Chem 220a

Problem Set 4

Chapter 5

Due: Monday, October 4, 2004

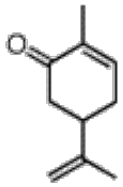
The Borremean Rings

Versions of this symbol date to the time of the Vikings. In the 15th century, it was apparently 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 are not superimposable on their 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 examples, click here.

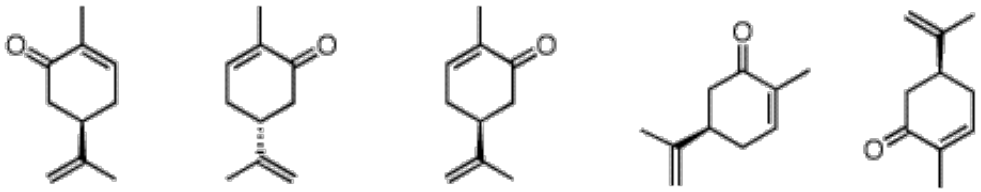
1. Read the stereoisomers module in the StudyAids and do the exercises. There is no need to record answers on your homework. Don't forget the Chirality of Shells (Powerpoint).

2. Free radical chlorination of **A** (C_5H_{12}) provides compound **B** ($C_5H_{11}Cl$, maximum theoretical yield = 25%) among other isomers. In principle, **B** can be resolved. The enantiomers of **B** both afford only racemate C ($C_5H_{10}BrCl$) upon free radical bromination. What are the structures of **A-C**? Explain and illustrate.

3. The terpene carvone (**1**) exists in nature as the individual enantiomers. The dextrorotatory enantiomer is of the S-configuration; it is present in dill seeds. [There is a handy mnemonic device.] The other enantiomer is the flavor of spearmint. Carvone has an optical rotation of [a] = 61°. Steam distillation of a mixture of caraway seeds and spearmint leaves produces a sample of carvone having [a] = -35°.



1



a) What percentage of the R and S enantiomer are present in the mixture?

b) What is the enantiomeric excess of the sample?

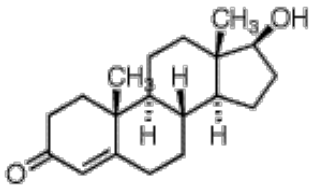
c) Label the five structures on the right as the R or S enantiomer of carvone.

3. Explain to your parents, in writing, the relationship of the pictures on the right to a specific tartaric acid.

4. a) Testosterone is one of how many possible stereoisomers? Explain. (Do not include the geometry of the double bond.)

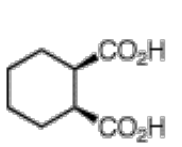
b) Knowing what you know about cyclohexane rings (and cyclopentane for that matter), what feature do the two methyl groups and three methine hydrogens share in common? Explain and illustrate.

c) Assign R and S configurations to the asymmetric carbons of testosterone.

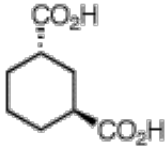


testosterone

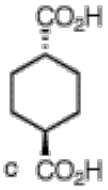
5. Which of the following compounds are, in principle, capable of resolution. Explain and illustrate.



a



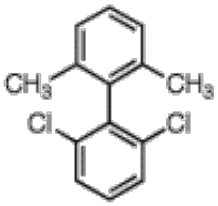
b



c

6-methyldodecane

d



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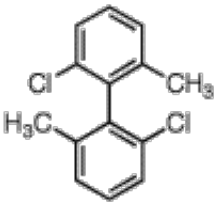

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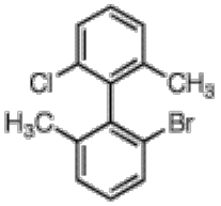

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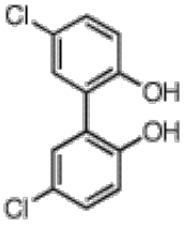

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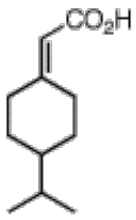

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k

l

6. When optically active (R)-2-bromo-2-deuteriobutane is reduced with tri-n-butyl tin hydride, racemic 2-deuteriobutane is formed. Explain and illustrate. (For help, see ORGO, Alkyl halides, #4)