

Course 343-5 Lecturer Prof. Gellman  
 Day Wen's Day Date 10/19/2016  
 Notes Taken By Sungho Total # of Pages 4

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Chap. 7 Cyclic Molecules  
 & Stereochemistry of Organic Rxns

Problems: 1, 4, 5, 7-13, 15, 17, 20, 25-38,  
 40-73

Cycloalkanes



etc.

}



Stability Considerations

Benchmark:

$\Delta H_f^\circ$  increment (from linear alkanes)

$\approx -5.0$  kcal/mol per  $-\text{CH}_2-$

$\Delta H_f^\circ$  per CH<sub>2</sub> (kcal/mol)



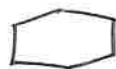
+ 4.2



+ 1.7



- 3.5

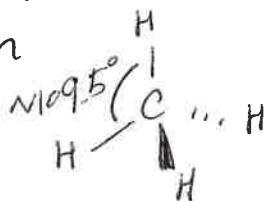


- 5.0 \* (gold star)

"Strain" - source(s) of instability in  $\Delta$  relative to  
 linear alkane (or larger ring)

2 specific types of strain ...

1) Angle strain



vs.



Angle strain:

60° vs 109.5°

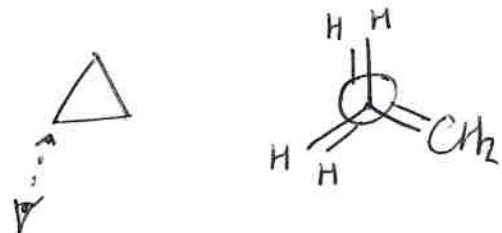
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## 2) Torsional strain (eclipsed conformations)



Must be totally eclipsed!

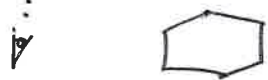
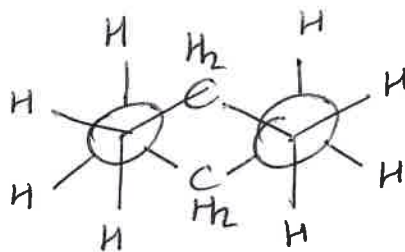
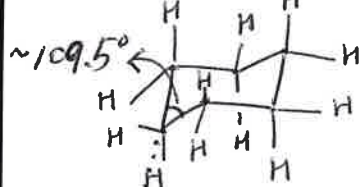
See text -  and   $109^\circ$

interplay between angle & torsional strain

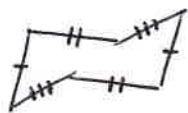
Why is there no internal strain in  ?

→ Can achieve a conformation w/o angle or torsional strain!

"Chair" conformation



Proper drawing of chair conformations  
(cyclohexane)



3 sets of parallel lines

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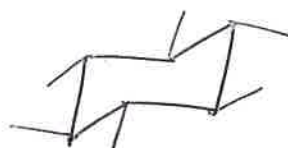
Proper placement of substituents, relative to  
 6-carbon ring

Each C has two substituent positions.  
 One is "axial", other is "equatorial".

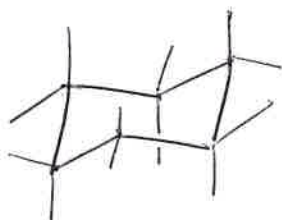
Axial positions



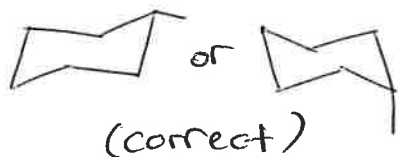
Eg positions



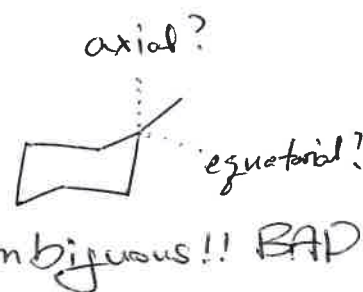
Total package



Incorrect drawings are possible

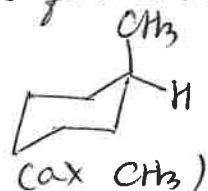
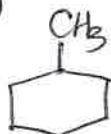


, NOT

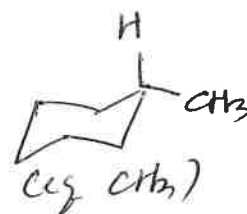


Axial vs equatorial positioning of substituents  
 (anything other than H)  
 has energetic consequences.

Ex:



less stable than



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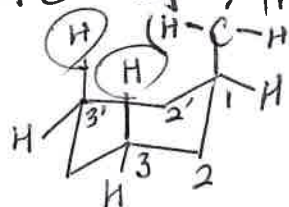
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Difference  $\approx 1.8$  kcal/mol

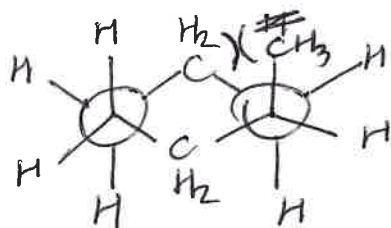
Source of  $\Delta H$  instability of axial  $\text{CH}_3$ : Steric repulsions



"1,3-diaxial interaction"

No such repulsion when  $e_z$   $\text{CH}_3$

Alternative view:



gauche-type interaction!

(Where is the other gauche-type interaction?)