

Test Bank for Organic Chemistry 11th Carey

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.

Answer: A

Difficulty: 1 Easy

Section: 02.01

Topic: Functional Groups

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hydrocarbons; Alkanes; Alkenes; Alkynes; Arenes (Aromatics)

- 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}

Answer: C

Difficulty: 1 Easy

Section: 02.05

Topic: Functional Groups; Alkanes (Acyclic and Cyclic)

Bloom's: 1. Remember

Chapter: 02

Subtopic: Hydrocarbons; Alkanes; Acyclic vs cyclic

- 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

Answer: D

Difficulty: 2 Medium

Section: 02.07

Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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.

Answer: D

Difficulty: 2 Medium

Section: 02.06

Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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.

Answer: C

Difficulty: 2 Medium

Section: 02.06

Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

6) What is the Cl-C-Cl bond angle in CCl_4 ?

- A) 60°
- B) 90°
- C) 109.5°
- D) 120°

Answer: C

Difficulty: 2 Medium

Section: 02.06

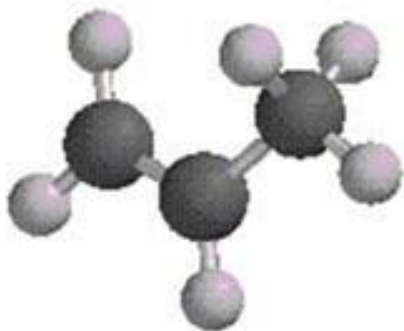
Topic: Molecular Shape

Bloom's: 3. Apply

Chapter: 02

Subtopic: Hybridization

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



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

Answer: C

Difficulty: 2 Medium

Section: 02.08

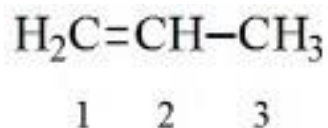
Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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



- 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 .

Answer: C

Difficulty: 2 Medium

Section: 02.08

Topic: Molecular Shape

Bloom's: 3. Apply

Chapter: 02

Subtopic: Hybridization

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



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

Answer: B

Difficulty: 2 Medium

Section: 02.09

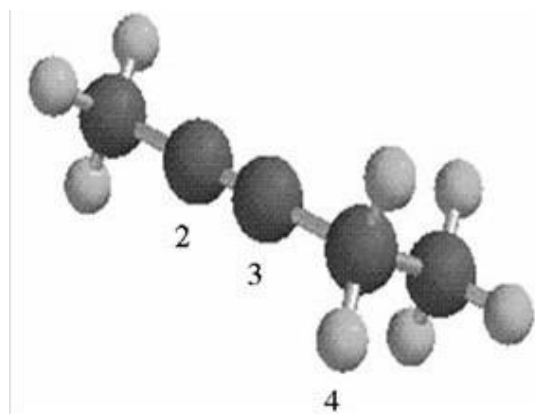
Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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



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

Answer: D

Difficulty: 2 Medium

Section: 02.09

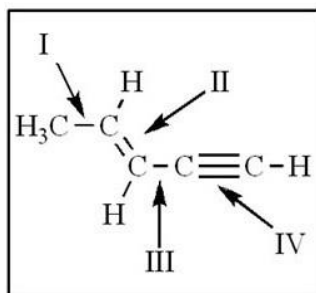
Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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.

Answer: D

Difficulty: 2 Medium

Section: 02.09

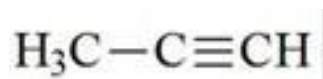
Topic: Structure and Bonding

Bloom's: 2. Understand

Chapter: 02

Subtopic: Bond properties; Types of bonds

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



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

Answer: D

Difficulty: 2 Medium

Section: 02.09

Topic: Molecular Shape

Bloom's: 3. Apply

Chapter: 02

Subtopic: Hybridization

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



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

Answer: C

Difficulty: 1 Easy

Section: 02.09

Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

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



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

Answer: B

Difficulty: 2 Medium

Section: 02.09

Topic: Molecular Shape

Bloom's: 2. Understand

Chapter: 02

Subtopic: Hybridization

15) How many isomers of C_4H_9Cl are possible?

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

Answer: C

Difficulty: 2 Medium

Section: 02.12

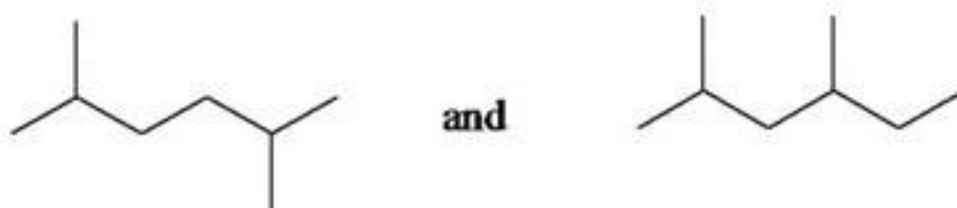
Topic: Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: Constitutional isomers

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

Answer: C

Difficulty: 2 Medium

Section: 02.13

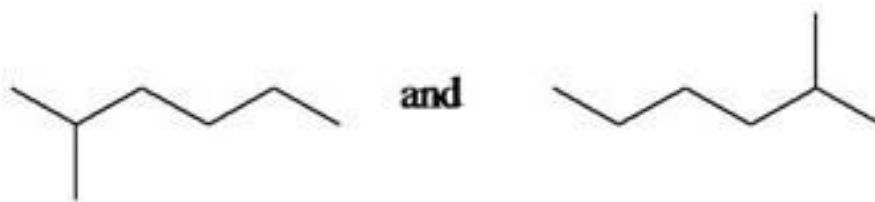
Topic: Drawing Organic Molecules

Bloom's: 2. Understand

Chapter: 02

Subtopic: Constitutional isomers

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

Answer: A

Difficulty: 1 Easy

Section: 02.13

Topic: Drawing Organic Molecules

Bloom's: 2. Understand

Chapter: 02

Subtopic: Skeletal/bond-line structures

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

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

Answer: B

Difficulty: 2 Medium

Section: 02.14

Topic: Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: Constitutional isomers

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

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

Answer: B

Difficulty: 2 Medium

Section: 02.16

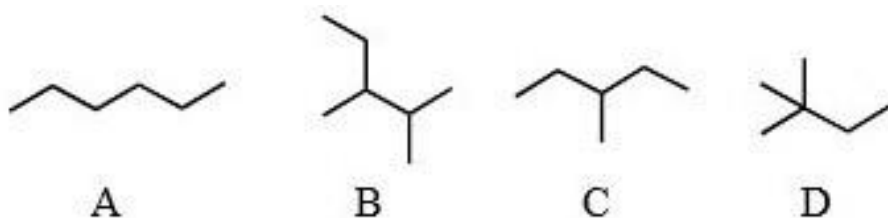
Topic: Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: Constitutional isomers

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



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

Answer: B

Difficulty: 1 Easy

Section: 02.16

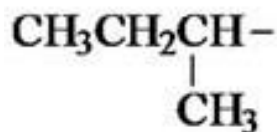
Topic: Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: Constitutional isomers; Skeletal/bond-line structures

21) The common name of the following group is



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

Answer: B

Difficulty: 2 Medium

Section: 02.17

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 1. Remember

Chapter: 02

Subtopic: Alkyl groups

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.

Answer: B

Difficulty: 2 Medium

Section: 02.17

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Alkyl groups

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

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

Answer: D

Difficulty: 2 Medium

Section: 02.17

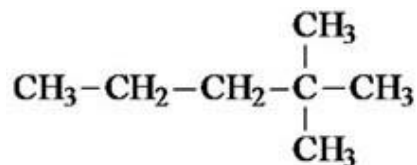
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Alkyl groups

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

Answer: C

Difficulty: 2 Medium

Section: 02.18

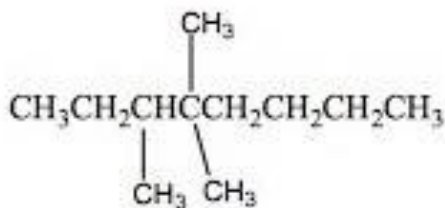
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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.

Answer: C

Difficulty: 2 Medium

Section: 02.18

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)_3$

Answer: B

Difficulty: 2 Medium

Section: 02.18

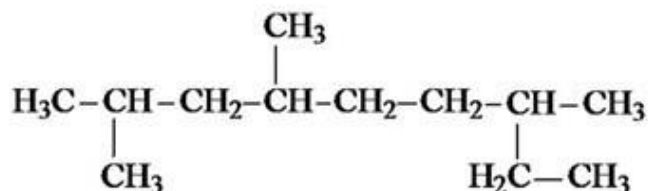
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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.

Answer: A

Difficulty: 2 Medium

Section: 02.18

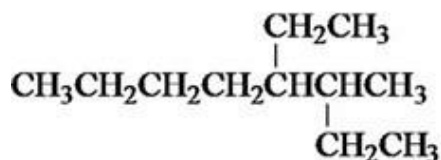
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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

Answer: D

Difficulty: 2 Medium

Section: 02.18

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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

Answer: D

Difficulty: 3 Hard

Section: 02.18

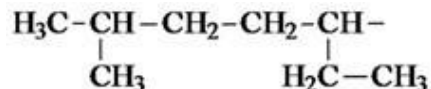
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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.

Answer: B

Difficulty: 2 Medium

Section: 02.18

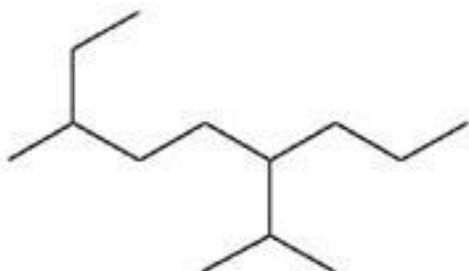
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: Alkyl groups

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

Answer: A

Difficulty: 2 Medium

Section: 02.18

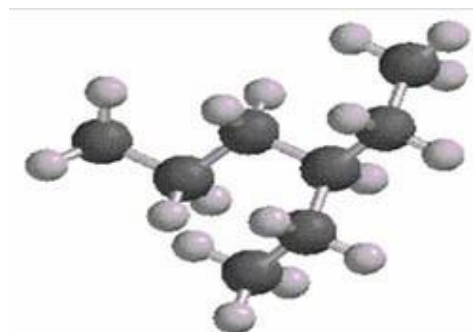
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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



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

Answer: B

Difficulty: 2 Medium

Section: 02.18

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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.

Answer: A

Difficulty: 2 Medium

Section: 02.18

Topic: Alkanes (Acyclic and Cyclic); Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes; 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} .

Answer: B

Difficulty: 1 Easy

Section: 02.19

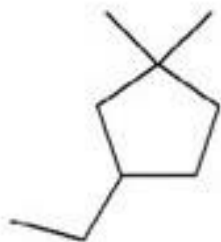
Topic: Functional Groups; Alkanes (Acyclic and Cyclic)

Bloom's: 1. Remember

Chapter: 02

Subtopic: Hydrocarbons; Alkanes; Acyclic vs cyclic

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

Answer: C

Difficulty: 2 Medium

Section: 02.19

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of cycloalkanes

36) All the carbons in cyclopentane are

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

Answer: B

Difficulty: 2 Medium

Section: 02.19

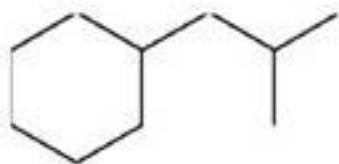
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: IUPAC Nomenclature of cycloalkanes

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.

Answer: B

Difficulty: 2 Medium

Section: 02.19

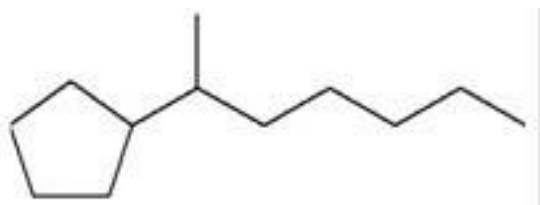
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of cycloalkanes

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.

Answer: C

Difficulty: 2 Medium

Section: 02.19

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 3. Apply

Chapter: 02

Subtopic: IUPAC Nomenclature of cycloalkanes

39) Cyclohexane is composed of

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

Answer: B

Difficulty: 2 Medium

Section: 02.19

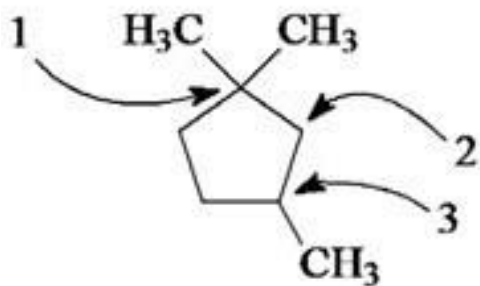
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: IUPAC Nomenclature of cycloalkanes

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.

Answer: D

Difficulty: 2 Medium

Section: 02.19

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Alkyl groups

41) How many methine groups are there in isopropylcyclopentane?

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

Answer: B

Difficulty: 2 Medium

Section: 02.19

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: IUPAC Nomenclature of acyclic alkanes

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

Answer: B

Difficulty: 1 Easy

Section: 02.20

Topic: Functional Groups

Bloom's: 1. Remember

Chapter: 02

Subtopic: Hydrocarbons; C-Z functional groups (Z = N, O, S, halogen)

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.

Answer: A

Difficulty: 2 Medium

Section: 02.22

Topic: Functional Groups

Bloom's: 2. Understand

Chapter: 02

Subtopic: Intermolecular 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

Answer: D

Difficulty: 2 Medium

Section: 02.22

Topic: Functional Groups

Bloom's: 4. Analyze

Chapter: 02

Subtopic: Intermolecular forces

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

Answer: D

Difficulty: 2 Medium

Section: 02.22

Topic: Functional Groups

Bloom's: 4. Analyze

Chapter: 02

Subtopic: Intermolecular forces

46) Which of the following has the lowest boiling point?

- A) pentane
- B) 2,2-dimethylpropane
- C) 2-methylbutane
- D) hexane

Answer: B

Difficulty: 2 Medium

Section: 02.22

Topic: Functional Groups

Bloom's: 2. Understand

Chapter: 02

Subtopic: Intermolecular forces

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

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

Answer: C

Difficulty: 2 Medium

Section: 02.22

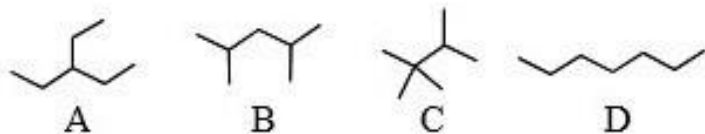
Topic: Functional Groups

Bloom's: 2. Understand

Chapter: 02

Subtopic: Intermolecular forces

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



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

Answer: C

Difficulty: 2 Medium

Section: 02.22

Topic: Functional Groups

Bloom's: 2. Understand

Chapter: 02

Subtopic: Intermolecular forces

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

Answer: D

Difficulty: 2 Medium

Section: 02.23

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Reactions of alkanes

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.

Answer: B

Difficulty: 2 Medium

Section: 02.23

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Reactions of alkanes

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

Answer: C

Difficulty: 3 Hard

Section: 02.23

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 4. Analyze

Chapter: 02

Subtopic: Reactions of alkanes

52) Which of the following has(have) a higher oxidation state of carbon than the carbon in formaldehyde, $H_2C=O$?

I. CH_3OH

II. HCO_2H

III. H_2CO_3

- A) I
- B) III
- C) II and III
- D) I, II, and III

Answer: C

Difficulty: 2 Medium

Section: 02.24

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 4. Analyze

Chapter: 02

Subtopic: Acyclic vs cyclic

53) The oxidation states of carbon range from

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

Answer: D

Difficulty: 1 Easy

Section: 02.24

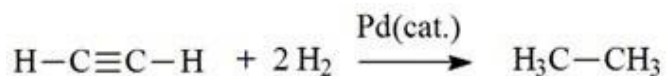
Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 1. Remember

Chapter: 02

Subtopic: Acyclic vs cyclic

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 H₂) 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

Answer: D

Difficulty: 2 Medium

Section: 02.24

Topic: Alkanes (Acyclic and Cyclic)

Bloom's: 2. Understand

Chapter: 02

Subtopic: Reactions of alkanes

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

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

Answer: B

Difficulty: 2 Medium

Section: 02.15

Topic: Drawing Organic Molecules

Bloom's: 3. Apply

Chapter: 02

Subtopic: Constitutional isomers