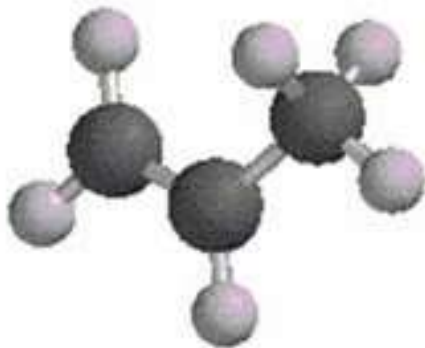


Organic Chemistry, 11e (Carey)

Chapter 2 Alkanes and Cycloalkanes: Introduction to Hydrocarbons

- 1) Which of the following statements is not true concerning hydrocarbons?
- A) Hydrocarbons are compounds that carbon, hydrogen, and oxygen atoms.
 - B) Alkanes, alkenes, and alkynes are examples of aliphatic hydrocarbons.
 - C) Aromatic hydrocarbons are also referred to as arenes.
 - D) Hydrocarbons may contain sigma bonds and/or pi bonds.
- 2) Alkanes are characterized by the general molecular formula:
- A) C_nH_{2n-2}
 - B) C_nH_{2n}
 - C) C_nH_{2n+2}
 - D) C_nH_{2n+4}
- 3) The carbon-carbon sigma bond in ethane is formed by overlap of which two orbitals?
- A) 2p-2p
 - B) sp-sp
 - C) sp^2-sp^2
 - D) sp^3-sp^3
- 4) The sp^3 orbitals of carbon in CH_4 are formed from the
- A) three 2p orbitals.
 - B) 2s and two of the 2p orbitals.
 - C) 2s and one of the 2p orbitals.
 - D) 2s and the three 2p orbitals.
- 5) The geometry of sp^3 hybrid orbitals can be described as pointing toward the corners of a
- A) triangle.
 - B) square.
 - C) tetrahedron.
 - D) square pyramid.
- 6) What is the Cl-C-Cl bond angle in CCl_4 ?
- A) 60°
 - B) 90°
 - C) 109.5°
 - D) 120°

7) What is the estimated C-C-C bond angle in the following model?



- A) 90°
- B) 109.5°
- C) 120°
- D) 180°

8) The hybridization of carbon atoms 1, 2, and 3 in the following are, respectively,



1 2 3

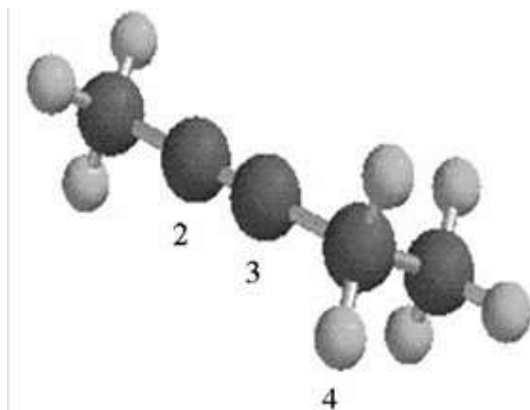
- A) sp , sp , and sp^2 .
- B) sp , sp , and sp^3 .
- C) sp^2 , sp^2 , and sp^3 .
- D) sp^2 , sp^3 , and sp^3 .

9) The C-C sigma bond in acetylene is formed by the overlap of which two orbitals?



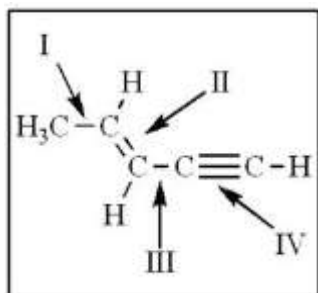
- A) $2p-2p$
- B) $sp-sp$
- C) sp^2-sp^2
- D) sp^3-sp^3

10) What are the hybridizations of carbon atoms 2, 3, and 4 shown in the model below?



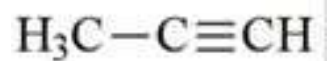
- A) sp, sp², sp²
- B) sp, sp², sp³
- C) sp, sp, sp²
- D) sp, sp, sp³

11) The shortest and longest carbon-carbon bonds, respectively, in this molecule are



- A) II and III.
- B) IV and III.
- C) I and IV.
- D) IV and I.

12) The C-C-C bond angle in propyne, shown below, is



- A) 90°.
- B) 109.5°.
- C) 120°.
- D) 180°.

13) How many π bonds are present in the following structure?



- A) one
- B) two
- C) three
- D) four

14) The carbon-carbon single bond in the following is formed by the overlap of which two orbitals?

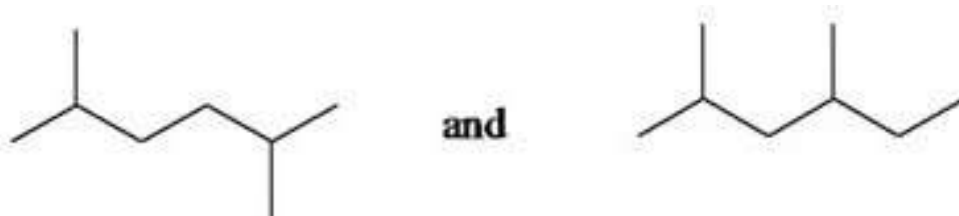


- A) $\text{sp}-\text{sp}$
- B) sp^2-sp
- C) sp^2-sp^2
- D) sp^2-sp^3

15) How many isomers of $\text{C}_4\text{H}_9\text{Cl}$ are possible?

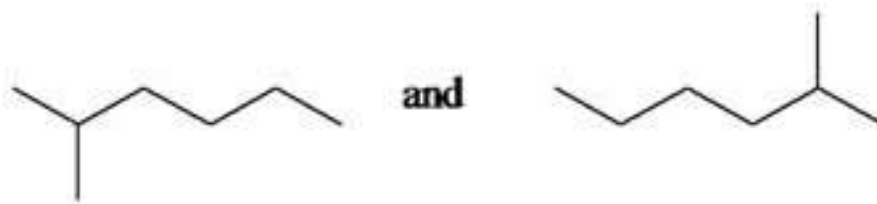
- A) two
- B) three
- C) four
- D) five

16) What is the relationship between the two structures below?



- A) identical structures
- B) resonance forms
- C) constitutional isomers
- D) different compounds with different compositions

17) What is the relationship between the following two structures?



- A) identical structures
- B) resonance forms
- C) constitutional isomers
- D) different compounds with different compositions

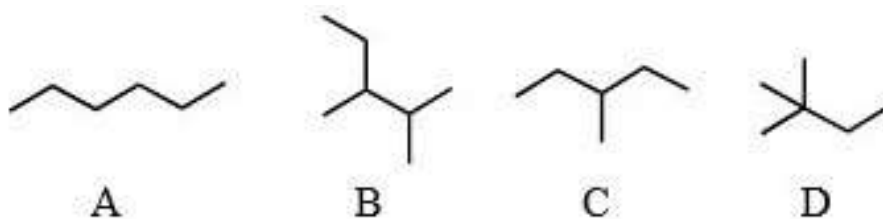
18) What is the total number of constitutional isomers with the formula C_5H_{12} ?

- A) two
- B) three
- C) four
- D) five

19) How many isomers of C_6H_{14} are possible?

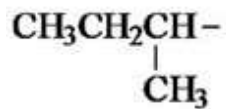
- A) four
- B) five
- C) six
- D) seven

20) Which of the molecules below is NOT an isomer of formula C_6H_{14} ?



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

21) The common name of the following group is



- A) *n*-butyl.
- B) *sec*-butyl.
- C) isobutyl.
- D) *tert*-butyl.

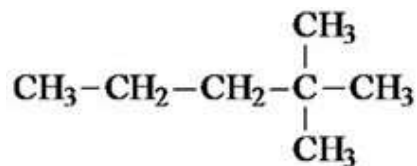
22) The *tert*-butyl group can also be called

- A) 1,1-dimethylpropyl.
- B) 1,1-dimethylethyl.
- C) 2,2-dimethylpropyl.
- D) 2,2-dimethylethyl.

23) The 1,1-dimethylethyl group, $-\text{C}(\text{CH}_3)_2\text{CH}_3$, can also be called

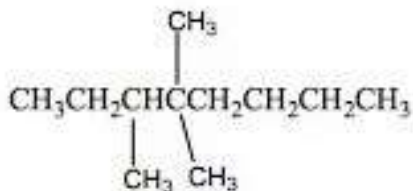
- A) butyl.
- B) isobutyl.
- C) *sec*-butyl.
- D) *tert*-butyl.

24) What is the IUPAC name of the following compound?



- A) 4,4-dimethylpentane
- B) 1-*tert*-butylpropane
- C) 2,2-dimethylpentane
- D) 1,1,1-trimethylbutane

25) The correct IUPAC name of the following compound is

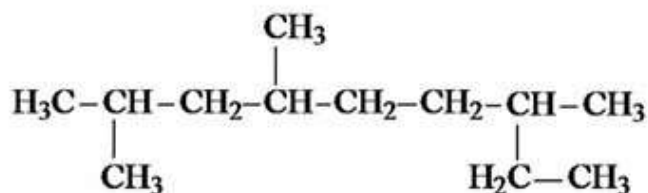


- A) 2-ethyl-3,5-dimethylheptane.
- B) 6-ethyl-5,5-dimethylheptane.
- C) 3,4,4-trimethyloctane.
- D) 5,5,6-trimethyloctane.

26) Which one of the following is 2,2,5-trimethylhexane?

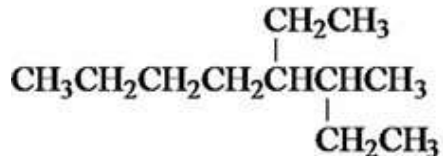
- A) $(\text{CH}_3)_2\text{CHCH}_2\text{C}(\text{CH}_3)_3$
- B) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{C}(\text{CH}_3)_3$
- C) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{C}(\text{CH}_3)_3$
- D) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)_3$

27) The correct IUPAC name of the following is



- A) 2,4,7-trimethylnonane.
- B) 7-ethyl-2,4-dimethyloctane.
- C) 3,6,8-trimethylnonane.
- D) 2-ethyl-5,7-dimethyloctane.

28) What is the IUPAC name of the following?

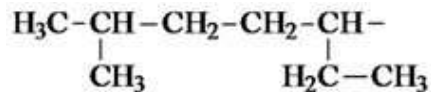


- A) 5,6-diethylhexane
- B) 5-ethyl-6-methylheptane
- C) 2,3-diethylhexane
- D) 4-ethyl-3-methylheptane

29) Identify the isomer of C_6H_{14} that only has primary and tertiary carbons.

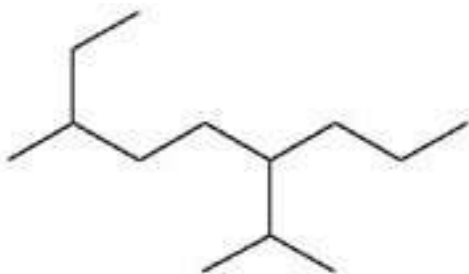
- A) hexane
- B) 2,2-dimethylbutane
- C) 3-methylpentane
- D) 2,3-dimethylbutane

30) The systematic name of the following group is



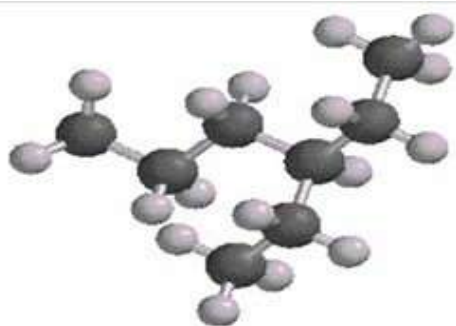
- A) 5-ethyl-2-methylpentyl.
- B) 1-ethyl-4-methylpentyl.
- C) 6-methyl-3-heptyl.
- D) 2-methyl-5-heptyl.

31) What is the IUPAC name of the following?



- A) 6-isopropyl-3-methylnonane
- B) 2-ethyl-5-isopropyloctane
- C) 6-propyl-3-methylnonane
- D) 2-ethyl-5-propyloctane

32) What is the IUPAC name of the following structure?



- A) 3-propylpentane
- B) 3-ethylhexane
- C) 2-ethylheptane
- D) 4-ethylpentane

33) Which of the following are constitutional isomers?

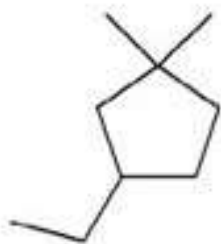
- I. 2,3,3-dimethylhexane
- II. 2,2-diethylpentane
- III. 3-ethyl-2-methylheptane

- A) I and II
- B) I and III
- C) II and III
- D) They are all constitutional isomers.

34) Cycloalkanes are characterized by the general molecular formula

- A) C_nH_{2n-2} .
- B) C_nH_{2n} .
- C) C_nH_{2n+2} .
- D) C_nH_{2n+4} .

35) What is the IUPAC name of the following?

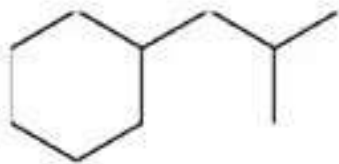


- A) 1-ethyl-4,4-dimethylcyclopentane
- B) 1-ethyl-3,3-dimethylcyclopentane
- C) 3-ethyl-1,1-dimethylcyclopentane
- D) 4-ethyl-1,1-dimethylcyclopentane

36) All the carbons in cyclopentane are

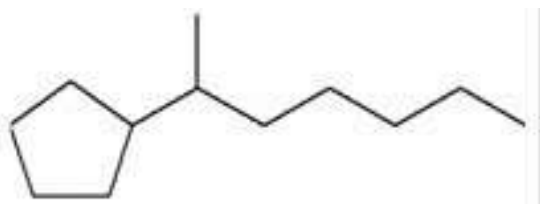
- A) primary carbons.
- B) secondary carbons.
- C) tertiary carbons.
- D) quaternary carbons.

37) The correct name of the following compound is



- A) (1-methylpropyl)cyclohexane.
- B) (2-methylpropyl)cyclohexane.
- C) (2,2-dimethylethyl)cyclohexane.
- D) (2,2-dimethylpropyl)cyclohexane.

38) The correct IUPAC name of the following compound is

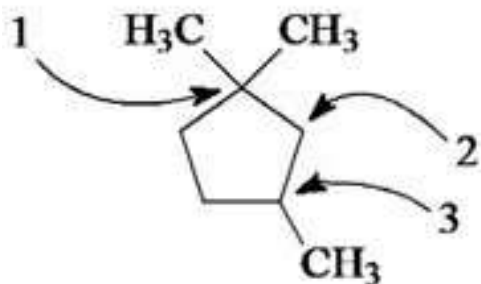


- A) (1-methylhexyl)cyclopentane.
- B) (1-pentylethyl)cyclopentane.
- C) 2-cyclopentylheptane.
- D) 1-cyclopentyl-2-heptane.

39) Cyclohexane is composed of

- A) methine groups.
- B) methylene groups.
- C) methyl groups.
- D) both methine and methylene groups.

40) Carbon atoms 1, 2, and 3 in the following structure are classified, respectively, as



- A) tertiary, primary, secondary.
- B) quaternary, secondary, secondary.
- C) quaternary, primary, tertiary.
- D) quaternary, secondary, tertiary.

- 41) How many methine groups are there in isopropylcyclopentane?
A) one
B) two
C) three
D) four
- 42) Which of the following describes an atom or group of atoms that has similar chemical properties when it occurs in different compounds?
A) hydrocarbon
B) functional group
C) paraffin
D) isomer
- 43) The boiling point of isobutane (-10.2°C) is lower than *n*-butane (-0.4°C) because isobutane has
A) weaker intermolecular van der Waals forces.
B) stronger intermolecular van der Waals forces.
C) weaker dipole-dipole attractive forces.
D) stronger dipole-dipole attractive forces.
- 44) Arrange the following hydrocarbons in order of increasing boiling point.
I. pentane
II. 2,2-dimethylpropane
III. 2-methylbutane
A) I < II < III
B) I < III < II
C) II < I < III
D) II < III < I
- 45) Arrange the following isomeric alkanes in order of increasing boiling point.
I. *n*-heptane
II. 2,3-dimethylpentane
III. 2,2,3-trimethylbutane
A) I < II < III
B) II < III < I
C) III < I < II
D) III < II < I
- 46) Which of the following has the lowest boiling point?
A) pentane
B) 2,2-dimethylpropane
C) 2-methylbutane
D) hexane

47) The smallest straight-chain alkane that is liquid at room temperature and atmospheric pressure is

- A) propane.
- B) butane.
- C) pentane.
- D) hexane.

48) The lowest-boiling isomer of C_7H_{16} would be



- A) A.
- B) B.
- C) C.
- D) D.

49) Why can heats of combustion of constitutional isomers of hydrocarbons be used to measure their stabilities?

- I. Combustion of constitutional isomers gives different final states.
- II. Combustion of constitutional isomers gives the same final states.
- III. Constitutional isomers of hydrocarbons have the same potential energies.
- IV. Constitutional isomers of hydrocarbons have different potential energies.

- A) only I
- B) only II
- C) I and III
- D) II and IV

50) The heats of combustion ($-\Delta H^\circ$) of heptane and 3,3-dimethylpentane are 4,817 and 4,809 kJ/mol, respectively. Which statement is true?

- A) Heptane is 8 kJ/mol more stable than 3,3-dimethylpentane.
- B) 3,3-Dimethylpentane is 8 kJ/mol more stable than heptane.
- C) Stabilities cannot be compared since they are not isomers.
- D) Stabilities cannot be compared since they give different combustion products.

51) How many moles of O_2 gas would be consumed in the complete combustion of 0.100 mole of C_5H_{12} ?

- A) 0.100 mole O_2
- B) 0.400 mole O_2
- C) 0.800 mole O_2
- D) 1.60 mole O_2

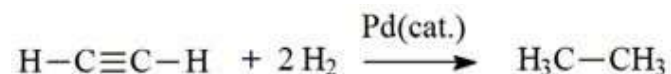
52) Which of the following has(have) a higher oxidation state of carbon than the carbon in formaldehyde, $\text{H}_2\text{C}=\text{O}$?

- I. CH_3OH
 - II. HCO_2H
 - III. H_2CO_3
- A) I
B) III
C) II and III
D) I, II, and III

53) The oxidation states of carbon range from

- A) 0 to +2.
B) 0 to +4.
C) -4 to 0.
D) -4 to +4.

54) The reaction of acetylene with hydrogen gas is shown below. Which statements are true concerning the reaction?



- I. Acetylene is oxidized to ethane.
 - II. Acetylene is reduced to ethane.
 - III. Carbon changes oxidation state from -1 to -3.
 - IV. Hydrogen (from H_2) changes oxidation state from 0 to +1.
- A) I and III
B) II and IV
C) I, III, and IV
D) II, III, and IV

55) How many constitutional isomers of C_6H_{14} are possible?

- A) four
B) five
C) six
D) seven