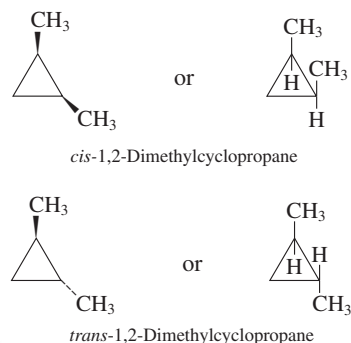
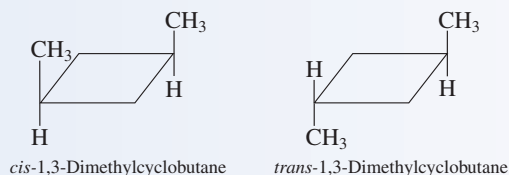


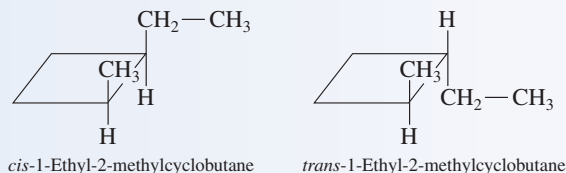
In cycloalkanes, *cis-trans* isomerism can also be denoted by using wedges and dotted lines. A heavy wedge-shaped bond to a ring structure indicates a bond *above* the plane of the ring, and a broken dotted line indicates a bond *below* the plane of the ring.



c. *Cis-trans* isomerism does exist.



d. *Cis-trans* isomerism does exist.

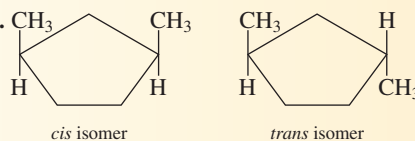


Practice Exercise 12.8

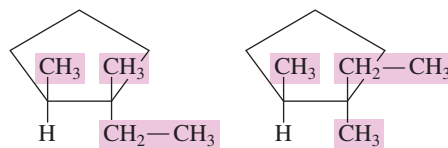
Determine whether *cis-trans* isomerism is possible for each of the following cycloalkanes. If so, then draw structural formulas for the *cis* and *trans* isomers.

- a. 1-Ethyl-1-methylcyclopentane b. Ethylcyclohexane
c. 1,3-Dimethylcyclopentane d. 1,1-Dimethylcyclooctane

Answers: a. Not possible; b. Not possible; c. Not possible; d. Not possible



Use of the terms *cis*- and *trans*- in designating stereoisomers in cycloalkanes is limited to substituted cycloalkanes in which the two substituted carbon atoms each have one hydrogen atom and one substituent other than hydrogen. The designations *cis*- and *trans*- become ambiguous in situations where either or both of the substituted carbons have two different substituents but no hydrogen atoms. Following is an example of such a situation in substituted cycloalkanes.



The first structure is the *cis*- isomer if the focus is on H and the ethyl group; the second structure is the *cis*- isomer if the focus is on H and the methyl group. A different nomenclature system, called the *E,Z* nomenclature system (which is not covered in this textbook), must be used to distinguish such isomerism.

12.15 SOURCES OF ALKANES AND CYCLOALKANES

The word *petroleum* comes from the Latin *petra*, which means “rock,” and *oleum*, which means “oil.”

Alkanes and cycloalkanes are not “laboratory curiosities” but rather two families of extremely important naturally occurring compounds. Natural gas and petroleum (crude oil) constitute their largest and most important natural source. Deposits of these resources are usually associated with underground dome-shaped rock formations (Figure 12.7). When a hole is drilled into such a rock formation, it is possible to recover some of the trapped