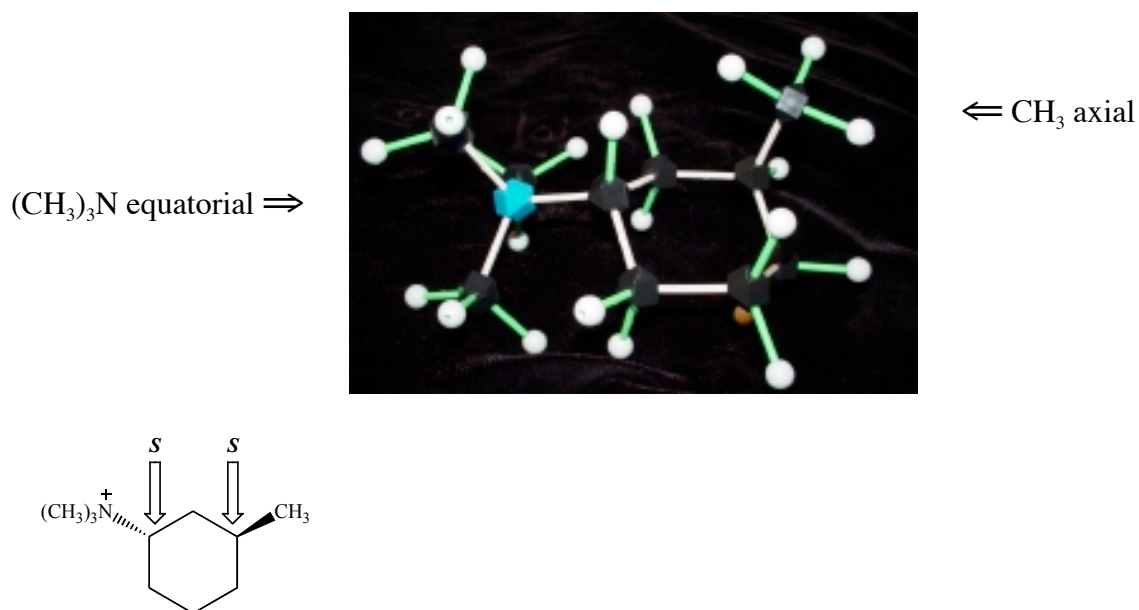


OWLS: Stereochemistry Solutions



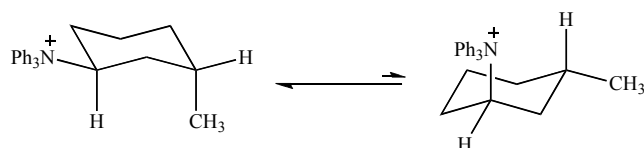
If your drawings do not look like these drawings, use models to test their equivalency.

3. (a) Arranged in the most stable conformation, your model will look like this:

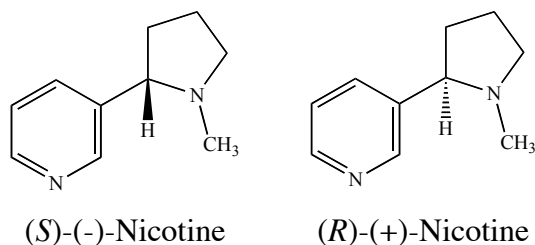


(c) The chairs can be interconverted by rotation around a single bond, so they are conformational isomers and not stereoisomers. *If you have trouble categorizing isomers, review the Classification of Isomers section in the stereochemistry tutorials on the course web site.*

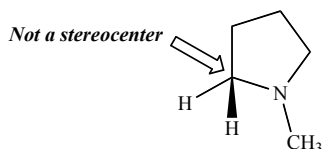
(d) The structure must be changed so that the *S* configurations are retained, yet the conformation bearing the equatorial (CH₃)₃N group is favored even more. This goal can be achieved in various ways. For example, changing the alkyl portions of the (CH₃)₃N group into larger groups such as benzene rings (abbreviate as Ph) will increase this group's equatorial preference, thus shifting the equilibrium even further.



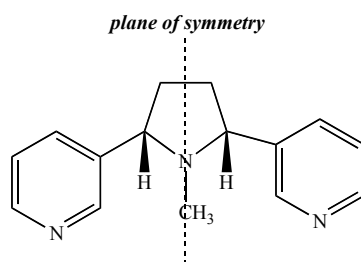
4. (a) The nicotine stereoisomer shown in the Stereochemistry Lecture Supplement is the (-) enantiomer (levorotatory). Its enantiomer is (+)-nicotine (dextrorotatory).



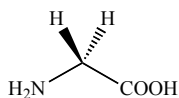
- (b) A molecule that is optically inactive is achiral (superposable on its mirror image). A meso compound has at least two stereocenters, but is achiral. A molecule that has a stereocenter can be made optically inactive but not meso if the stereocenter is removed. This can be achieved, for example, by replacing the stereocenter pyridine ring with a hydrogen atom.



- (c) Meso compounds have at least two stereocenters but are not chiral (and hence not optically active). Adding another pyridine ring creates a second stereocenter. If the new stereocenter creates a plane of symmetry, the modified nicotine is meso.

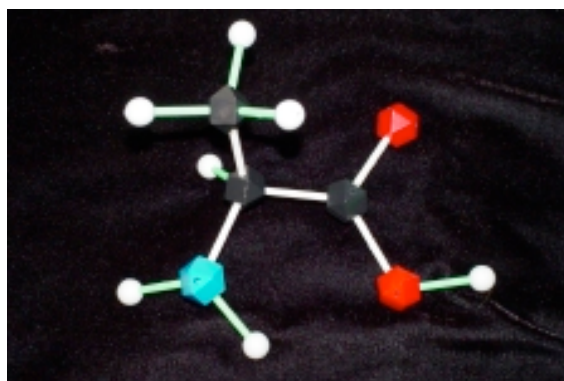


5. (a) For the amino acid to be achiral, it must either be meso (not possible in this case with only one stereocenter), or it must have no stereocenter at all. Thus if R = NH₂, COOH, or H, the carbon bearing the R group is not a stereocenter. The only natural achiral amino acid is glycine (R = H) is shown.



(b)

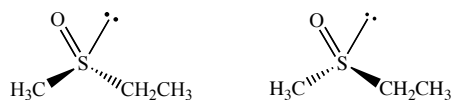
amine \Rightarrow



\Leftarrow carboxylic acid

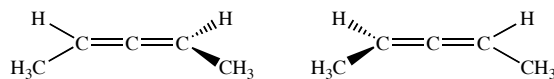
Assignment of the amino acid stereocenter as *R* or *S* depends upon the relative Cahn-Ingold-Prelog priorities of the atoms or groups attached to the stereocenter carbon. The stereocenter of alanine is *S*. As it turns out, most of the amino acid R groups all have a priority that is less than NH_2 and COOH but more than hydrogen so most natural amino acids have the *S* configuration. The exceptions are cysteine ($\text{R} = \text{CH}_2\text{SH}$) and selenocysteine ($\text{R} = \text{CH}_2\text{SeH}$). Examine natural amino acids list at the Illustrated Glossary of Organic Chemistry at the course web site to verify.

6. A simple way to analyze chirality is to build a model of the molecule and its mirror image, then test for superposability.
- (a) Achiral, as is true for all planar molecules.
- (b) Achiral, as is true for all planar molecules.
- (c) Chiral. The sulfur atom bears four different attachments (methyl, ethyl, oxygen, and lone pair), so it is a stereocenter. This molecule has as a pair of enantiomers. Verify that these structures are enantiomers with molecular models.



This sulfoxide has a sulfur stereocenter and therefore has a pair of enantiomers.

- (d) Chiral. This is a rare example of a molecule that is chiral but does not have a stereocenter, but instead has an axis of chirality. This molecule has as a pair of enantiomers. Verify that these structures are enantiomers with molecular models.



There are two enantiomers of 2,3 – pentadiene, even though the molecule has no stereocenter.