Chapter 3: Conformations of Alkanes and Cycloalkanes

1. Identify the conformation of butane shown below.

   ![Butane molecule](image)

   A) anti   B) gauche   C) skewed   D) eclipsed
   Ans: B

2. What is the IUPAC name of the compound shown in the following Newman projection?

   ![Newman projection](image)

   A) 1,1,2,2-tetramethylethane   C) 2,2,3,3-tetramethylbutane
   B) 1,2-dimethylethane   D) 2,3-dimethylbutane
   Ans: D

3. What is the IUPAC name of the compound shown below?

   ![Compund](image)

   A) 1,2,3-trimethylbutane   C) 2,3,4-trimethylpentane
   B) 2,3-dimethylpentane   D) 2-isopropylbutane
   Ans: B
4. What is the dihedral (torsion) angle between the two bromine atoms in the following sawhorse drawing?

A) 0° B) 30° C) 60° D) 90°
Ans: C

5. At room temperature, the various conformations of butane
A) do not interconvert; only the anti form is present.
B) do not interconvert, but all conformations are present.
C) interconvert very slowly.
D) interconvert very rapidly.
Ans: D

6. Which statement is correct concerning the relative stabilities of the two conformations, A and B, below?

A) A is more stable.
B) B is more stable.
C) A and B are equal in stabilities.
D) A and B are not equal in stability, but the preferred conformation cannot be determined by inspection.
Ans: C
7. Identify the spatial relationship of the two chlorine atoms.

A) gauche B) anti C) eclipsed D) twist
Ans: B

8. Which statement is correct concerning the relative stabilities of the two conformations, A and B, below?

A) A is more stable.
B) B is more stable.
C) A and B are equal in stabilities.
D) A and B are not equal in stability, but the preferred conformation cannot be determined by inspection.
Ans: B

9. What is the IUPAC name of the following compound?

A) \textit{trans}-1,4-dimethylcyclohexane C) \textit{trans}-1,3-dimethylcyclohexane
B) \textit{cis}-1,4-dimethylcyclohexane D) \textit{cis}-1,3-dimethylcyclohexane
Ans: A
10. What is the dihedral (torsion) angle between the two bromine atoms in the wedge-and-dash drawing below?

\[
\begin{align*}
\text{H} & \quad \text{Br} \\
\text{H}\text{C} & \quad \text{CH}_3 \\
\text{H}_3\text{C} & \quad \text{H} \\
\text{Br} & \quad \text{H}
\end{align*}
\]

A) 60°  B) 90°  C) 120°  D) 180°

Ans: D

11. Identify the relationship between the following two structures.

A) constitutional isomers  
B) stereoisomers  
C) different conformations of the same compound  
D) identical

Ans: C

12. Predict which of the following constitutional isomers of C\textsubscript{5}H\textsubscript{10} would have the highest heat of combustion?

A) methylcyclobutane  
B) cyclopentane  
C) \textit{cis}-1,2-dimethylcyclopropane  
D) \textit{trans}-1,2-dimethylcyclopropane

Ans: C

13. Identify the two atoms \textit{anti} to the bromine.

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{Br} \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}
\]

A) the equatorial H's on C-2 and C-6  
B) the axial H's on C-2 and C-6  
C) C-2 and C-6  
D) C-3 and C-5

Ans: D
14. Cyclohexane adopts the chair conformation rather than a planar structure because
I. torsional strain is minimized.
II. the C—C—C bond angles are close to 109.5°.
III. there are no 1,3-diaxial interactions in a planar structure.
A) only I  B) only II  C) I and II  D) I, II, and III
Ans: C

15. Identify the relationship between the following two structures.

A) constitutional isomers
B) stereoisomers
C) different conformations of the same compound
D) identical
Ans: B

16. The most stable conformation of the compound shown has

A) all methyl groups equatorial.
B) equatorial methyl groups at C-1 and C-2, axial at C-4.
C) equatorial methyl groups at C-1 and C-4, axial at C-2.
D) equatorial methyl groups at C-2 and C-4, axial at C-1.
Ans: D

17. The most stable chair conformation of cis-1-tert-butyl-3-methylcyclohexane has
A) both groups equatorial.
B) both groups axial.
C) the tert-butyl group equatorial and the methyl group axial.
D) the tert-butyl group axial and the methyl group equatorial.
Ans: A
18. Identify the relationship of the two compounds below.

A) identical
B) constitutional isomers
C) stereoisomers
D) different conformations of the same compound

Ans: C
19. Identify the correct stereoisomer and the most stable conformation of the following compound.

A)  

B)  

C)  

D)  

A) A  B) B  C) C  D) D  

Ans: B
20. Identify the relationship of the two compounds below.

![Compounds](image)

A) identical  
B) constitutional isomers  
C) stereoisomers  
D) different conformations of the same compound  
Ans: A

21. What is the IUPAC name of the following compound?

![Compound](image)

A) bicyclo[2.2.2]octane  
B) bicyclo[2.2.2]hexane  
C) bicyclo[3.3.3]octane  
D) bicyclo[3.3.3]hexane  
Ans: A

22. Which statement below is true concerning the conversion of cis-1,4-dimethylcyclohexane to trans-1,4-dimethylcyclohexane?

A) The conversion takes place by chair conformation ring-flipping.  
B) You cannot do the conversion without breaking covalent bonds.  
C) The conversion takes place by rotating the C(1)-C(2) bond by 180°.  
D) The conversion takes place through the skew boat conformations.  
Ans: B

23. What is the IUPAC name of the following bicycloalkane?

![Bicycloalkane](image)

A) bicyclo[6.3.0]heptane  
B) bicyclo[4.1.0]hexane  
C) bicyclo[4.2.1]hexane  
D) bicyclo[4.1.0]heptane  
Ans: D
24. Identify the relationship between the following two structures.

A) identical
B) different conformations of the same compound
C) stereoisomers
D) constitutional isomers
Ans: C
25. Which isomer of 1-tert-butyl-3-ethyl-5-methylcyclohexane below is thermodynamically the most stable?

A) A    B) B    C) C    D) D

Ans: A

26. What would the C—C—C bond angles be in a planar cyclohexane?

A) 60°  B) 90°  C) 109.5°  D) 120°

Ans: D
27. Identify the relationship between the following two Newman projections.

A) identical  
B) stereoisomers  
C) different conformations of the same compound  
D) constitutional isomers  
Ans: C

28. The IUPAC name of the following compound is

A) cis-1,2-dimethylcyclohexane.  
B) trans-1,2-dimethylcyclohexane.  
C) 1,1-dimethylcyclohexane.  
D) cis-1,3-dimethylcyclohexane.  
Ans: A

29. The following structure is

A) cis-1,3-dimethylcyclohexane.  
B) cis-1,4-dimethylcyclohexane.  
C) trans-1,3-dimethylcyclohexane.  
D) trans-1,4-dimethylcyclohexane.  
Ans: C
30. The sawhorse drawing of butane below is

A) a gauche conformation.
B) the anti conformation.
C) the least stable eclipsed conformation.
D) the most stable eclipsed conformation.
Ans: A

31. The sawhorse drawing of butane below is the

A) least stable staggered conformation.
B) most stable staggered conformation.
C) least stable eclipsed conformation.
D) most stable eclipsed conformation.
Ans: C

32. Which constitutional isomer of dimethycyclohexane does not exhibit cis-trans isomerism?
A) 1,1-dimethycyclohexane
B) 1,2-dimethycyclohexane
C) 1,3-dimethycyclohexane
D) 1,4-dimethycyclohexane
Ans: A
33. What is the estimated dihedral angle between the two methyl groups on the structure shown below?

![Structure Image]

A) 30°  B) 60°  C) 90°  D) 120°
Ans: B

34. Which one of the following is a stereoisomer isomer of *trans*-1,3-dimethylcyclopentane?

A) 1,1-dimethylcyclopentane  C) ethylcyclopentane
B) *cis*-1,2-dimethylcyclopentane  D) *cis*-1,3-dimethylcyclopentane
Ans: D

35. Which of the following best describes the conformation of propane shown below?

![Propane Image]

A) C(1) - C(2) staggered and C(2) - C(3) staggered
B) C(1) - C(2) staggered and C(2) - C(3) eclipsed
C) C(1) - C(2) eclipsed and C(2) - C(3) staggered
D) C(1) - C(2) eclipsed and C(2) - C(3) eclipsed
Ans: C
36. Which one of the following is the butane conformation shown below?

A) gauche  B) anti  C) skew  D) eclipsed
Ans: A

37. What is the correct IUPAC name of the following compound?

A) *cis*-1-ethyl-2-methylicyclohexane  C) *cis*-1-ethyl-6-methylicyclohexane
B) *trans*-1-ethyl-2-methylicyclohexane  D) *trans*-1-ethyl-6-methylicyclohexane
Ans: B

38. Which of the following can have *cis*-trans stereoisomers?
A) 1,1-dimethylicyclobutane  C) 1,1,3-trimethylicyclobutane
B) 1,3-dimethylicyclobutane  D) 1,1,3,3-tetramethylicyclobutane
Ans: B

39. The C—C—C bond angle in cyclopropane is
A) 60°  B) 90°  C) 109.5°  D) 120°
Ans: A

40. The most stable conformation of *cis*-4-methyl-1-*tert*-butylcyclohexane is a chair conformation with
A) both the -CH₃ and -C(CH₃)₃ equatorial.
B) both the -CH₃ and -C(CH₃)₃ axial.
C) the -CH₃ equatorial and the -C(CH₃)₃ axial.
D) the -CH₃ axial and -C(CH₃)₃ equatorial.
Ans: D
Chapter 3 Conformations of Alkanes and Cycloalkanes: Answers

41. What is the IUPAC name of the compound shown below?

![IUPAC Name](image)

A) cis-1,3-dimethylcyclohexane  
B) trans-1,3-dimethylcyclohexane  
C) cis-1,4-dimethylcyclohexane  
D) trans-1,5-dimethylcyclohexane  

Ans: B

42. What is the IUPAC name of the compound shown below?

![IUPAC Name](image)

A) cis-1,2-diethylcyclobutane  
B) trans-1,2-diethylcyclobutane  
C) cis-1,3-diethylcyclobutane  
D) trans-1,3-diethylcyclobutane  

Ans: C

43. Which is more stable, cis-1,3-dimethylcyclohexane or trans-1,3-dimethylcyclohexane?

A) trans-1,3-dimethylcyclohexane  
B) cis-1,3-dimethylcyclohexane  
C) They are equally stable.  
D) Stabilities of cis, trans stereoisomers cannot be compared.  

Ans: B
44. What is the relationship between the following two structures?

A) identical  
B) stereoisomers  
C) different conformations of the same compound  
D) constitutional isomers  
Ans: D

45. How many alkyl groups would be equatorial in the most stable conformation of the cyclohexane below?

A) one  
B) two  
C) three  
D) four  
Ans: B

46. Menthol is the most stable isomer of 2-isopropyl-5-methylcyclohexanol. Which compound is it?

A) A  
B) B  
C) C  
D) D  
Ans: C
47. The **planar** form of which ring would have bond angles close to the tetrahedral value but is destabilized by eclipsing interactions?

A) A  B) B  C) C  D) D
Ans: C

48. Consider these two molecules; which statement is true?

I

II

A) I is more stable than II.  
B) II is more stable than I.  
C) I and II are equally stable.  
D) There is no way to predict this.

Ans: B

49. Which of the staggered conformations of 2-methylbutane is most stable?

A) A  B) B  C) C  D) D
Ans: A

50. What would be the least stable isomer of 1,2,3,4,5,6-hexamethylcyclohexane?

A) A  B) B  C) C  D) D
Ans: A
51. What is the most specific name for the conformation shown?

![Conformation Diagram]

A) anti  B) staggered  C) gauche  D) eclipsed  
Ans: C

52. β-D-Glucose is the six-carbon sugar with all non-hydrogen groups equatorial. Which structure is it?

![Glucose Structures]

A) A  B) B  C) C  D) D  
Ans: B