4.1: Names and Physical Properties of Cycloalkanes

4.2: Ring Strain and the Structure of Cycloalkanes

4.3: Cyclohexane: A Strain-Free Cycloalkane

4.4: Substituted Cyclohexanes

4.5: Larger Cycloalkanes

4.6: Polycyclic Alkanes

4.7: Carbocyclic Products in Nature

Practice Problems

Q21

Draw all of the different structures with the formula C₆H₁₂ with only one ring and name them.

Q22

Draw all of the different structures with the formula C₇H₁₄ with only one ring and name them.

Q23

Name each of the following structures.
Q24

Draw the following structures, and if the name is not in accordance with IUPAC naming, give the proper name.

(a) isopropylcyclohexane (b) 1,1-dimethylcyclobutane (c) cyclobutylcyclopentane (d) cyclopropylpropane (e) 1-iodo-4-chlorocyclohexane (f) 1-ethyl-2-cyclobutane

Q25

Draw the following structures, no indication of the ring conformation is necessary.

a. trans-1-bromo-2-methylcyclohexane  
b. cis-1-bromo-2-methylcyclohexane  
c. trans-1-bromo-2-iodocyclopropane  
d. 1-bromo-2-iodocyclopropane  
e. 1-fluoro-4-methylcycloheptane

Q26

Given that the ideal bond angle for an sp\(^3\) hybridized carbon is 109.5\(^0\) and that the ideal angle for an sp\(^2\) hybridized carbon is 120\(^0\), what radical is the most stable based on the angle strain? Is the radical more stable than the previous cycloalkane, again based on angle strain alone? (Hint, a transition from an sp\(^3\) hybridized to an sp\(^2\) hybridized carbon occurs).

(a) cyclobutane (angle=88\(^0\)) (b) cyclopropane (angle=60\(^0\)) (c) cyclohexane (angle ~ 109.5\(^0\))

Solutions
Notice how many more different structures that can be drawn for C\textsubscript{7}H\textsubscript{14} than C\textsubscript{6}H\textsubscript{12}. If more than one ring were an option, even more structures could be drawn.
**S23**

(a) Br

(b) Cl

(bromocyclohexane) (1-chloroethyl)cyclohexane

Cl

(c) methylcyclopropane

(d) Br

(b) Cl

1-iodo-3-methylcyclobutane

1-ethyl-4-methylcycloheptane

(e) 1-bromo-5-iodocyclooctane

**S24**

(a) 1-(1-methyl-1-ethyl)cyclohexane

1-ethyl-2-methylcyclohexane

(b) 1,1-dimethylcyclobutane

(c) cyclobutylcyclopentane

(d) propylcyclopropane

(e) 1-chloro-4-iodocyclohexane

1-ethyl-2-methylcyclobutane
Given that the ideal bond angle for an sp\(^3\) hybridized carbon is 109.5° and that the ideal angle for an sp\(^2\) hybridized carbon is 120°, what radical is the most stable based on the angle strain? Is the radical more stable than the previous cycloalkane, again based on angle strain alone? (Hint, a transition from an sp\(^3\) hybridized to an sp\(^2\) hybridized carbon occurs).

(a) cyclobutane (angle=88°)

- Before the radical forms: 109.5-88= 21.5°
- After the radical forms: 120-88= 32°

The radical creates more ring strain

(b) cyclopropane (angle=60°)

- Before the radical forms: 109.5-60=49.5°
- After the radical forms: 120-60=60°

The radical creates more ring strain

(c) cyclohexane (angle ~ 109.5°)

- Before the radical forms: 109.5-109.5=0
- After the radical forms: 120-109.5=10.5° The radical creates more ring strain

The cyclohexane radical is the most stable based on angle strain alone