CHAPTER 22 Study Guide

Study Tip

Organize new information. Use flashcards to help you visualize the different types of hydrocarbons. Try to integrate what you're studying with what you already know. Find a study partner and quiz one another using the flashcards.

Interactive Textbook

If your class subscribes to the Interactive Textbook with ChemASAP, your students can go online to access an interactive version of the Student Edition and a self-test.

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CHAPTER 22 Study Guide

Key Concepts

22.1 Hydrocarbons
- Because carbon has four valence electrons, carbon atoms always form four covalent bonds.
- The carbon atoms in an alkane can be arranged in a straight chain or in a chain that has branches.
- Molecules of hydrocarbons, such as alkanes, are nonpolar molecules.

22.2 Unsaturated Hydrocarbons
- At least one carbon-carbon bond in an alkene is a double bond. Other bonds may be single carbon-carbon and carbon-hydrogen bonds.
- At least one carbon-carbon bond in an alkyne is a triple bond. Other bonds may be single or double carbon-carbon bonds and single carbon-hydrogen bonds.

22.3 Isomers
- Structural isomers differ in physical properties and have different chemical reactivites.
- Two types of stereoisomers are geometric isomers and optical isomers.

22.4 Hydrocarbon Rings
- Some hydrocarbon compounds have a carbon chain that is in the form of a ring.
- In a benzene molecule, the bonding electrons between carbon atoms are shared evenly around the ring.

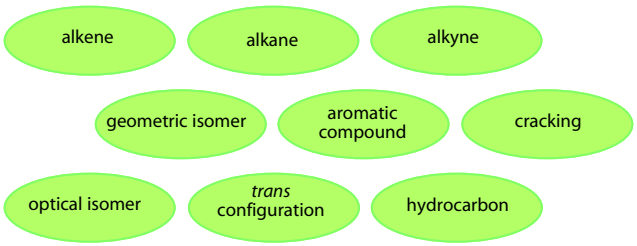
22.5 Hydrocarbons From Earth's Crust
- Natural gas is an important source of alkanes of low molar mass.
- The refining of petroleum starts with the distillation of petroleum into fractions according to boiling point.
- Coal consists largely of condensed aromatic compounds of extremely high molar mass. These compounds have a high proportion of carbon compared with hydrogen.

Vocabulary

- aliphatic hydrocarbons (p. 703)
- alkanes (p. 694)
- alkenes (p. 702)
- alkyl group (p. 698)
- alkynes (p. 703)
- aromatic compound (p. 710)
- asymmetric carbon (p. 705)
- branched-chain alkane (p. 698)
- *cis* configuration (p. 705)
- condensed structural formulas (p. 696)
- cracking (p. 713)
- cyclic hydrocarbon (p. 709)
- homologous series (p. 695)
- hydrocarbons (p. 693)
- geometric isomers (p. 705)
- isomers (p. 704)
- optical isomers (p. 706)
- saturated compounds (p. 702)
- stereoisomers (p. 705)
- straight-chain alkanes (p. 695)
- structural isomers (p. 704)
- substituent (p. 697)
- *trans* configuration (p. 705)
- unsaturated compounds (p. 702)

Organizing Information

Use these terms to construct a concept map that organizes the major ideas of this chapter.



Interactive Textbook

Concept Map 22 Create your Concept Map using the computer.

with ChemASAP

Chapter Resources

Print
- **Core Teaching Resources,** Chapter 22, *Practice Problems*, *Vocabulary Review*, *Quiz*, *Chapter Test A*, *Chapter Test B*

Technology
- **Computer Test Bank,** Chapter 22 Test
- **Interactive Textbook with ChemASAP,** Chapter 22

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CHAPTER 22

Assessment

Reviewing Content

22.1 Hydrocarbons

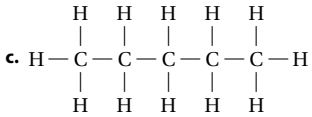
37. Draw condensed structural formulas for pentane and hexane. Assume that the C — H and C — C bonds are understood.

38. Name the alkanes that have the following molecular or structural formulas.

a. $CH_3CH_2CH_3$

b. $CH_3(CH_2)_6CH_3$

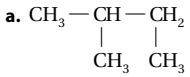
c.



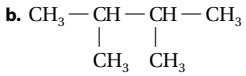
39. Draw structures for the alkyl groups derived from methane, ethane, and propane.

40. Give the IUPAC name for each compound.

a.



b.



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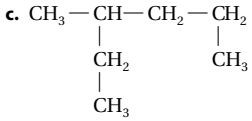


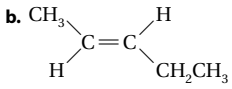
41. Why are alkane molecules nonpolar?

22.2 Unsaturated Hydrocarbons

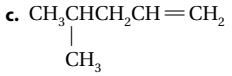
42. Give a systematic name for these alkenes.

a. $CH_3CH=CH_2$

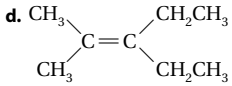
b.



c.



d.



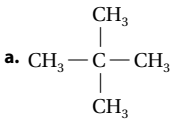
43. Name and draw a structural formula for each alkene with the molecular formula C_5H_{10}.

22.3 Isomers

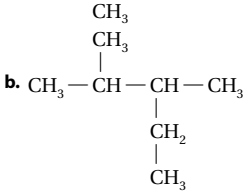
44. Draw and name all the structural isomers with the molecular formula C_6H_{14}. (You may wish to draw only the carbon skeletons.)

45. Draw one structural isomer of each compound.

a.



b.



46. Draw a structural formula or carbon skeleton for each of the following alkenes. If *cis* and *trans* forms are present, include both forms.

a. 2-pentene **b.** 2-methyl-2-pentene

c. 3-ethyl-2-pentene

47. Do all molecules have optical isomers? Explain.

48. Can you draw a structural isomer of hexane (C_6H_{14}) that has an asymmetric carbon? Explain.

22.4 Hydrocarbon Rings

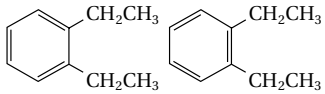
49. Draw a structural formula for each compound.

a. 1,4-diethylbenzene

b. 2-methyl-3-phenylpentane

c. 1,3-dimethylbenzene

50. Explain why both of these structures represent 1,2-diethylbenzene.



22.5 Hydrocarbons From Earth's Crust

51. How are catalysts used in petroleum refining?

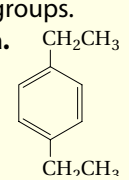
52. Rank these materials in order of increasing hardness: bituminous coal, peat, lignite, and anthracite coal.

53. What happens to the sulfur when coal burns?

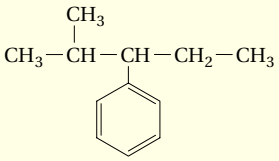
47. No, Only molecules with at least one asymmetric carbon have optical isomers.

48. No, Hexane contains no substituted groups.

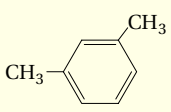
49. a.



b.



c.



50. Two different structural formulas are possible because a benzene ring exhibits resonance.

51. During cracking, catalysts are used to produce more short-chain components.

52. peat, lignite, bituminous coal, anthracite coal

53. When coal that contains a high percent of sulfur burns, the major air pollutants SO_2 and SO_3 are by-products.

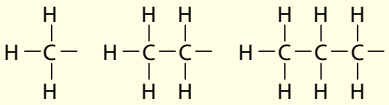
CHAPTER 22 Assessment

Reviewing Content

37. pentane: $CH_3CH_2CH_2CH_2CH_3$
hexane: $CH_3CH_2CH_2CH_2CH_2CH_3$

38. a. propane **b.** octane **c.** pentane

39.



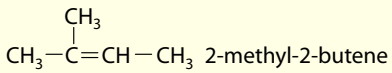
40. a. 2-methylbutane
b. 2,3-dimethylbutane
c. 3-methylhexane

41. The carbon-carbon bonds are nonpolar and the carbon-hydrogen bonds are very weakly polar..

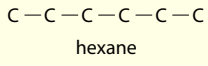
42. a. propene **b.** *trans*-2-pentene
c. 4-methyl-1-pentene
d. 3-ethyl-2-methyl-2-pentene

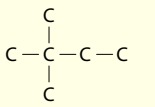
43. $CH_2=CHCH_2CH_2CH_3$ 1-pentene

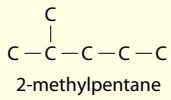
$CH_3CH=CHCH_2CH_3$ 2-pentene

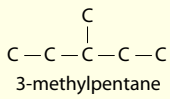

2-methyl-2-butene

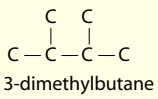
44. Five structural isomers with the molecular formula C_6H_{14} exist.


hexane


2, 2-dimethylbutane

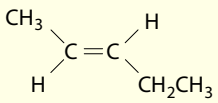

2-methylpentane

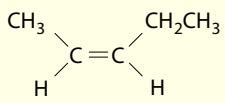

3-methylpentane


2, 3-dimethylbutane

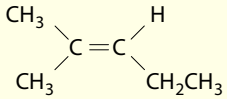
45. a. Accept any isomer with 5 carbons and 12 hydrogens. **b.** Accept any isomer with 7 carbons and 16 hydrogens.

46. a.

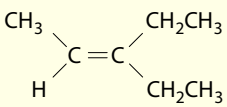

trans-2-pentene


cis-2-pentene

b.


2-methyl-2-pentene

c.

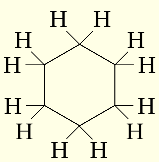

3-ethyl-2-pentene

Understanding Concepts

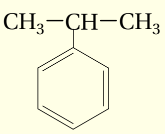
54. a. The *di-* indicates two methyl groups, but only one location is given; 2,2-dimethylpentane.
b. Alkyl groups on end carbons are part of the chain; pentane.
c. The chain wasn't numbered so the substituent has the lowest possible number; 2-methylbutane.
d. The methyl group on carbon 4 is part of the chain; 3-methylpentane

55. a. Ethyne has one triple C–C bond and two single C–H bonds.
b. All bonds in propane are single bonds. **c.** In methylbenzene, there are hybrid bonds within the ring and single bonds within substituents and between substituents and the ring.

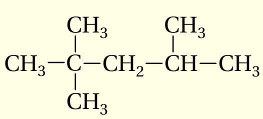
56. a. $CH \equiv C - CH_3$ **b.**



c.



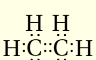
d.



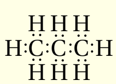
57. propane, butane, pentane

58. Geometric isomers differ in the arrangement of substituent groups attached to each carbon in a double bond. In optical isomers, there is at least one asymmetric carbon.

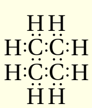
59. a.



b.



c. H:C:::C:H **d.**



60. $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

61. The middle structure is most stable due to resonance within the ring.

62. a. 9.6 billion **b.** 81%

63. No, the structures are identical; one has been flipped over.

64. a. (3) **b.** (1) **c.** (5) **d.** (4) **e.** (2)

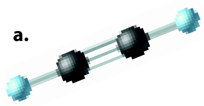
CHAPTER 22 Assessment continued

Understanding Concepts

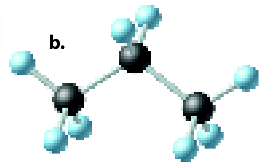
54. Why are the following names incorrect? What are the correct names?
a. 2-dimethylpentane
b. 1,3-dimethylpropane
c. 3-methylbutane
d. 3,4-dimethylbutane

55. For each hydrocarbon shown, identify the type of covalent bonds and name the compound.

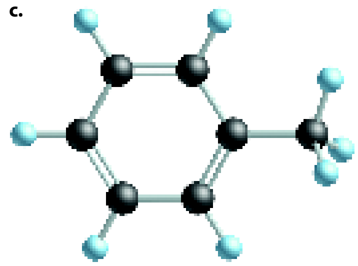
a.



b.



c.



56. Write structural formulas for these compounds.
a. propyne
b. cyclohexane
c. 2-phenylpropane
d. 2,2,4-trimethylpentane

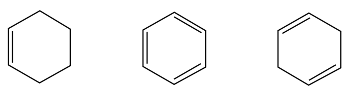
57. Name the next three higher homologs of ethane.

58. Compare geometric and optical isomers.

59. Draw electron dot structures for each compound.
a. ethene **b.** propane
c. ethyne **d.** cyclobutane

60. Write an equation for the combustion of octane.

61. Compare these three molecular structures. Which would you expect to be most stable? Why?

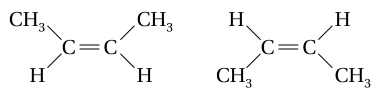


62. The seven organic chemicals produced in the largest amounts in the United States in a recent year are listed in the table below. Answer the following questions based on the data given.

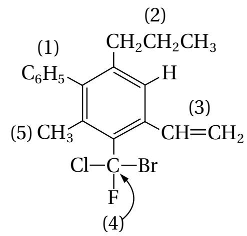
Chemical	Amount produced (billions of kg)
Ethylene	15.9
Propylene	8.4
Urea	6.8
Ethylene dichloride	6.3
Benzene	5.3
Ethyl benzene	4.3
Vinyl chloride	3.7

a. How many billion kilograms of aromatic compounds were produced?
b. Of the total mass of all seven compounds produced, what percent by mass was made up of aliphatic compounds?

63. Are these two structures geometric isomers? Explain your answer.



64. Use the labeled features in the molecular structure to answer the following questions.



a. Which label identifies a double bond?
b. Which label identifies a phenyl group?
c. Which label identifies a methyl group?
d. Which label identifies an asymmetric carbon?
e. Which label identifies a propyl group?

Critical Thinking

65. Methane (CH_4), a widely used fuel, has a heat of combustion (ΔH) of −890 kJ/mol. The ΔH for benzene (C_6H_6) is much higher, −3268 kJ/mol, yet benzene alone is never used as a fuel. Suggest some reasons why benzene is a less desirable fuel than methane.

66. Explain why you cannot draw a structural formula for methene.

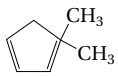
67. Use the isomers of 2-pentene to show how lack of rotation about a carbon-carbon double bond leads to geometric isomers.

68. Most cyclic hydrocarbons have higher boiling points than alkanes with the same number of carbons. Suggest a possible explanation for this general difference in boiling points.

69. Alkadienes are hydrocarbons with two double bonds. Draw the structural formula of the alkadiene with the molecular formula C_3H_4.

70. The molecular formula C_4H_6 could represent an alkyne, a cycloalkene, or a hydrocarbon with two double bonds. Write the condensed structural formulas for each. Which compound do you think is the least stable, and why?

71. Draw structural formulas for the following compounds.
a. *cis*-2,3-dimethyl-3-hexene
b. 1-ethyl-2-methylcyclopentane

72. Draw the correct structure for any of the ones below that are incorrect.
a. $CH_3-CH=CH-CH_2-CH_3$
b. 
c. $CH_3-C\equiv CH-CH_2-CH_3$
d. $CH_3=CH-CH_2-CH_3$

73. What structural feature is associated with each of these hydrocarbons: an alkane; an alkene; an aromatic hydrocarbon; a cycloalkane.

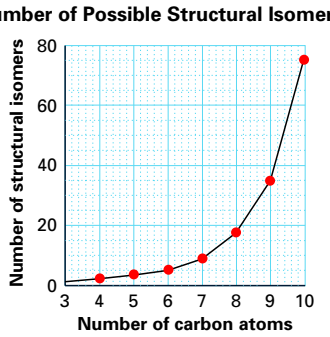
74. Alkenes can undergo an addition reaction in which substances are added to the carbons in the carbon-carbon double bond. Predict whether an alkane or an alkyne is more likely to undergo an addition reaction. Explain your answer.

Concept Challenge

75. Use the data in Table 22.1 to make a graph of boiling point versus number of carbons for the first ten straight-chain alkanes. Is the graph a straight line? Use the graph to predict the boiling point of undecane, the straight-chain alkane containing eleven carbons. Use a chemistry handbook to find the actual boiling point of undecane. Compare the actual boiling point with your prediction.

76. Fossil fuels such as oil and natural gas are the raw materials for many consumer products. Should this information affect the decision to develop energy sources other than fossil fuels? Explain.

77. The graph shows the number of structural isomers for alkanes with three through ten carbon atoms.

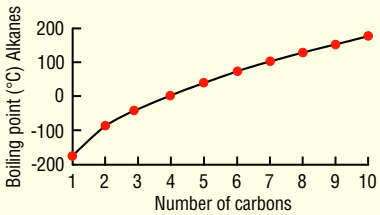


a. How many structural isomers are there for the C_6, C_7, C_8, C_9, and C_{10} alkanes?
b. The difference between the number of isomers for C_7 and C_8 is 9. The difference between the number of isomers for C_9 and C_{10} is 40. In each case, one additional carbon atom is added to the molecule. Why is the change in the number of isomers so different?

78. Correct each of the following names and draw the correct structural formulas.
a. 4-methylhexane
b. 1,4-diethyl cyclopentane
c. 3,3methyl-4-ethyloctane

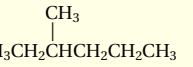
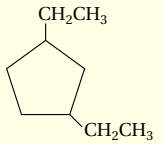
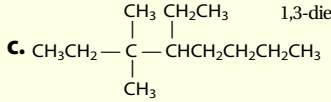
Concept Challenge

75. The graph isn't a straight line. The estimated bp should be greater than 150°C. The actual bp is 196°C.



76. Answers will vary, but should reflect that fossil fuels are not renewable.

77. **a.** $C_6 = 5, C_7 = 9, C_8 = 18, C_9 = 35, C_{10} = 75$
b. the more carbon atoms, the more possible ways to arrange them

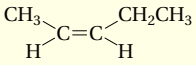
78. **a.** 
3-methylhexane
b. 
1,3-diethylcyclopentane
c. 
3,3-dimethyl-4-ethyloctane

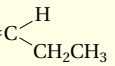
Critical Thinking

65. The amount of heat per carbon is higher for methane (–890 kJ/mol of carbon) than for benzene (–545 kJ/mol of carbon). Methane undergoes complete combustion if sufficient air is present. Burning aromatic compounds produces more soot.

66. *Meth-* implies one carbon atom; *ene-* implies a double bond, which requires two carbon atoms.

67. The methyl and ethyl groups can be on the same side of the bond or opposite sides.

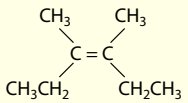
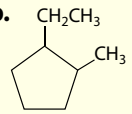

trans-2-pentene


cis-2-pentene

68. Students may infer that the ring structures in cyclic hydrocarbons produce stronger van der Waals attractions, which increase the energy required for vaporization.

69. $H_2C=C=CH_2$

70. The cycloalkene would be most unstable because the bond angles are 90° instead of the 120° predicted by VSEPR theory.
$C\equiv C-C-C$ (alkyne)
□ (cycloalkene)
$C=C-C=C$ (alkadiene)

71. **a.** 
b. 

72. **b.** 
c. $CH_3-C\equiv C-CH_2-CH_3$
d. $CH_2=CH-CH_2-CH_3$

73. Alkanes contain only single bonds. Alkenes contain at least one double bond. Aromatic hydrocarbons contain a benzene ring or a similar ring. Cycloalkanes contain aliphatic chains linked end-to-end.

74. an alkyne, because it contains a triple bond

Cumulative Review

79. **a.** 13.9 L **b.** 1 L **c.** 20 kPa

80. 3.04×10^2 calories

81. 1.13 mol KNO_3; 1.14×10^2 g KNO_3

82. 1.67×10^2 J

83. 1 cal = 4.184 J; 4.184×10^3 J

84. **a.** Smaller particle size speeds up the reaction. **b.** Higher temperature usually speeds up the reaction.

85. **a.** favors reactants **b.** favors products

86. **a.** $K_{eq} = \dfrac{[ICl]^2}{[I_2][Cl_2]}$

b. $K_{eq} = \dfrac{[H_2][Br_2]}{[HBr]^2}$

c. $K_{eq} = \dfrac{[HCl]^4[S]^3[SO_2]}{[S_2Cl_2]^2[H_2O]^2}$

d. $K_{eq} = \dfrac{[NH_3]^2}{[N_2][H_2]^2}$

87. **a.** 10.00
b. 7.59
c. 12.00
d. 11.70

88. **a.** ~8 **b.** Use a pH meter

89. **a.** H_3PO_4 **b.** CsOH
c. H_2CO_3 **d.** $Be(OH)_2$

90. **a.** $NaOH \rightarrow Na^+ + OH^-$
b. $Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

91. **a.** Ca, +2; C, +4; O, −2 **b.** Cl, 0
c. Li, +1; I, +5; O, −2
d. Na, +1; S, +4; O, −2

92. **a.** reduction **b.** reduction
c. reduction **d.** oxidation

93. **a.** +4 **b.** +4 **c.** +3 **d.** +5 **e.** +5 **f.** +2

94. **a.** The coefficients are 2, 9, 6, 8.
b. The coefficients are 3, 2, 1, 3.

95. It is the cell potential when the ion concentrations in the half-cells are 1*M*, the temperature is 25°C, and the pressure of any gases present is 101.3 kPa.

96. Reduction occurs in the half-cell with the more positive, or less negative, reduction potential. Ni^{2+} is reduced and Al is oxidized.
Cell reaction: $3Ni^{2+}(aq) + 2Al(s) \rightarrow 3Ni(s) + 2Al^{+3}(aq)$; $E^o_{cell} = +1.66$ V

97. The reaction is nonspontaneous.

98. reduction; reduction

Cumulative Review

79. Calculate the following quantities. (*Chapter 14*)
a. The number of liters occupied at STP by 6.20×10^{-1} mol $Cl_2(g)$.
b. The volume of a gas at 3 kPa of pressure if the same gas has a volume of 6 L at 0.5 kPa and the temperature is constant.
c. The partial pressure of gas X (P_x) in a mixture of three gases, X, Y, and Z, if the total pressure (P_{total}) is 50 kPa and the sum of the partial pressures of Y and Z is 30 kPa.

80. How many calories are absorbed when 56.0 g of liquid water at 100°C is vaporized to steam at 100°C? (*Chapter 15*)

81. How many moles of solute are in 750 mL of 1.50*M* KNO_3? How many grams of KNO_3 is this? (*Chapter 16*)

82. A silver dollar is heated and placed in a foam cup calorimeter containing 50.0 mL of water at 26.5°C. The water reached a maximum temperature of 27.3°C. How many joules of heat were released by the silver dollar? (*Chapter 17*)

83. What is the relationship between a calorie and a joule? How many joules is 1 kcal? (*Chapter 17*)

84. How does (**a**) particle size and (**b**) temperature affect the rate of a chemical reaction? (*Chapter 18*)

85. Explain how the equilibrium position of this reaction is affected by (**a**) decreasing the temperature and (**b**) removing CO_2. (*Chapter 18*)
$CaCO_3(s) + \text{heat} \rightleftharpoons CaO(s) + CO_2(g)$

86. Write equilibrium constant expressions for the following reactions. (*Chapter 18*)
a. $Cl_2(g) + I_2(g) \rightleftharpoons 2ICl(g)$
b. $2HBr(g) \rightleftharpoons H_2(g) + Br_2(g)$
c. $2S_2Cl_2(g) + 2H_2O(g) \rightleftharpoons 4HCl(g) + 3S(g) + SO_2(g)$
d. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

87. What are the pH values for aqueous solutions containing each of the following hydroxide-ion concentrations? (*Chapter 19*)
a. $1.0 \times 10^{-4}M$ **b.** $3.9 \times 10^{-7}M$
c. $0.010M$ **d.** $0.0050M$

88. A colorless solution of unknown pH turns blue when tested with the acid-base indicator bromthymol blue. It remains colorless when tested with phenolphthalein. (*Chapter 19*)
a. What is the approximate pH of the solution?
b. How could you determine the pH more accurately?

89. Write the formula for each acid or base. (*Chapter 19*)
a. phosphoric acid **b.** cesium hydroxide
c. carbonic acid **d.** beryllium hydroxide

90. Write the reaction for the dissociation of each of the following compounds in water. (*Chapter 19*)
a. sodium hydroxide **b.** barium hydroxide

91. Give the oxidation number of each element in the following substances. (*Chapter 20*)
a. $CaCO_3$ **b.** Cl_2
c. $LiIO_3$ **d.** Na_2SO_3

92. Identify these processes as either oxidation or reduction. (*Chapter 20*)
a. $Fe^{3+} + e^- \longrightarrow Fe^{2+}$ **b.** $Cl_2 + 2e^- \longrightarrow 2Cl^-$
c. $Fe^{3+} + 3e^- \longrightarrow Fe$ **d.** $Zn \longrightarrow Zn^{2+} + 2e^-$

93. Determine the oxidation number of nitrogen in the following substances and ions. (*Chapter 20*)
a. N_2O_4 **b.** NO_2 **c.** NH_3
d. NO_3^- **e.** NH_4^+ **f.** NO

94. Balance these redox equations. (*Chapter 20*)
a. $C_3H_7OH(l) + O_2(g) \longrightarrow CO_2(g) + H_2O(l)$
b. $BaO(s) + Al(s) \longrightarrow Al_2O_3(s) + Ba(s)$

95. Explain the term *Standard Cell Potential.* (*Chapter 21*)

96. A voltaic cell is made of the following half-cells. Determine the cell reaction and calculate the standard cell potential. (*Chapter 21*)
$Al^{3+}(aq) + 3e^- \longrightarrow Al(s)\ E^0_{Al^{3+}} = -1.66V$
$Ni^{2+}(aq) + 2e^- \longrightarrow Ni(s)\ E^0_{Ni^{2+}} = -0.25V$

97. The calculated standard cell potential for a redox reaction is a negative number. What does this tell you about the reaction? (*Chapter 21*)

98. What process always occurs at the cathode of an electrolytic cell? At the cathode of a voltaic cell? (*Chapter 21*)

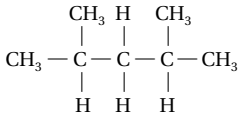
Standardized Test Prep

Test-Taking Tip

Eliminate Wrong Answers If you don't know which response to a question is correct, start by eliminating those you know are wrong. If you can rule out some choices, you'll have fewer choices left to consider and you'll increase your chances of choosing the correct answer.

Select the choice that best answers each question or completes each statement.

1. What is the name of the compound with the following structural formula?



a. 1,2,3,3-tetramethylpropane
b. heptane
c. 2,4-dimethylpentane
d. 1,5-dimethylbutane

2. Which of these are characteristic of all alkenes?
I. unsaturated
II. carbon-carbon double bond
III. optical isomers
a. I and II only
b. II and III only
c. I and III only
d. I, II, and III

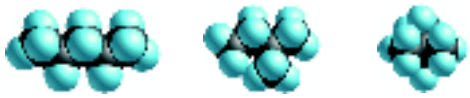
3. How many carbon atoms are in a molecule of 4,5-diethyloctane?
a. 10 **b.** 12
c. 14 **d.** 16

4. *Cis-trans* geometric isomerism is possible in
a. 2-pentene.
b. 2-butane.
c. propyne.
d. benzene.

5. A structural isomer of heptane is
a. methylbenzene.
b. 3,3-dimethylpentane.
c. cycloheptane.
d. 3-methylhexene.

6. Which molecule has optical isomers?
a. CH_4 **b.** CF_2H_2
c. CFClBrI **d.** CF_2ClH

Use the space-filling models of pentane isomers to answer Questions 7 and 8.



7. Write structural formulas for the three structural isomers of pentane, C_5H_{12}. Name each isomer.

8. Write structural formulas for the four structural isomers of cyclopentane. Draw ball-and-stick models of the isomers.

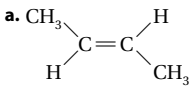
The lettered choices below refer to Questions 9–12. A lettered choice may be used once, more than once, or not at all.

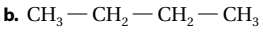
(A) alkene
(B) arene
(C) alkyne
(D) alkane

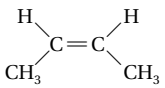
To which of the above classes of hydrocarbons does each of the following compounds belong?

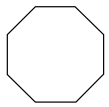
9. C_7H_{16}
10. C_5H_8
11. C_6H_6
12. C_8H_{16}

Use the molecular structures below to answer Questions 13–16. A molecular structure may be used once, more than once, or not at all.

a. 

b. 

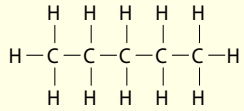
c. 

d. 

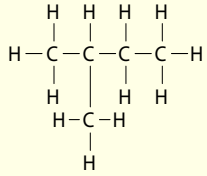
13. Which structure is a cycloalkane?
14. Which structure is a saturated hydrocarbon?
15. Which structure is a *cis*-isomer?
16. Which structure is a *trans*-isomer?

Standardized Test Prep

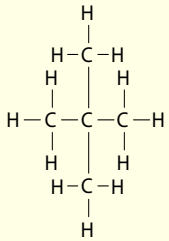
1. c
2. a
3. b
4. a
5. b
6. c
7.



pentane

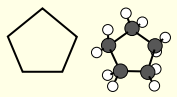


2-methylbutane

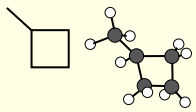


2,2-dimethylpropane

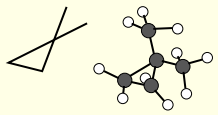
8. In the ball-and-stick models, the black spheres represent carbon and the white spheres represent hydrogen.



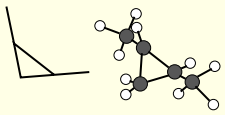
cyclopentane



methylcyclobutane



1,1-dimethylcyclopropane



1,2-dimethylcyclopropane

9. D
10. C
11. B
12. A
13. d
14. b, d
15. c
16. a