- Chem 220 - Organic Chemistry

Stereochemistry

Chapter 5

Due: Monday, October 5, 2009

The Borremean Rings

Versions of this symbol date to the time of the Vikings. In the 15th century, it was the symbol of a tripartite alliance of the Milanese families Visconti, Sforza and Borromeo via intermarriage. Break any (wedding?) ring and the others separate, hence the alliance is broken. The rings form a chiral object (left) that is not superimposable on its mirror image. A set of Borremean rings has been used as the logo for a certain refreshment that extols purity, body, and flavor. Is the sense of chirality of the two sets of Borremean rings the same or different? For some

other discourses on chirality, see:

Potpourri

The Figure 8 Knot

Gentlemen's Neckties

Molecular Knots

Read the stereoisomers module in the StudyAids and do the exercises. There is no need to record answers on your homework.

Don't forget the Chirality of Shells (Powerpoint). Do left-handed whelks have a better survival rate than their mirror image brethren? Click here.

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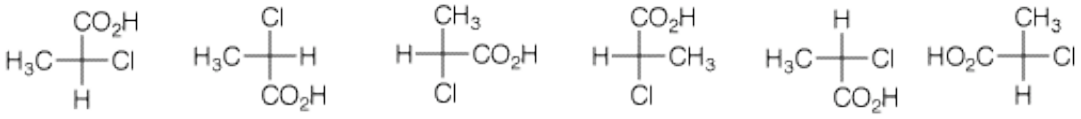
1. When (*R*)-1-chloro-2-methylbutane undergoes free radical chlorination, four dichloro constitutional isomers are formed. What are these structures? Draw them. Be explicit as to diastereomers, enantiomers, racemates, etc.

2. There are twelve possible Fischer projections for a given enantiomer of α-chloropropionic acid. Six of the 24 of the total are shown below. Assign R,S-configurations to each one. Draw the remaining (*S*)-enantiomers.



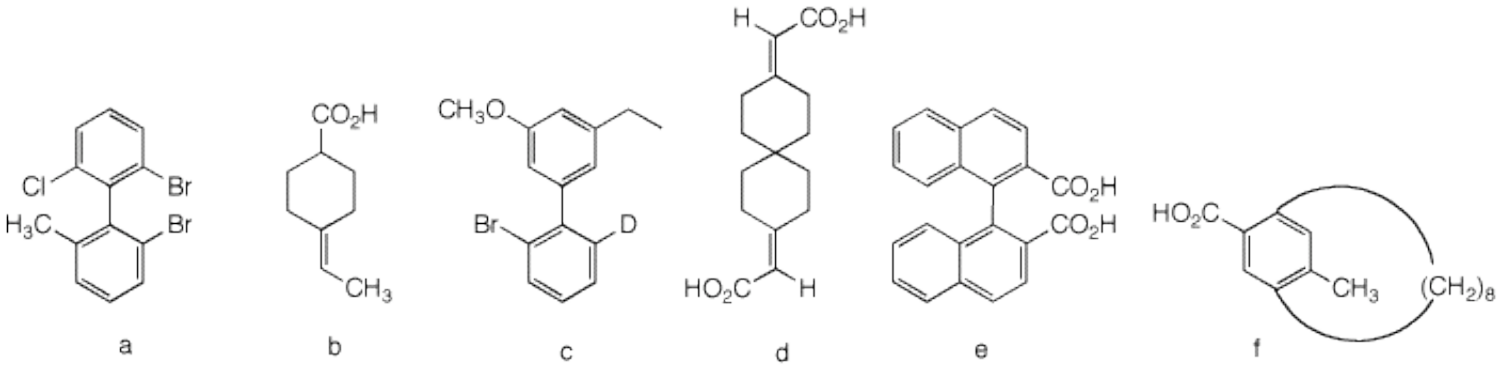
a b c d e f

3. A 3:1 mixture of enantiomers has $[\alpha]_D = -60^o$. What is the rotation of the d- and l-enantiomers? Show work.

4. a) 1,2-Dibromoethane is optically inactive yet it has a dipole moment. Explain and illustrate. [Hint: Draw the staggered conformations and assess optical activity and dipole moment for each.]

b) meso-Tartaric acid exists in three staggered conformations, none of which has a plane of symmetry. Yet the compound is optically-inactive. Indeed, the only conformation that has a plane of symmetry is quite unstable. Explain and illustrate.

5. Which of the following compounds are, in principle, capable of resolution? Explain and illustrate. [For 3-D Jmol views of these structures click here.: 5a, 5b, 5c, 5d, 5e, 5f.]



6. (*S*)-α-Phellandrene ($[\alpha]_D = +86^o$) is a monoterpene with the characteristic fragrance of dill. (*S*)-α-Phellandrene reacts with 2 moles of hydrogen gas in the presence of Pd to give two cyclohexanes **A** and **B**, both of which have the formula $C_{10}H_{20}$ and both of which are optically inactive. Compound **A** has an energy difference of 0.4 kcal/mol between its two chair conformations while compound **B** has a value of 3.8 kcal/mol for the same equilibrium.
Explain the loss of optical activity, the energy differences, and identify the structures **A** and **B**.

7. (*R*)-α-Phellandrene has been reported to have a specific optical rotation of -217°. This observation suggests that the sample of the enantiomer used in problem 6 above is contaminated. Assume that the contaminant is the (*R*)-enantiomer and that the (*R*)-enantiomer is pure.What percentage of each enantiomer is present in the sample of problem 6? Show work.