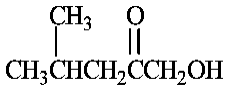
Chapter 2 - Alkanes: The Nature of Organic Compounds

1. Which of the following functional group classifications do **not** contain oxygen?
   a. ether
   b. thiol
   c. aldehyde
   d. ester
   e. amide

   ANS: B

2. To which functional group classification does the following molecule belong?



   a. ester
   b. ketone
   c. alcohol
   d. carboxylic acid
   e. both b and c

   ANS: E

3. One of the functional group classifications is characterized by the presence of an sp^2 hybridized carbon atom. This functional group could be:
   a. alkyl halide
   b. sulfide
   c. alcohol
   d. aldehyde
   e. alkyne

   ANS: D

4. The carbon atoms **within the functional group** of the following classifications are:

   alkene ester carboxylic acid amide

   a. *sp*
   b. sp^2
   c. sp^3
   d. sp^2 and sp^3

   ANS: B

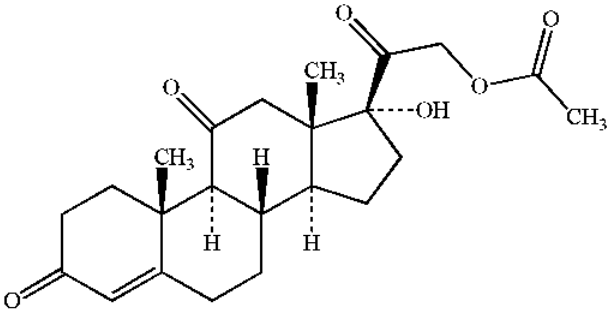
5. 4-ethyl-3,3,4-trimethylheptane could be classified as:
   a. an alkane
   b. saturated
   c. aliphatic
   d. a paraffin
   e. all of these

ANS: E

6. 4-ethyl-3,3,4-trimethylheptane contains:
   a. two quaternary carbon atoms
   b. two tertiary carbon atoms
   c. four secondary carbon atoms
   d. a and c
   e. all of these

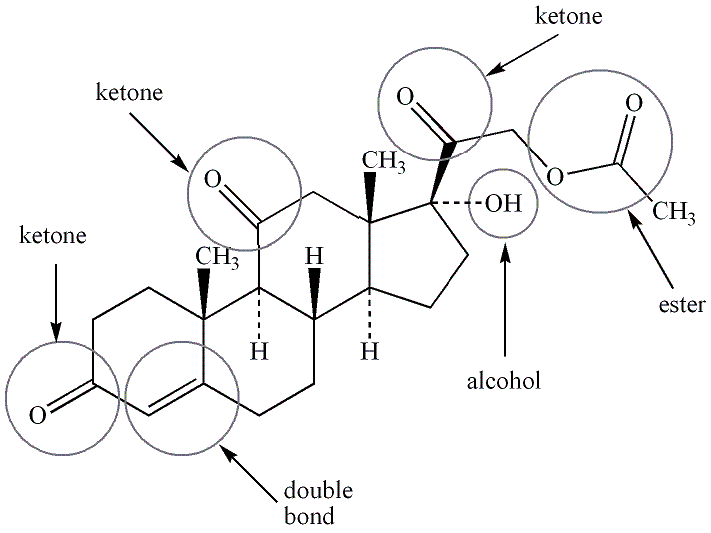
   ANS: D

7. Circle and name each functional group in the following structure.

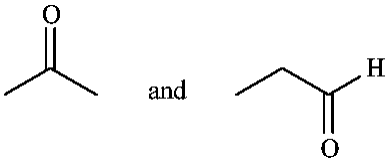


cortisone acetate (*active ingredient in steroid skin cream*)

ANS:



8. Label the following pair of compounds as:

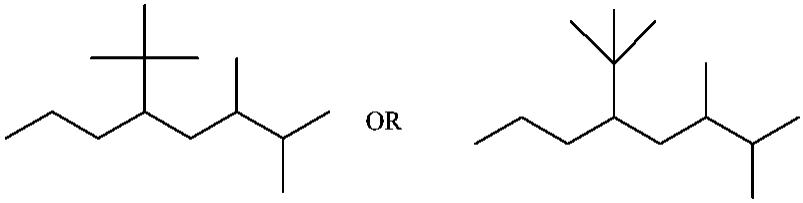


a. identical
b. constitutional isomers
c. stereoisomers
d. unrelated

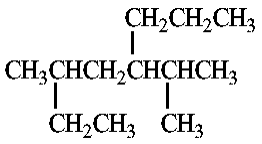
ANS: B

9. Provide a skeletal structure for 5-*tert*-butyl-2,3-dimethyloctane.

ANS:



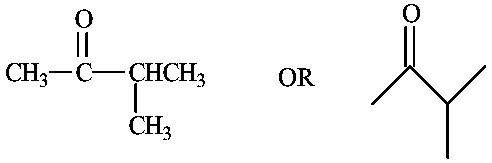
10. Provide a proper IUPAC name for the compound given below.



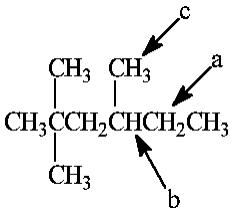
ANS:
3-methyl-5-isopropyloctane *or* 3-methyl-5-(1-methylethyl)octane

11. Draw the structure of a five carbon ketone containing one tertiary carbon atom.

ANS:



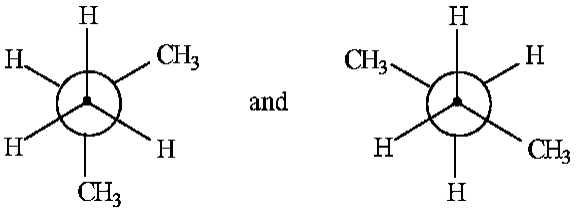
12. Which hydrogen atom(s) in the following compound is (are) classified as tertiary?



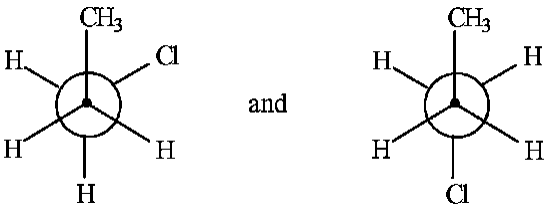
a. a
b. b
c. c
d. both a and c
e. There are no tertiary hydrogen atoms.

ANS: B

Instructions: Label each pair of compounds below as:
a. identical
b. stereoisomers
c. constitutional isomers
d. identical, but differing in conformation

13. 

ANS: C

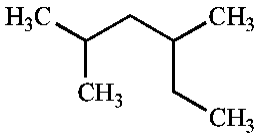
14. 

ANS: D

15. How many constitutional isomers are there with the molecular formula C_6H_{14}?
a. 3
b. 4
c. 5
d. 8

ANS: C

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



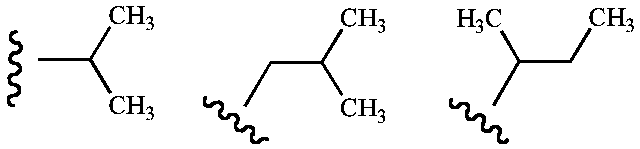
a. 2-ethyl-4-methylpentane
b. 2,4-dimethylhexane
c. 3,5-dimethylhexane
d. 1,1,3-trimethylpentane

ANS: B

17. Which of the following alkanes is the most likely to be a liquid at room temperature?
a. propane
b. butane
c. pentane
d. hexane

ANS: D

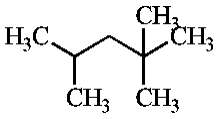
18. Name these groups (left to right).



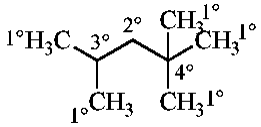
where ~~~~ represents the parent chain.
a. *sec*-propyl, *sec*-butyl, isobutyl
b. isopropyl, isobutyl, *sec*-butyl
c. *sec*-propyl, *tert*-butyl, isobutyl
d. isopropyl, *tert*-butyl, isobutyl
e. isopropyl, *tert*-butyl, *sec*-butyl

ANS: B

19. Designate *each carbon* as primary, secondary, tertiary, or quaternary.

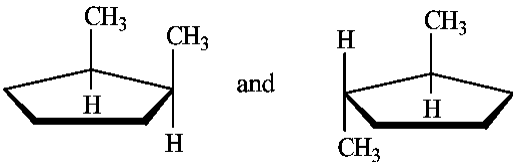


ANS:

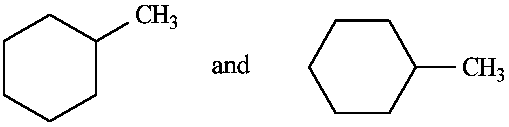


Instructions: Label each pair of compounds below as:

a. identical
b. constitutional isomers
c. stereoisomers

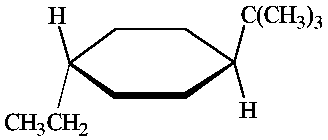
20. 

ANS: C

21. 

ANS: A

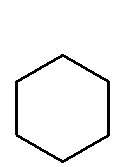
22. Provide the proper IUPAC name for the compound below.

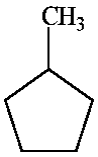


ANS:
trans-1-*tert*-butyl-4-ethylcyclohexane *or trans*-1-(1,1-dimethylethyl)-4-ethylcyclohexane

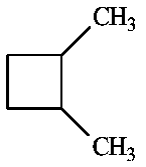
23. Draw and name the seven constitutional isomers for cycloalkane, C_6H_{12}.

ANS:

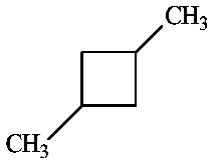

cyclohexane



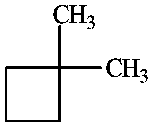
methylcyclopentane



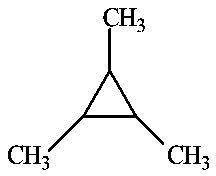
1,2-dimethylcyclobutane



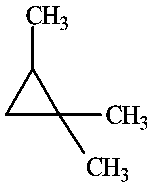
1,2-dimethylcyclobutane



1,1-dimethylcyclobutane

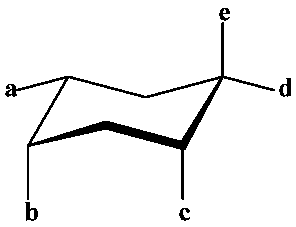


1,2,3-trimethylcyclopropane



1,1,2-trimethylcyclopropane

Instructions: Refer to the structure below to answer the following question(s).



24. Refer to instructions. Which of the labeled groups in the structure are *equatorial*?

    ANS: a and d

25. Refer to instructions. Which of the labeled groups is *trans* to **b**?

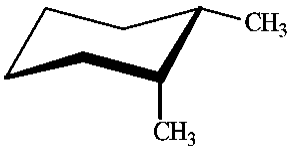
    ANS: e

26. Refer to instructions. Which groups have a 1,3-diaxial interaction with each other?

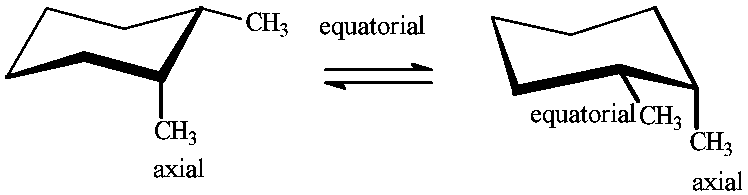
    ANS: b and c

Instructions: For each disubstituted cyclohexane below, draw its ring-flip isomer. Circle the *most* stable conformation and label the substituent groups as axial or equatorial.

27. Draw and label:

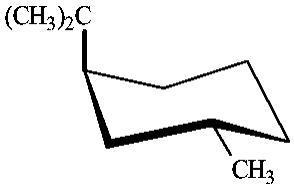


ANS:

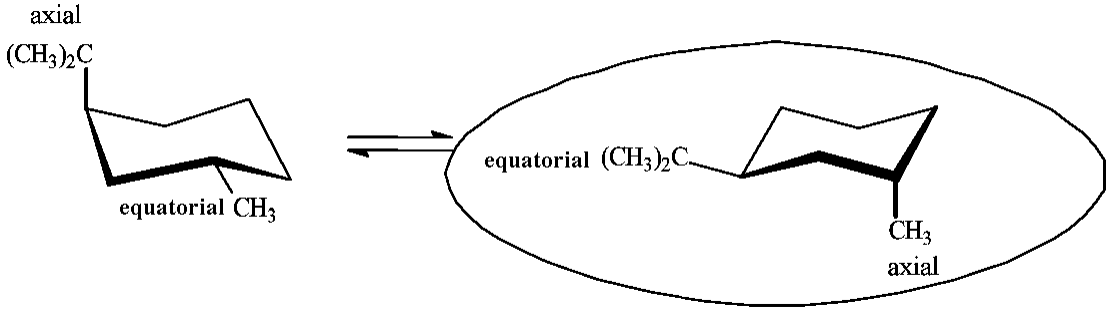


conformations are of equal stability

28.Draw and label:



ANS:

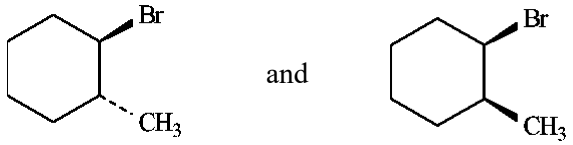


Instructions: Label each pair of compounds below as:

a. identical
b. stereoisomers
c. constitutional isomers
d. identical, but differing in conformation

Where stereoisomers are present, label the isomers as *cis* and *trans*.

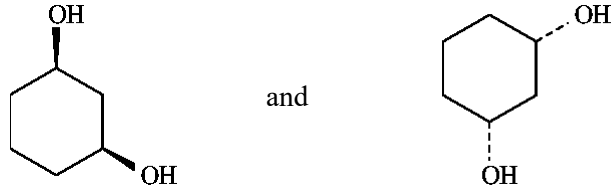
29. Label:



ANS: b

trans *cis*

30. Label:



ANS: a

31. Which of the following cycloalkanes has the most ring strain?
    a. cyclopropane
    b. cyclobutane
    c. cyclopentane
    d. cyclohexane

    ANS: A

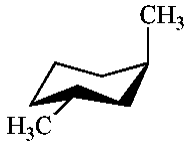
32. In which of the following compounds would the carbon–carbon bond angle diverge the greatest from 109°?
    a. cyclodecane
    b. cyclooctane
    c. cyclopentane
    d. cyclopropane

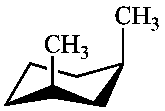
    ANS: D

33. Substitution of which of the following groups on a cycloalkane would result in the greatest amount of steric strain?
    a. bromo
    b. ethyl
    c. isopropyl
    d. hydroxyl

    ANS: C

34. Which of the following structures represents *trans*-1,3-dimethylcyclohexane?
    a. 

    b. 

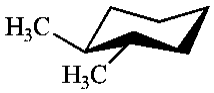
    c. 

    d. 

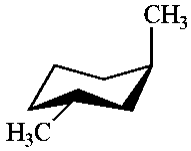
    ANS: B

35. Which of the following structures represents *trans*-1,2-dimethylcyclohexane?

a. 

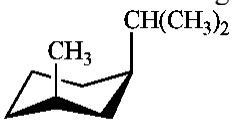
b. 

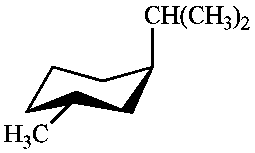
c. 

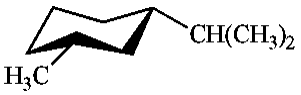
d. 

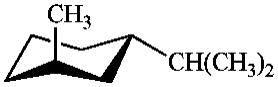
ANS: B

36. Which of the following is the most stable conformation of *cis*-1-isopropyl-3-methylcyclohexane?

a. 

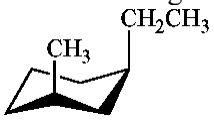
b. 

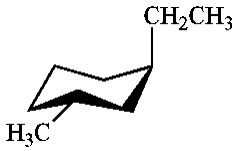
c. 

d. 

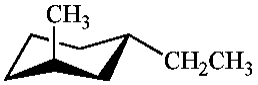
ANS: C

37. Which of the following is the most stable conformation of *trans*-1-ethyl-3-methylcyclohexane?

a. 

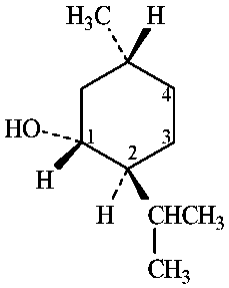
b. 

c. 

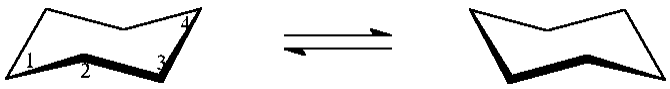
d. 

ANS: D

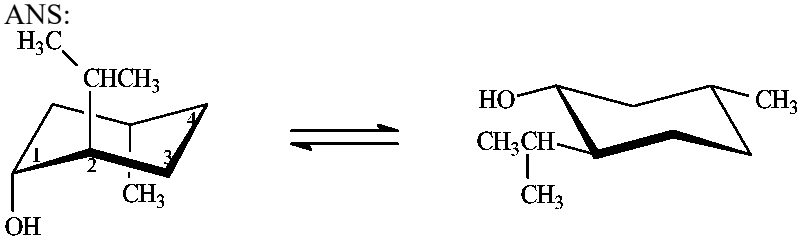
Instructions: (–)-Menthol is responsible for the characteristic flavor and taste of peppermint. The structure of (–)-menthol is shown below. Use this information to answer the following question.



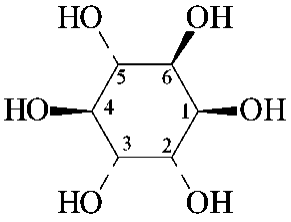
38. Refer to instructions. On the chair template provided below, draw the two chair conformations that are in equilibrium for (–)-menthol.



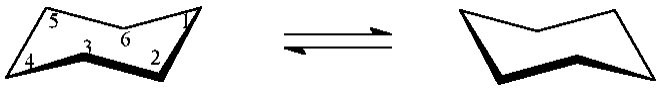
ANS:



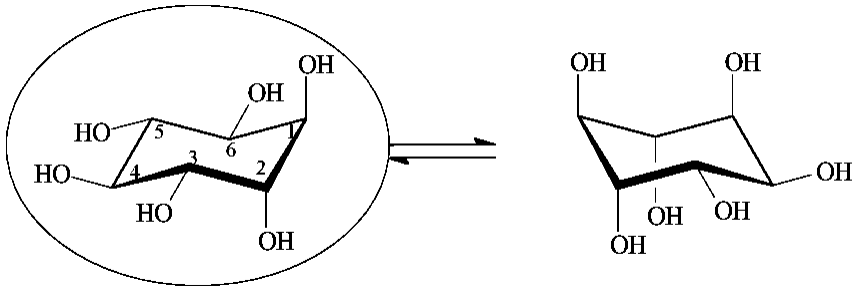
39.D-Pinitol is an interesting hexahydroxycyclohexane, whose structure is shown below.



On the templates provided, draw the two chair conformations that are in equilibrium for D-pinitol. *Circle* the ***most*** stable conformation.

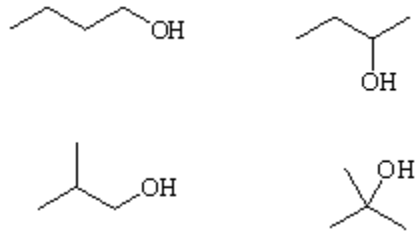


ANS:

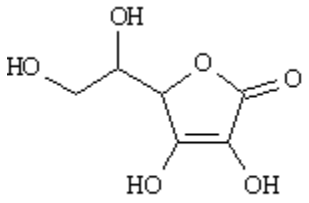


40. Draw two isomeric alcohols with the formula $C_4H_{10}O$.

ANS:



41. This skeletal structure corresponds to the molecular formula:

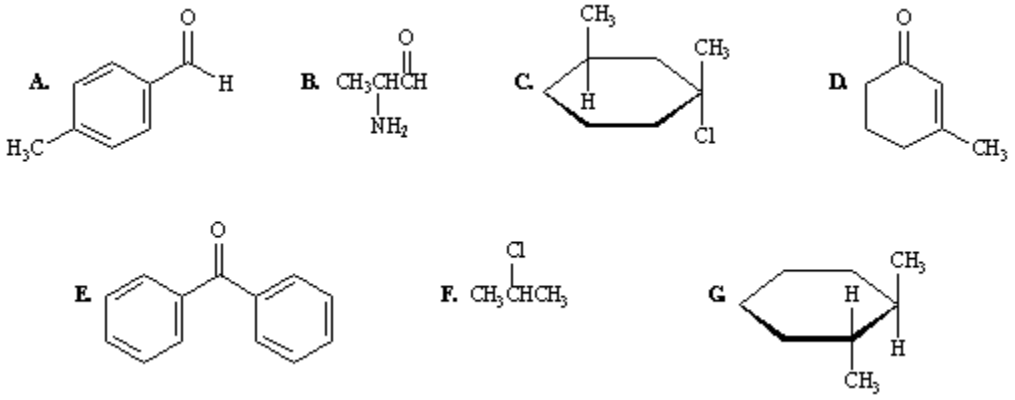


Vitamin C

a. $C_5H_6O_6$
b. $C_7H_{10}O_6$
c. $C_6H_6O_6$
d. $C_6H_8O_6$

ANS: d

Instructions:
MATCH a structure below to each of the following descriptions and place the letter corresponding to the structure in the blank.



42. Refer to Instructions. _____is an amino aldehyde.

ANS: B

43. Refer to Instructions. _____is an aromatic ketone.

ANS: E

44. Refer to Instructions. _____is a tertiary chloride.

ANS: C

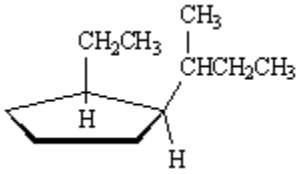
45. Refer to Instructions. _____is a cyclic alkane with two cis methyl groups.

ANS: C

46. Draw a structure corresponding to the following name:

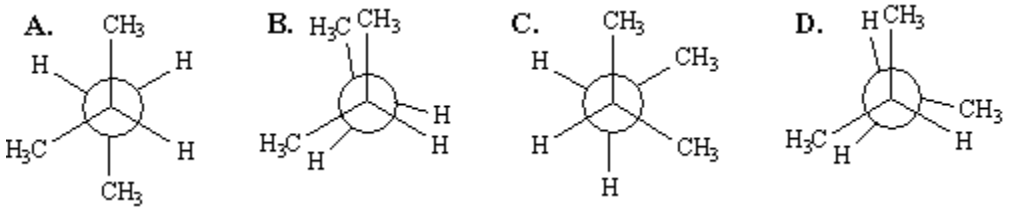
cis-1-*sec*-butyl-2-ethylcyclopentane

ANS:



Instructions:

Consider the conformations of 2-methylbutane shown below to answer the following questions.



47. Refer to Instructions. Which of the structures represents the ***most*** stable conformation of 2-methylbutane?

ANS: A

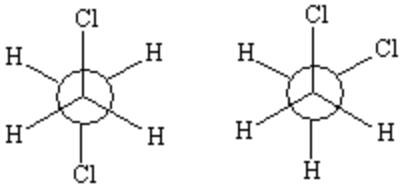
48. Refer to Instructions. Which of the structures represents the ***least*** stable conformation of 2-methylbutane?

ANS: B

49. Draw the Newman projection for the specified conformations for rotation about the C-C bond of 1,2-dichloroethane.

There are two staggered conformations of 1,2-dichloroethane. Draw them.

ANS:



50. Draw the Newman projection for the specified conformations for rotation about the C-C bond of 1,2-dichloroethane.

There are two eclipsed conformations of 1,2-dichloroethane. Draw them.

ANS: