CHAPTER 4 (Lecture 5 HW)

**Problem 4.1**
Give IUPAC names for the following cycloalkanes:

(a) \( \text{CH}_3 \)

(b) \( \text{CH}_2\text{CH}_2\text{CH}_3 \)

(c) \( \text{CH}_3 \)

(d) \( \text{CH}_2\text{CH}_3 \)

(e) \( \text{CH}_3 \)

(f) \( \text{Br} \)

**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) \( \text{CH}_3 \)

(b) \( \text{H}_3\text{C} \)

**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 \((-\text{OH})\) on the cyclopentane ring *cis* or *trans* to each other? What about the two carbon chains attached to the ring?
Problem 4.7
Name the following substances, including the *cis*- or *trans*- prefix (red-brown = Br):

(a) ![Image](https://via.placeholder.com/150)
(b) ![Image](https://via.placeholder.com/150)

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) ![Image](https://via.placeholder.com/150)
(b) ![Image](https://via.placeholder.com/150)

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

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**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) cis-1,2-Dimethylcyclohexane and cis-2,3-Dimethylcyclohexane

**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.