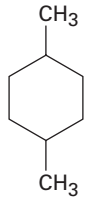
CHAPTER 4 (Lecture 5 HW)

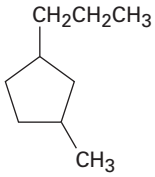
Problem 4.1

Give IUPAC names for the following cycloalkanes:

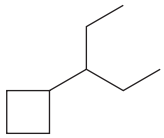
(a)



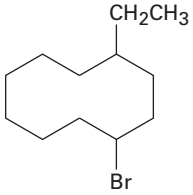
(b)



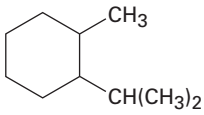
(c)



(d)



(e)



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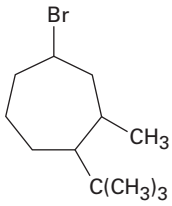


Problem 4.2

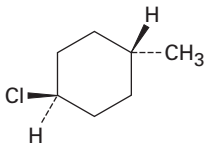
Draw structures corresponding to the following IUPAC names:

(a) 1,1-Dimethylcyclooctane **(b)** 3-Cyclobutylhexane
(c) 1,2-Dichlorocyclopentane **(d)** 1,3-Dibromo-5-methylcyclohexane

Problem 4.4

Name the following substances, including the *cis*- or *trans*- prefix:

(a)



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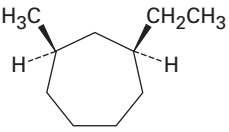


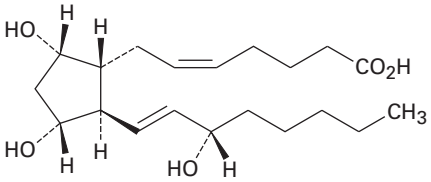
Problem 4.5

Draw the structures of the following molecules:

(a) *trans*-1-Bromo-3-methylcyclohexane **(b)** *cis*-1,2-Dimethylcyclobutane
(c) *trans*-1-*tert*-Butyl-2-ethylcyclohexane

Problem 4.6

Prostaglandin $F_{2\alpha}$, a hormone that causes uterine contraction during childbirth, has the following structure. Are the two hydroxyl groups (—OH) on the cyclopentane ring cis or trans to each other? What about the two carbon chains attached to the ring?

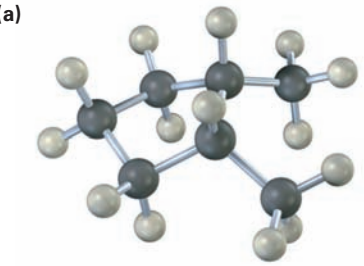


Prostaglandin $F_{2\alpha}$

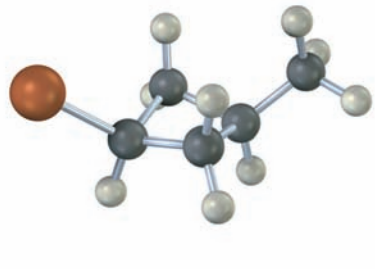
Problem 4.7

Name the following substances, including the *cis*- or *trans*- prefix (red-brown = Br):

(a)



(b)



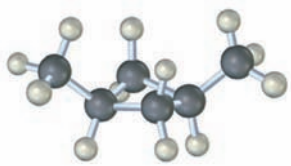
Problem 4.9

cis-1,2-Dimethylcyclopropane has more strain than *trans*-1,2-dimethylcyclopropane. How can you account for this difference? Which of the two compounds is more stable?

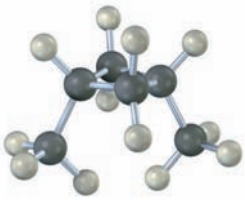
Problem 4.11

Two conformations of *cis*-1,3-dimethylcyclobutane are shown. What is the difference between them, and which do you think is likely to be more stable?

(a)



(b)



Problem 4.12

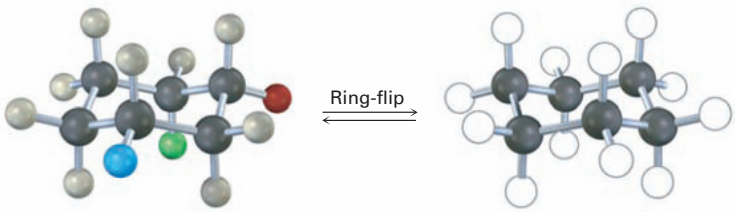
Draw two different chair conformations of cyclohexanol (hydroxycyclohexane), showing all hydrogen atoms. Identify each position as axial or equatorial.

Problem 4.13

Draw two different chair conformations of *trans*-1,4-dimethylcyclohexane, and label all positions as axial or equatorial.

Problem 4.14

Identify each of the colored positions—red, blue, and green—as axial or equatorial. Then carry out a ring-flip, and show the new positions occupied by each color.



Problem 4.15

What is the energy difference between the axial and equatorial conformations of cyclohexanol (hydroxycyclohexane)?

Problem 4.18

Draw the more stable chair conformation of the following molecules, and estimate the amount of strain in each:

(a) *trans*-1-Chloro-3-methylcyclohexane **(b)** *cis*-1-Ethyl-2-methylcyclohexane
(c) *cis*-1-Bromo-4-ethylcyclohexane **(d)** *cis*-1-*tert*-Butyl-4-ethylcyclohexane

Additional Problems

Cycloalkane Isomers

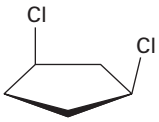
4.30 Tell whether the following pairs of compounds are identical, constitutional isomers, stereoisomers, or unrelated.

(a) *cis*-1,3-Dibromocyclohexane and *trans*-1,4-dibromocyclohexane

(b) 2,3-Dimethylhexane and 2,3,3-trimethylpentane

(c)

and



Cycloalkane Conformation and Stability

4.35 A 1,2-cis disubstituted cyclohexane, such as *cis*-1,2-dichlorocyclohexane, must have one group axial and one group equatorial. Explain.

4.36 A 1,2-trans disubstituted cyclohexane must have either both groups axial or both groups equatorial. Explain.

4.37 Why is a 1,3-cis disubstituted cyclohexane more stable than its trans isomer?

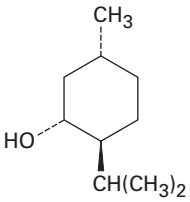
4.38 Which is more stable, a 1,4-trans disubstituted cyclohexane or its cis isomer?

4.39 *cis*-1,2-Dimethylcyclobutane is less stable than its trans isomer, but *cis*-1,3-dimethylcyclobutane is more stable than its trans isomer. Draw the most stable conformations of both, and explain.

Cyclohexane Conformational Analysis

4.42 Draw the two chair conformations of *cis*-1-chloro-2-methylcyclohexane. Which is more stable, and by how much?

4.45 Draw the two chair conformations of menthol, and tell which is more stable.



Menthol