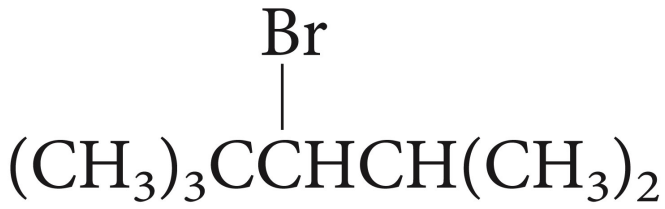
Chapter 2:L2

Physical properties
Conformations
Isomerism
cycloalkanes

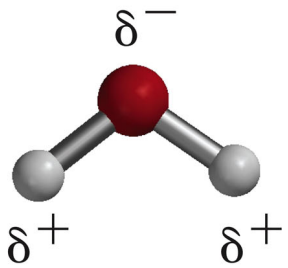
Name the following compounds by the IUPAC system:

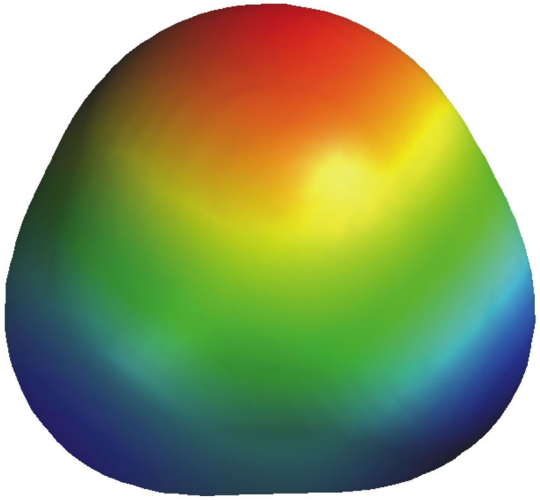


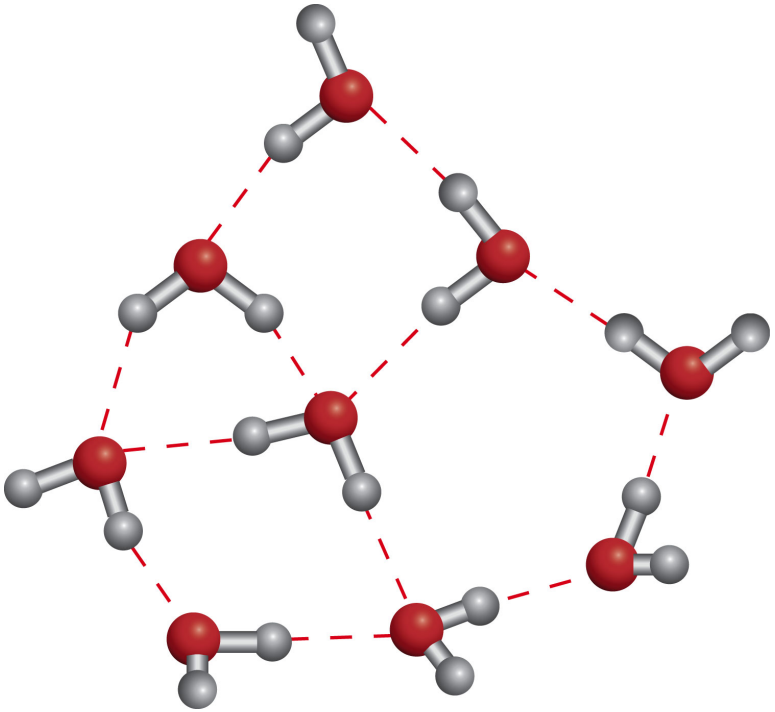
$CH_3CHFCH_2CH_3$

Write the structure for 3,3-dimethyloctane

Physical Properties of Alkanes and Nonbonding Intermolecular Interactions



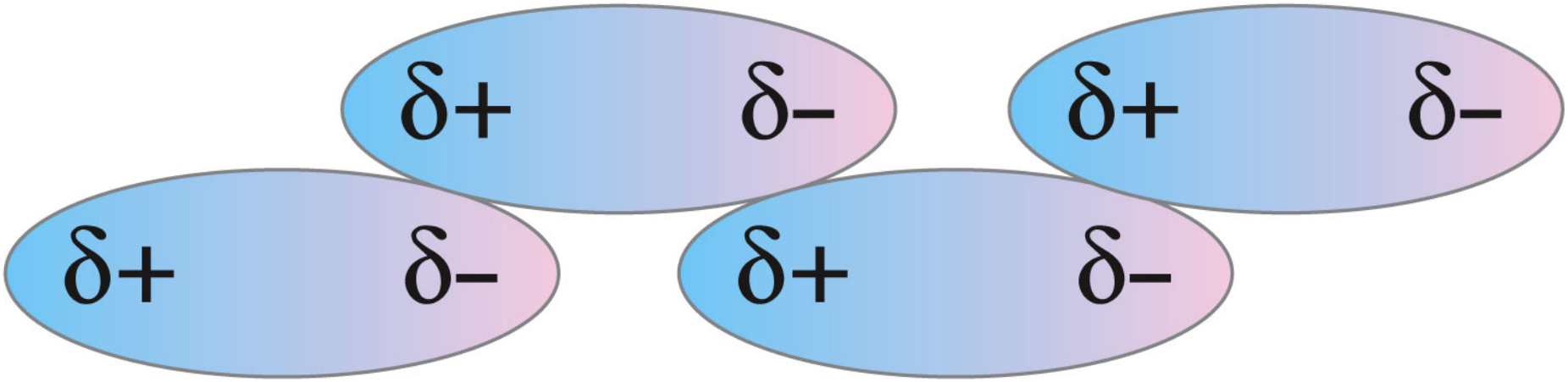




Water molecules are polar and they have special attractions called *hydrogen bonding.*

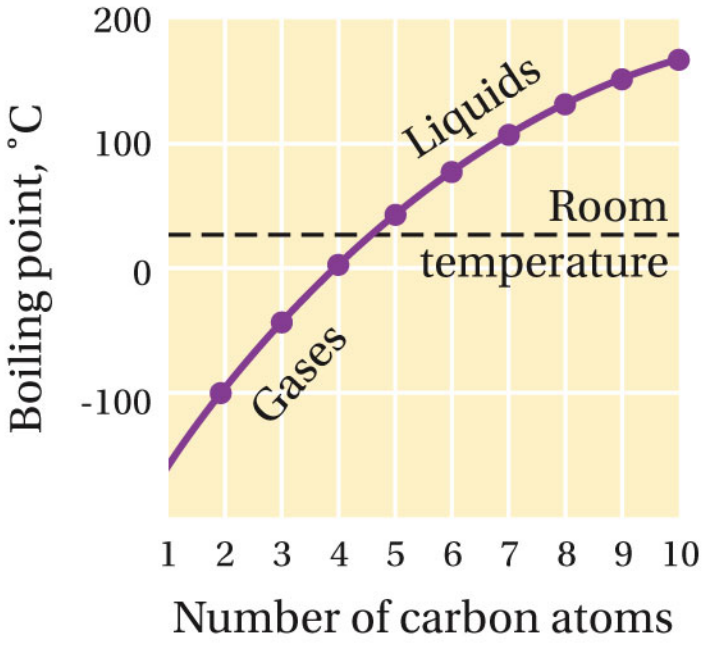
Alkanes are insoluble in water because they are non-polar (all the C-C and C-H are nearly purely covalent)

Van der Waals attractions

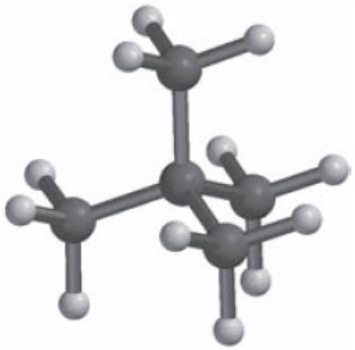


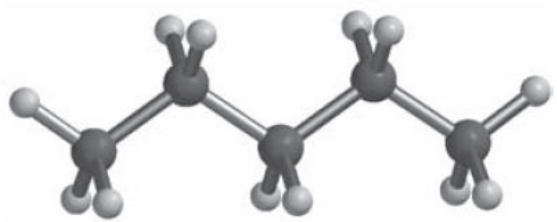
The boiling points of alkanes rise as the chain length increases and fall as the chains become branched and more nearly spherical in shape

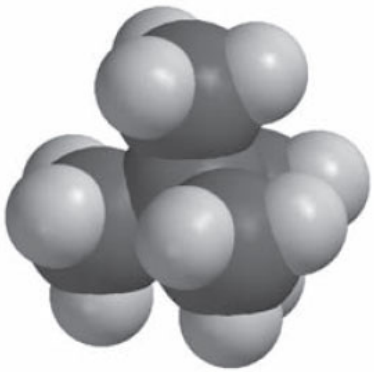
The effect of molecular shapes on van der Waals attractions

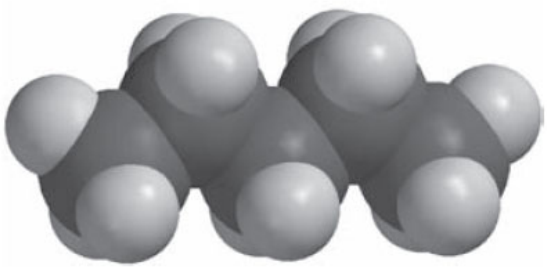


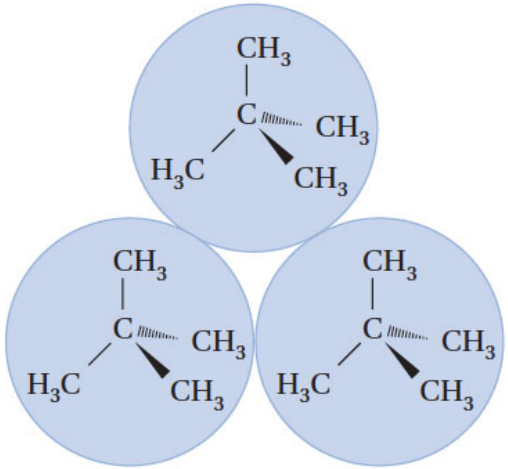
Name	Formula	Boiling point, °C
pentane	$CH_3CH_2CH_2CH_2CH_3$	36
2-methylbutane (isopentane)	$CH_3CH(CH_3)CH_2CH_3$	28
2,2-dimethyl-propane (neopentane)	$C(CH_3)_4$	10





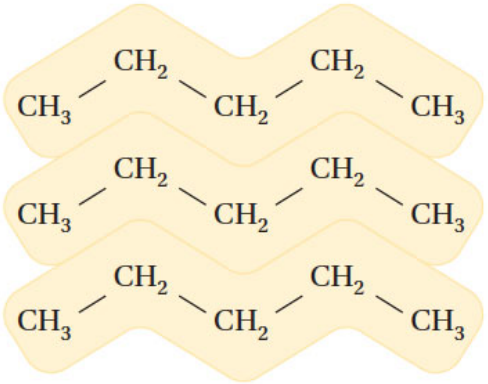






2,2-dimethylpropane
bp 10°C

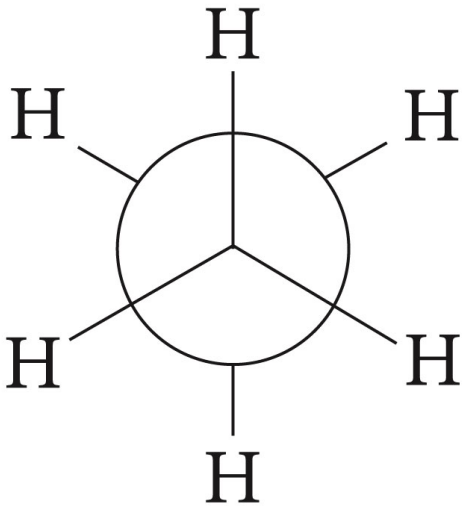
(a)



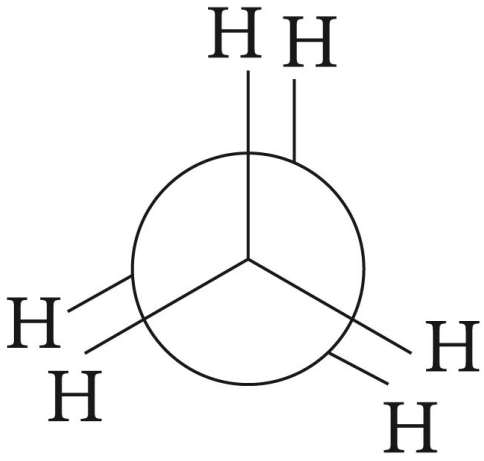
pentane
bp 36°C

(b)

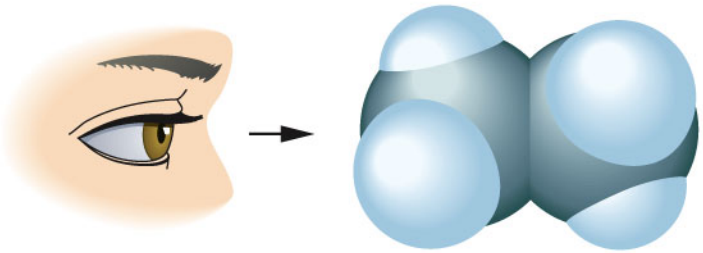
Conformations of Alkanes



staggered



eclipsed



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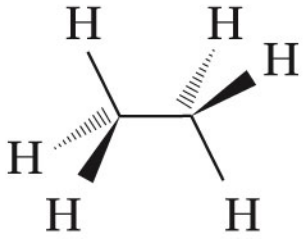
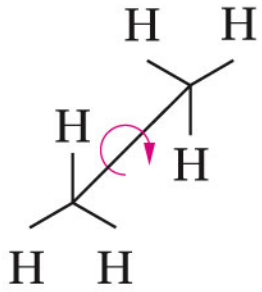
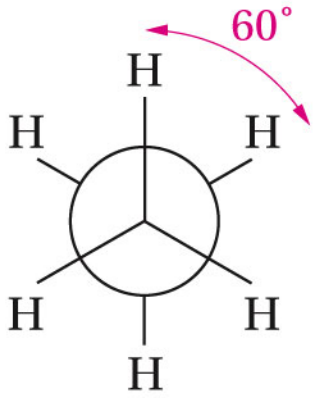


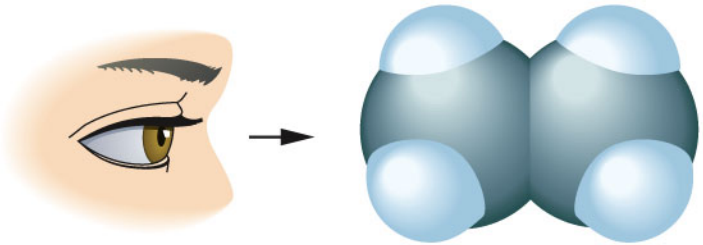
“dash-wedge”



“sawhorse”



Newman



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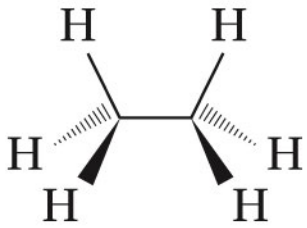
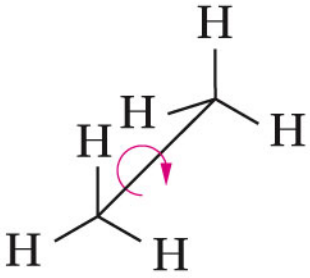
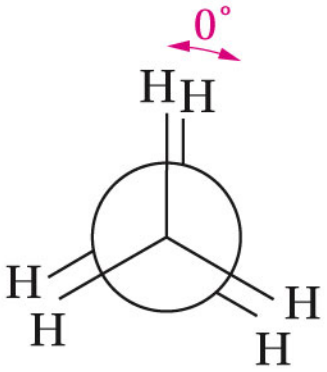


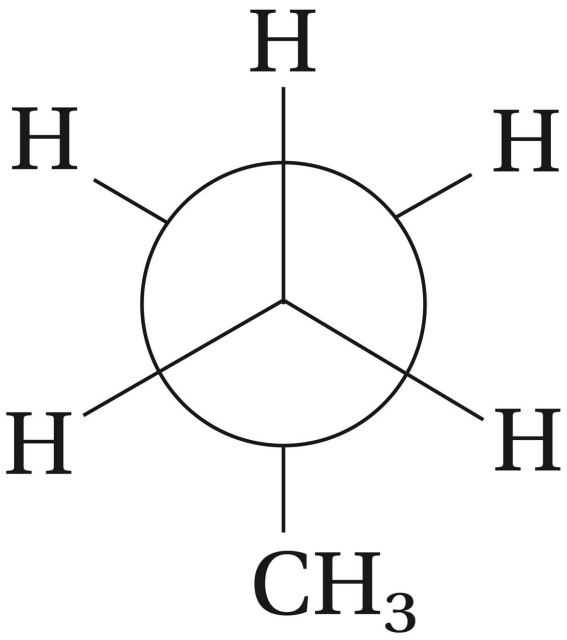
“dash-wedge”



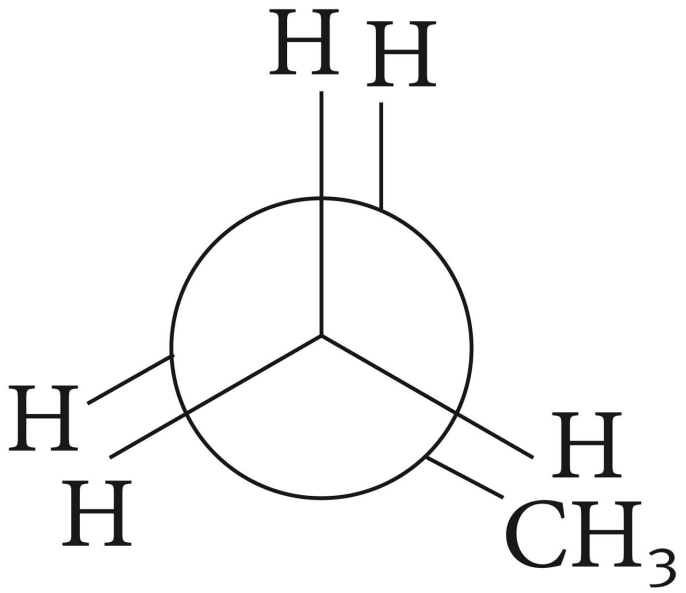
“sawhorse”



Newman

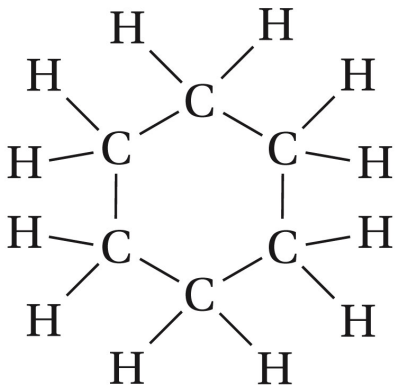


staggered

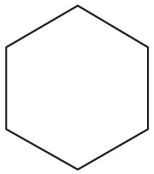


eclipsed

Cycloalkane Nomenclature and Conformation



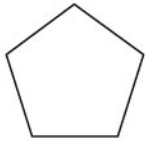
or



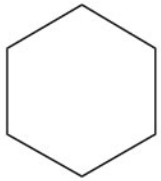
Structural and abbreviated structural formulas for cyclohexane

cyclopropane
bp −32.7°C

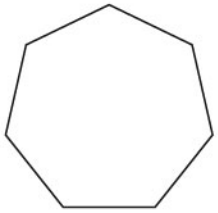
cyclobutane
bp 12°C



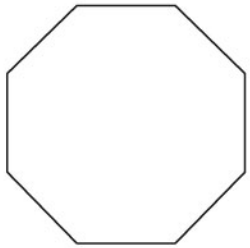
cyclopentane
bp 49.3°C



cyclohexane
bp 80.7°C

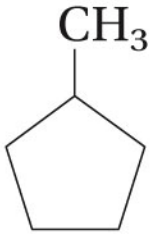


cycloheptane
bp 118.5°C

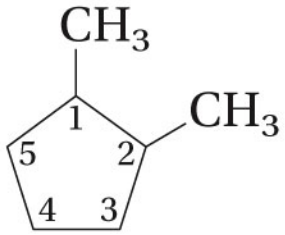


cyclooctane
bp 149°C

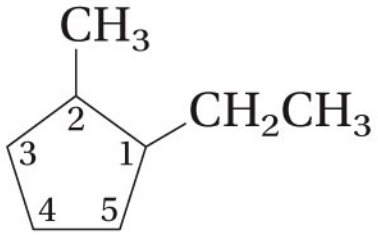
One substituent is always located at ring carbon numbered 1, the remaining carbons are then numbered consecutively in a way that gives the other substituents the lowest possible numbers. With different substituents, the one with highest alphabetic priority is located at carbon 1.



methylcyclopentane
(*not* 1-methylcyclopentane)

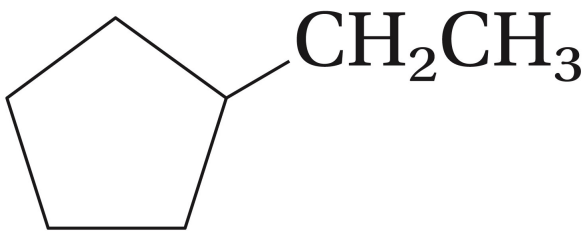


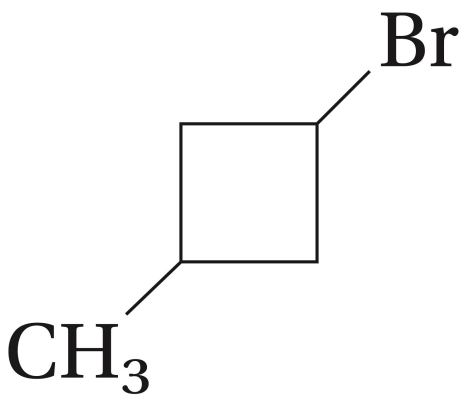
1,2-dimethylcyclopentane
(*not* 1,5-dimethylcyclopentane)

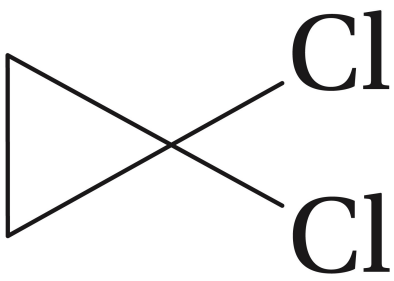


1-ethyl-2-methylcyclopentane
(*not* 2-ethyl-1-methylcyclopentane)

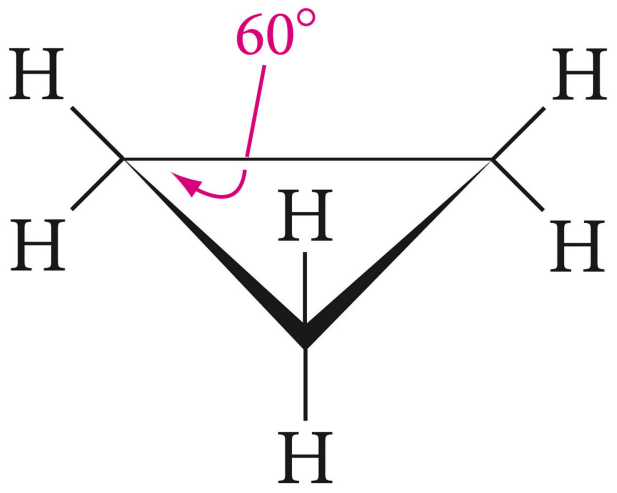
Give the IUPAC names for the following compounds



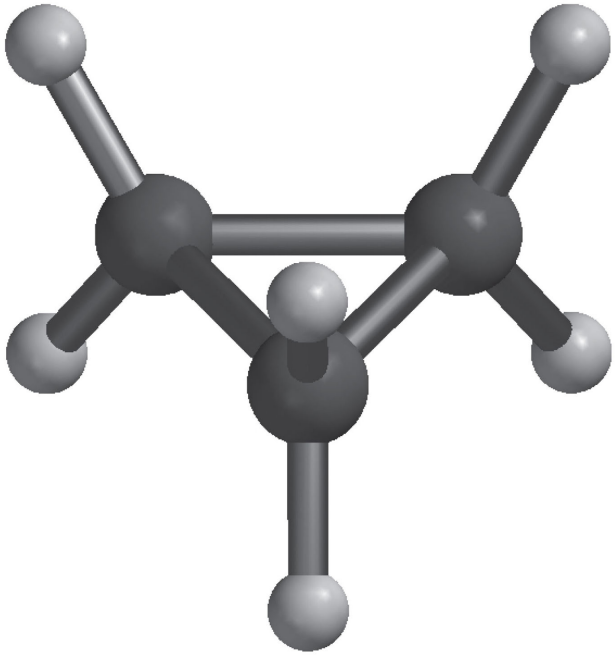


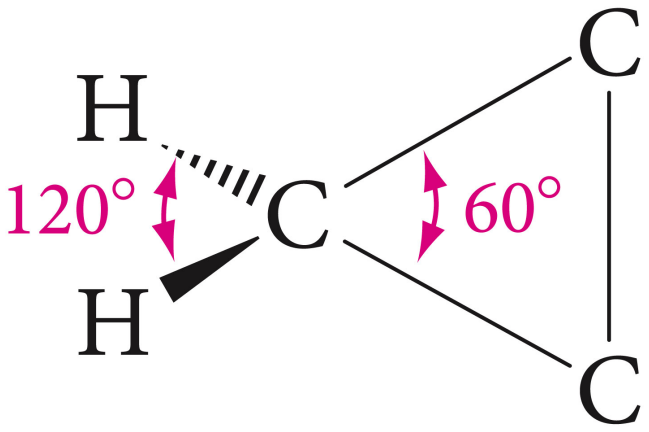


Cyclopropane

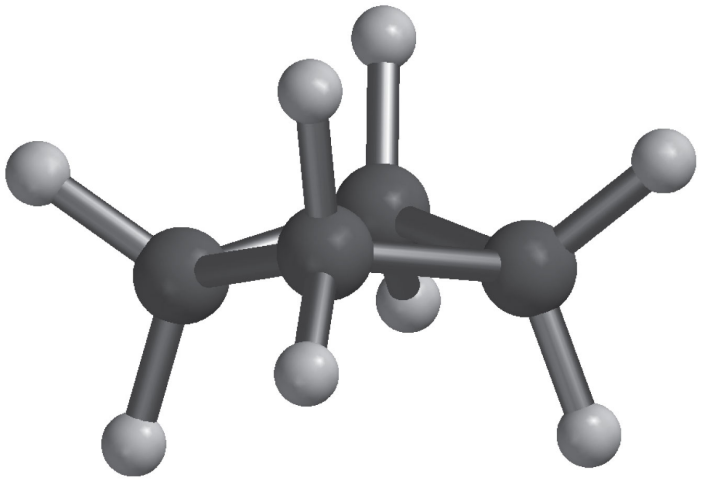


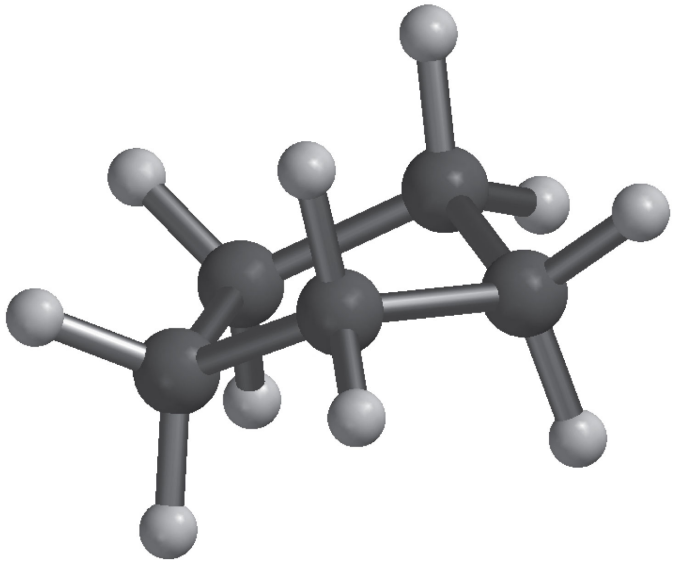
cyclopropane

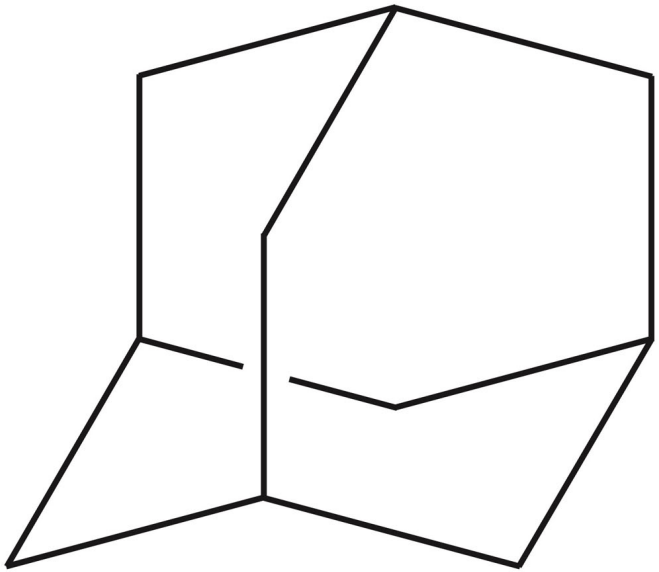


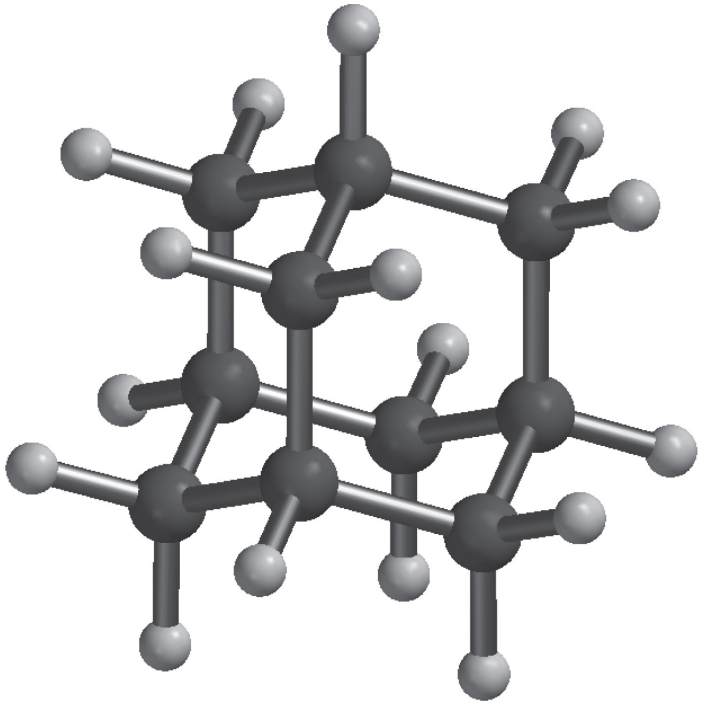


Cycloalkanes with more than three carbon atoms are nonpolar and have “ puckered” conformations.





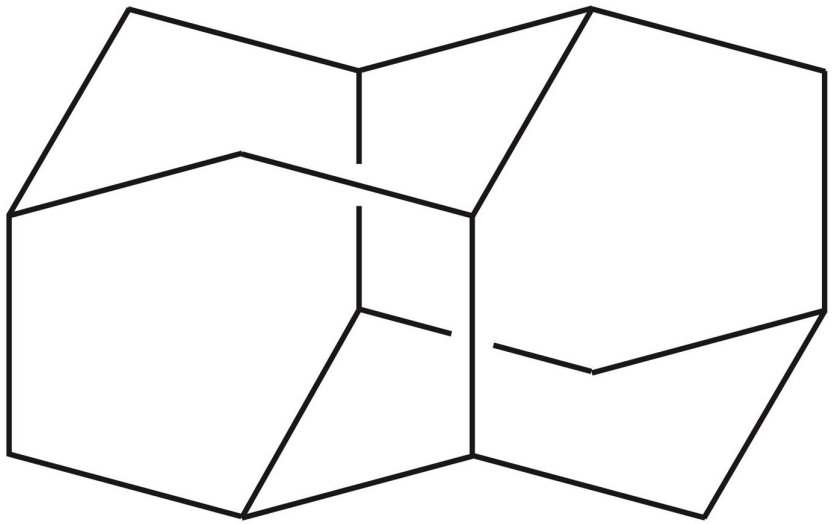


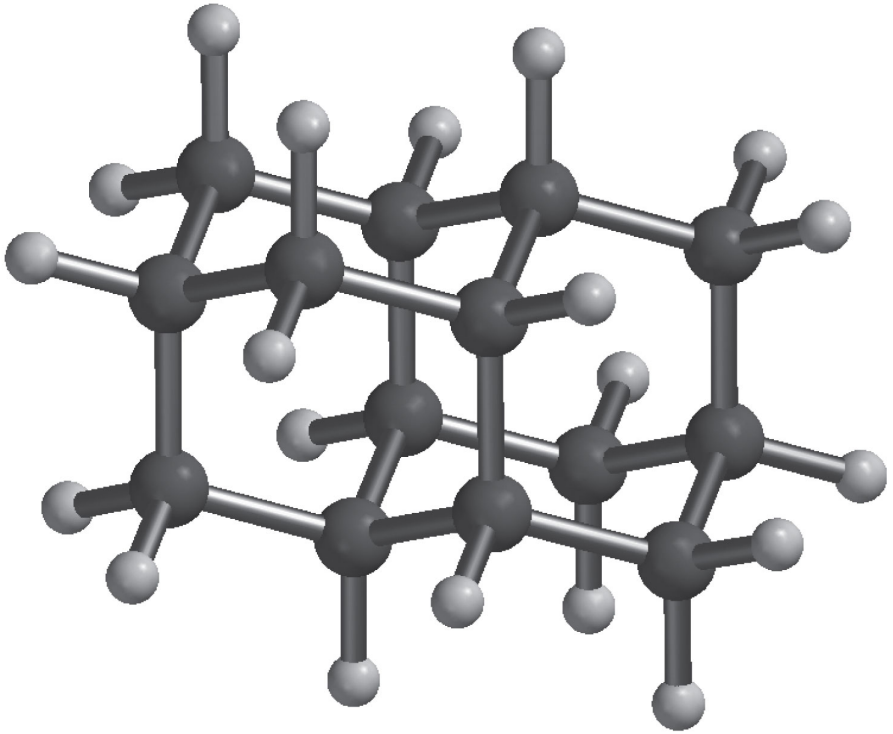


adamantane

$(C_{10}H_{16})$

mp 268–269°C



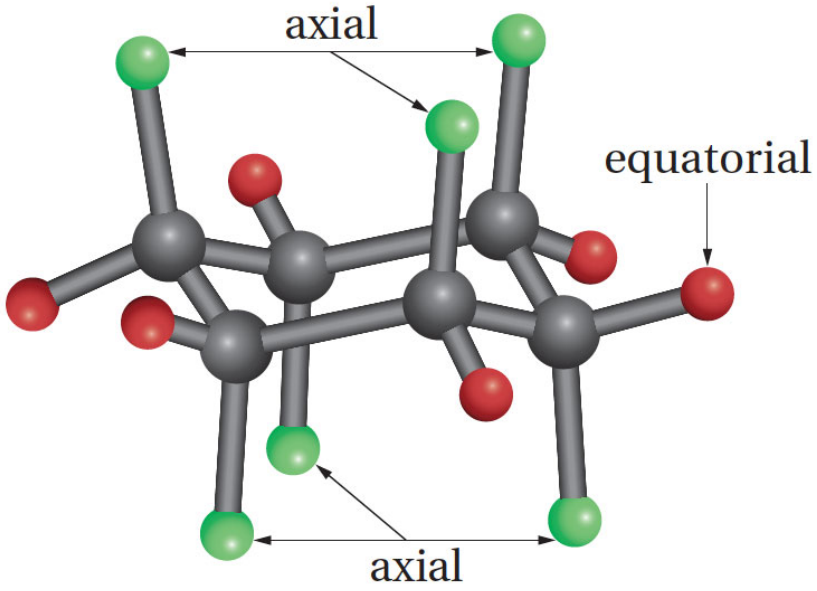


diamantane

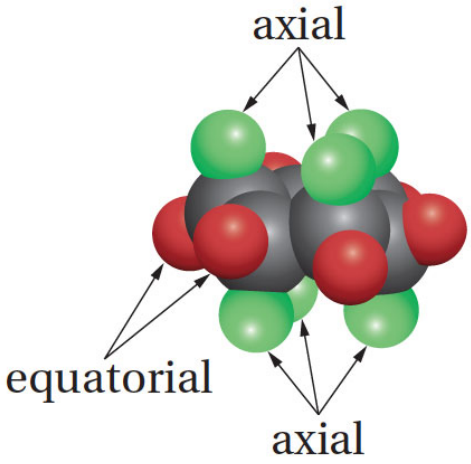
$(C_{14}H_{20})$

mp 236–237°C

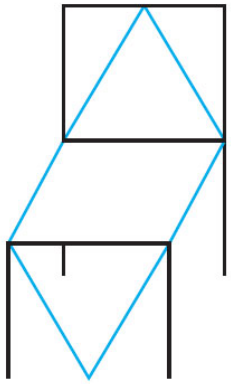
The chair conformation of cyclohexane



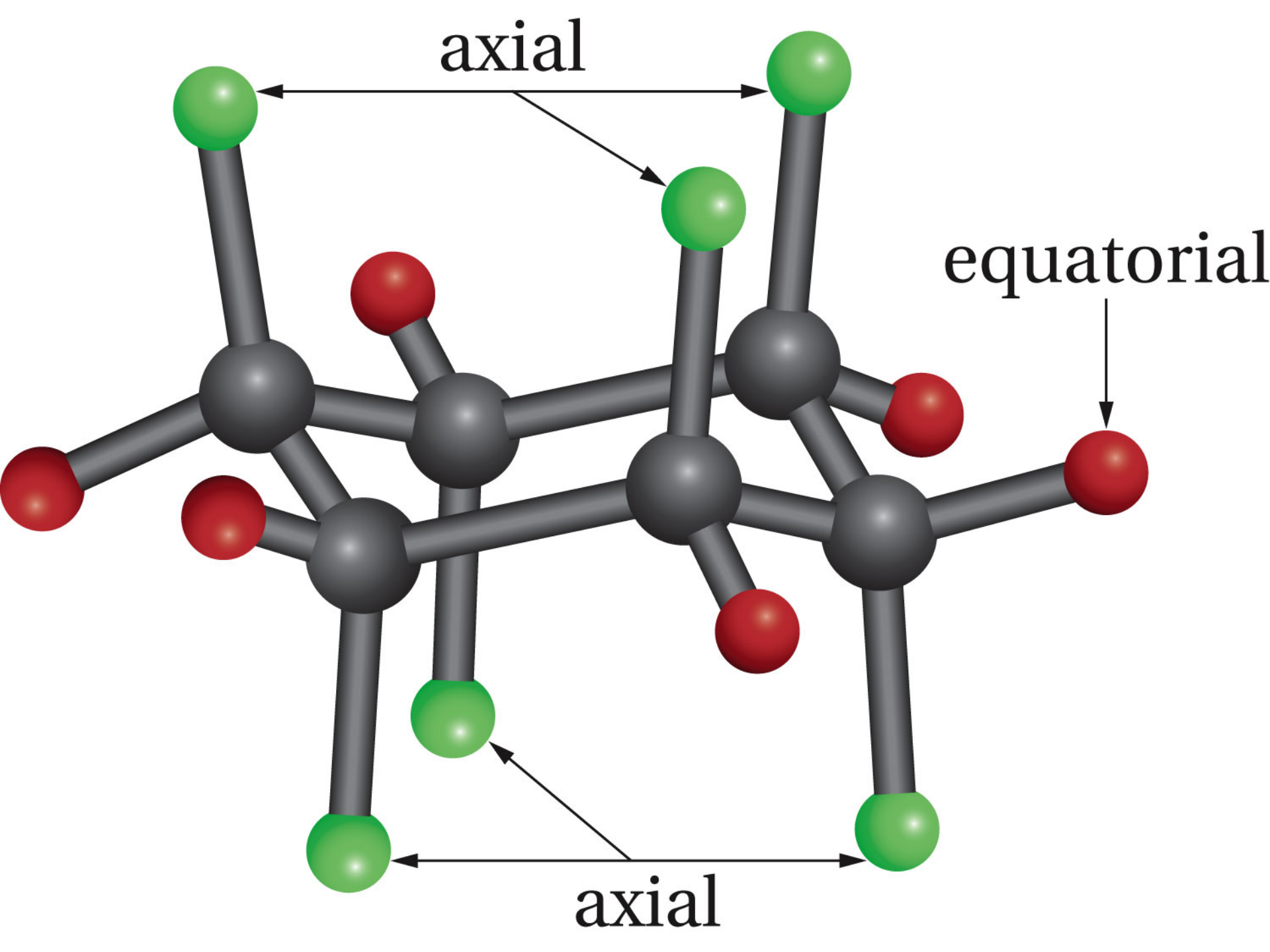
ball-and-stick model

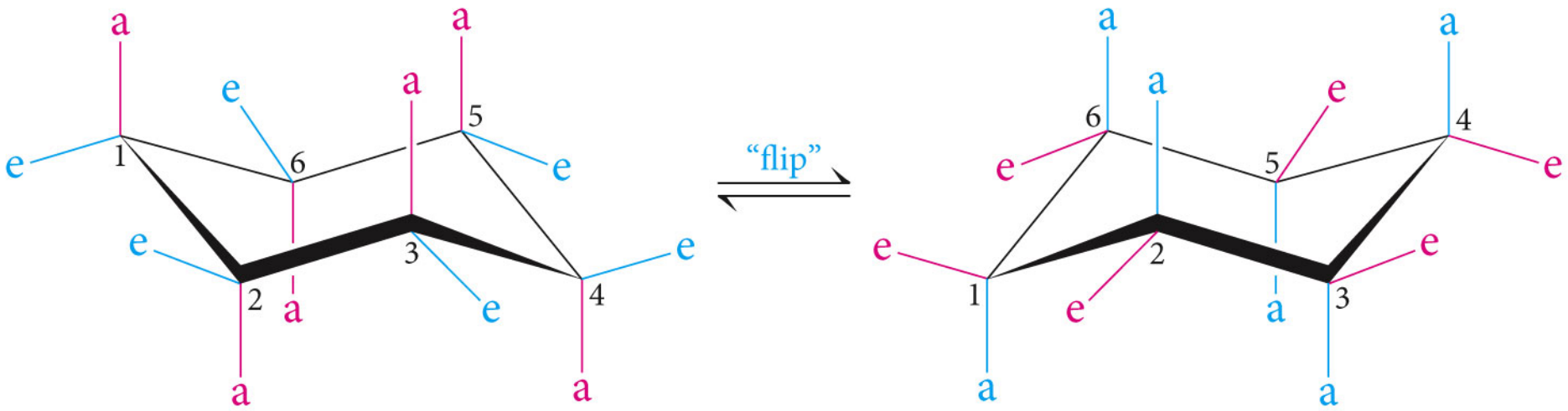


space-filling model



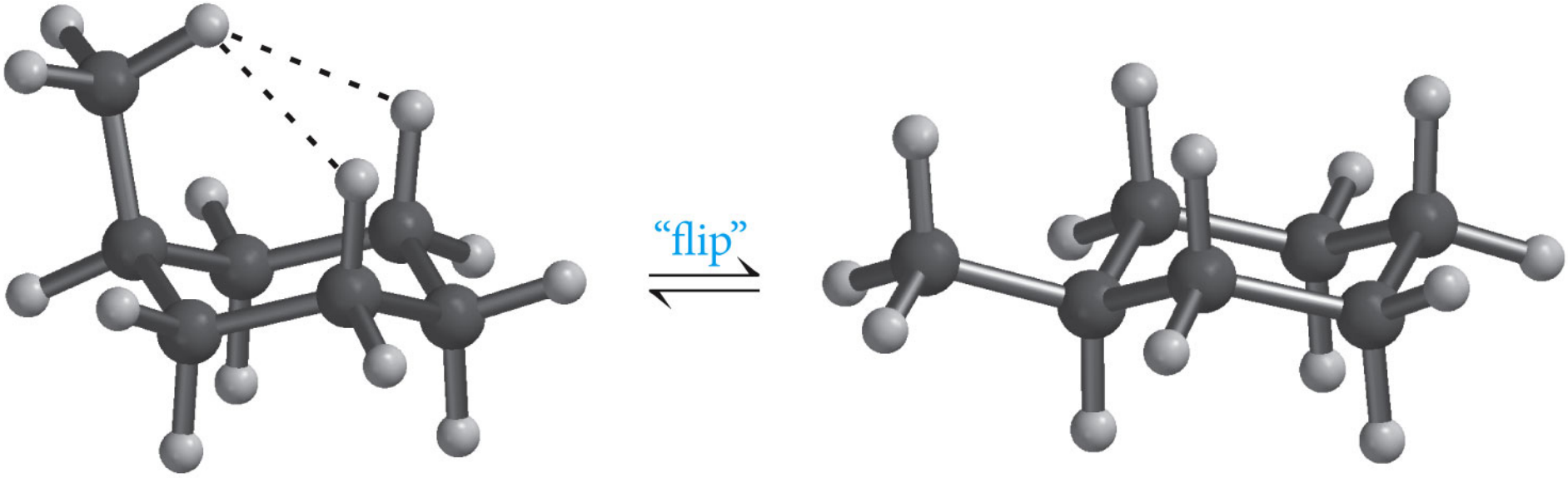
chair framework
(has a chair shape)


axial
equatorial
axial



Axial bonds (red) in the left structure become equatorial bonds (red) in the right structure when the ring "flips."

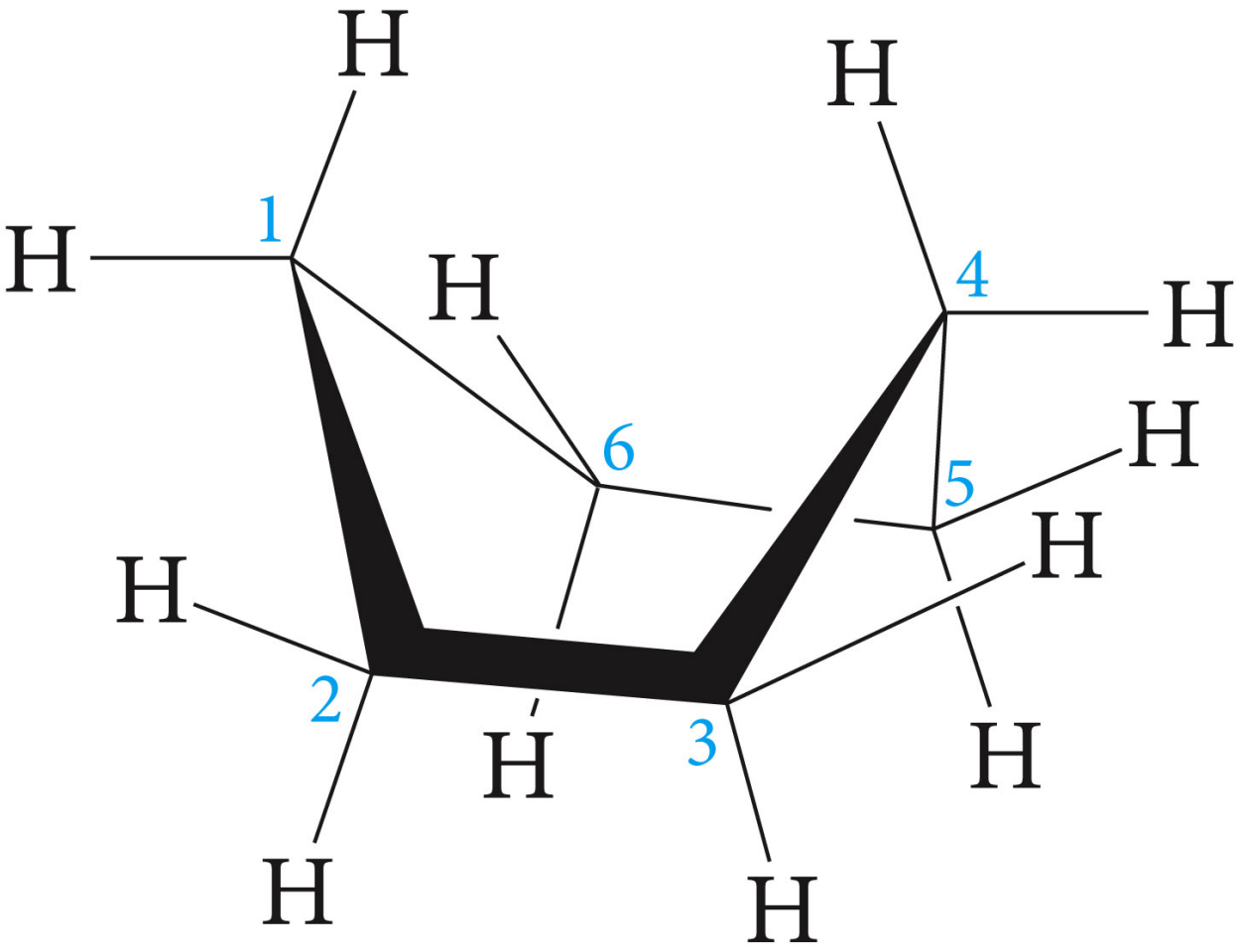
Larger substituents on cyclohexane (such as methyl group) are stable in the equatorial positions to avoid the axial crowding.



methyl axial
5%

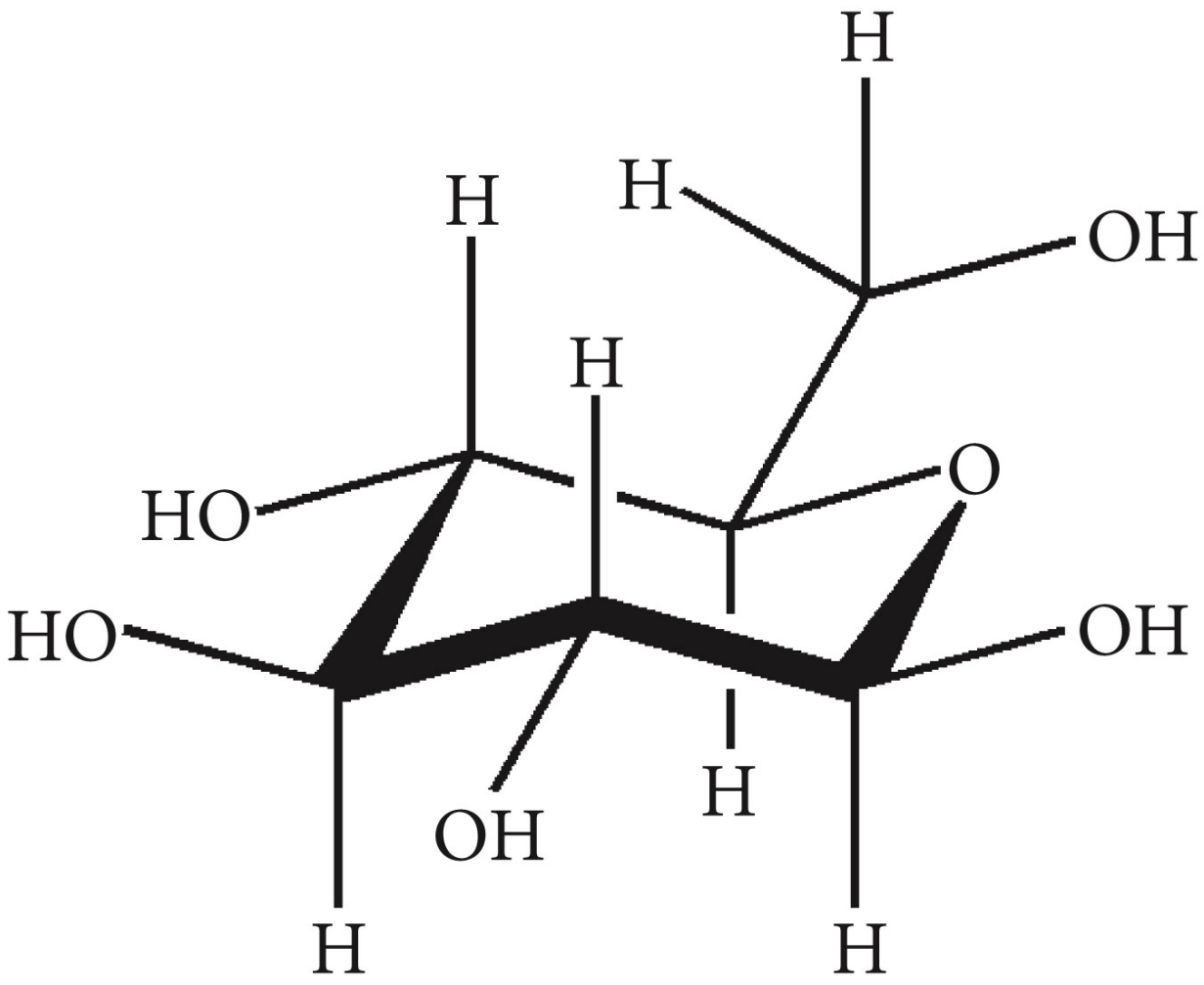
methyl equatorial
95%

Boat Conformation

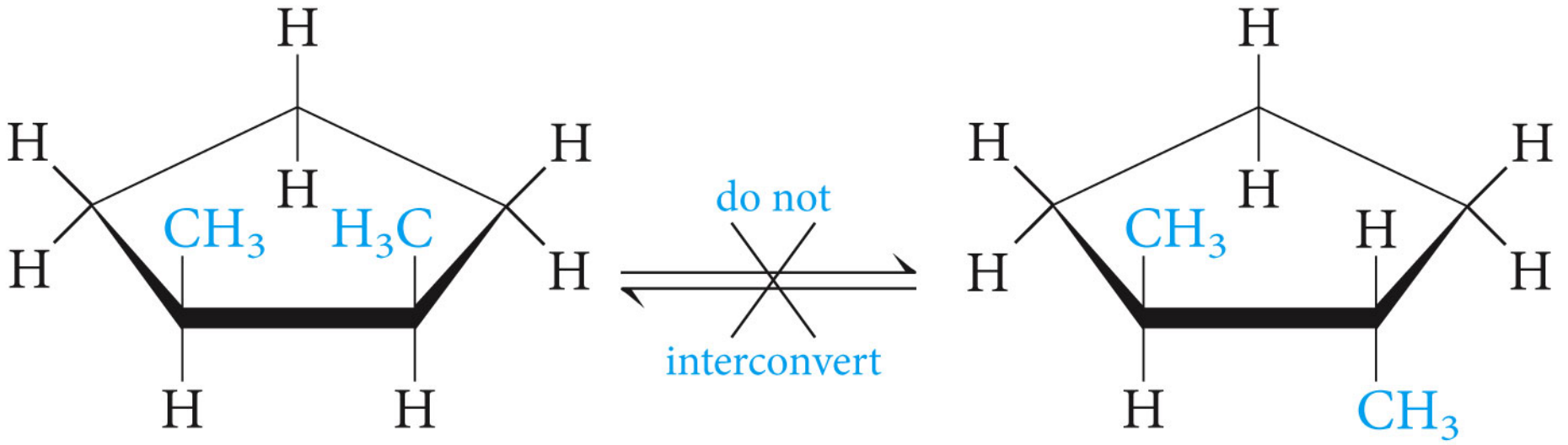


boat cyclohexane

Glucose molecule (six-membered ring in the chair conformation.



Cis-Trans Isomerism of Cycloalkanes



cis-1,2-dimethylcyclopentane
bp 99°C

trans-1,2-dimethylcyclopentane
bp 92°C