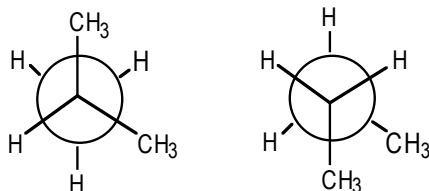


CONFORMATIONAL ANALYSIS – PRACTICE EXERCISES

- 1) Draw a Newman projection of the most stable conformation of 2-methylpropane.
- 2) The structures below are:



- A) not isomers.
 - B) conformational isomers.
 - C) cis-trans isomers.
 - D) structural isomers.
 - E) both B and D
- 3) Define the term conformation.
 - 4) View a butane molecule along the C₂-C₃ bond and provide a Newman projection of the lowest energy conformer.
 - 5) Provide a representation of the gauche conformer of butane.
 - 6) Among the butane conformers, which occur at energy minima on a graph of potential energy versus dihedral angle?
 - A) gauche only
 - B) eclipsed and totally eclipsed
 - C) gauche and anti
 - D) eclipsed only
 - E) anti only
 - 7) Which of the following cycloalkanes exhibits the greatest molar heat of combustion per CH₂ group?
 - A) cyclooctane
 - B) cycloheptane
 - C) cyclohexane
 - D) cyclobutane
 - E) cyclopropane
 - 8) Which of the following correctly ranks the cycloalkanes in order of **increasing** ring strain per methylene (CH₂ group)?
 - A) cyclopropane < cyclobutane < cyclohexane < cyclopentane
 - B) cyclohexane < cyclopentane < cyclobutane < cyclopropane
 - C) cyclohexane < cyclobutane < cyclopentane < cyclopropane
 - D) cyclopentane < cyclopropane < cyclobutane < cyclohexane
 - E) cyclopropane < cyclopentane < cyclobutane < cyclohexane
 - 9) Describe the source of angle strain and torsional strain present in cyclopropane.

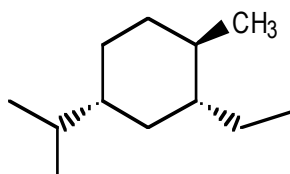
- 10) Which of the following statements is a correct description of the most stable conformation of 1,1,3-trimethylcyclohexane?
- A) The methyl group at C-3 is equatorial.
 - B) C-1 is a tertiary carbon and C-3 is a primary carbon.
 - C) C-1 is a quaternary carbon and C-3 is a secondary carbon.
 - D) C-1 is a tertiary carbon and C-3 is a secondary carbon.
 - E) Both methyl groups at C-1 are equatorial.
- 11) Draw the most stable conformation of *trans*-1,2-dimethylcyclohexane.
- 12) Draw the most stable conformation of *cis*-1,2-dimethylcyclohexane.
- 13) Which of the statements below correctly describes the chair conformations of *trans*-1,4-dimethylcyclohexane?
- A) The two chair conformations are of equal energy.
 - B) The higher energy chair conformation contains one axial methyl group and one equatorial methyl group.
 - C) The lower energy chair conformation contains one axial methyl group and one equatorial methyl group.
 - D) The higher energy chair conformation contains two axial methyl groups.
 - E) The lower energy chair conformation contains two axial methyl groups.
- 14) Which of the statements below correctly describes the chair conformations of *trans*-1,3-diethylcyclohexane.
- A) The two chair conformations are equal in energy.
 - B) The higher energy chair conformation contains two axial ethyl groups.
 - C) The higher energy chair conformation contains two equatorial ethyl groups.
 - D) The lower energy chair conformation contains two axial ethyl groups.
 - E) The lower energy chair conformation contains two equatorial ethyl groups.
- 15) Draw the most stable conformation of *trans*-1-*tert*-butyl-3-ethylcyclohexane.
- 16) Which of the following correctly lists the conformations of cyclohexane in order of increasing energy?
- A) chair < boat < twist < half-chair
 - B) half-chair < boat < twist < chair
 - C) chair < twist < half-chair < boat
 - D) chair < twist < boat < half-chair
 - E) half-chair < twist < boat < chair
- 17) The energy difference between the axial and equatorial conformers of methylcyclohexane is:
- A) < 0.1 kcal/mol B) 0.9 kcal/mol C) 1.7 kcal/mol D) 2.5 kcal/mol E) > 5.0 kcal/mol
- 18) Draw the most stable conformation of *cis*-1-ethyl-3-methylcyclohexane.
- 19) Draw the most stable conformation of *cis*-1-ethyl-4-isopropylcyclohexane.
- 20) From the perspective of viewing down the C2-C3 bond, draw the Newman projection of the most stable conformation of 2,3-dimethylbutane.

21) In the lowest energy chair conformation of *cis*-1,3-dimethylcyclohexane, how many axial positions are occupied by hydrogen atoms?

- A) 2 B) 3 C) 4 D) 5 E) 6

22) Arrange the following conformers of butane in order of energy, lowest to highest: eclipsed, totally eclipsed, gauche, and anti.

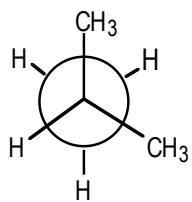
23) In the lowest energy conformation of the compound below, how many alkyl substituents are axial?



- A) 0 B) 1 C) 2 D) 3 E) 6

ANSWERS

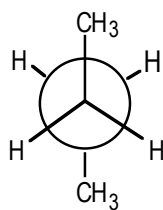
1)



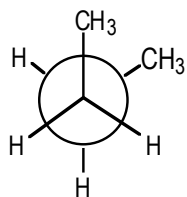
2) D

3) Conformations are different arrangements of the same molecule formed by rotations about single bonds.

4)



5)



6) C

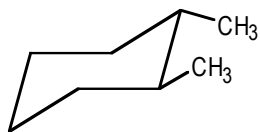
7) E – cyclopropane, due to its high ring strain.

8) B

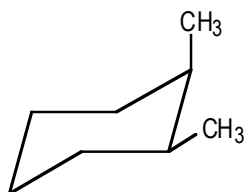
9) The angle strain arises from the compression of the ideal tetrahedral bond angle of 109.5° to 60° . The large torsional strain occurs since all C-H bonds on adjacent carbons are eclipsed.

10) A

11)



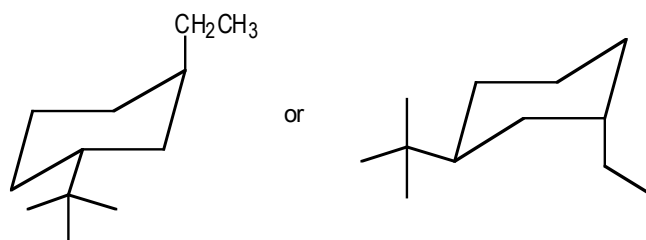
12)



13) D

14) A

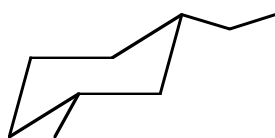
15)



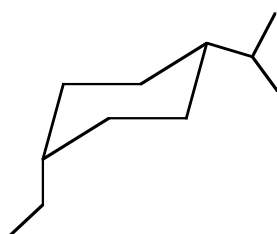
16) D

17) C (see table 3-6 in the textbook)

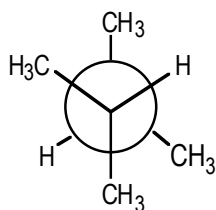
18)



19)



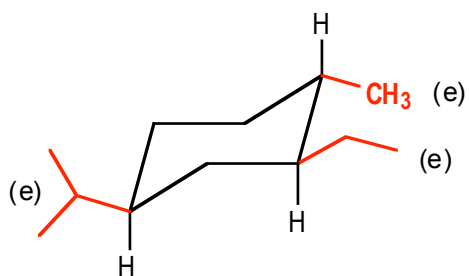
20)



21) E

22) anti < gauche < eclipsed < totally eclipsed

23) A – all alkyl groups are equatorial.



The most stable conformation has to be a chair and the bulkiest group (isopropyl) has to be equatorial. The ethyl group has to be *cis* to isopropyl, and the methyl group has to be *trans* to ethyl.