Chapter 01 Test Bank: Structure and Bonding

*Student: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. What is the ground-state electronic configuration of a carbon atom?

A. 1s2, 2s2, 2p5  
B. 1s2, 2s2, 2p2  
C. 1s2, 2s2, 2p6  
D. 1s2, 2s2, 2p4

1. What is the ground-state electronic configuration of a fluorine atom?

A. 1s2, 2s2, 2p2  
B. 1s2, 2s2, 2p3  
C. 1s2, 2s2, 2p4  
D. 1s2, 2s2, 2p5

1. What is the ground-state electronic configuration of a magnesium cation (Mg2+)?

A. 1s2, 2s2, 2p6  
B. 1s2, 2s2, 2p6, 3s1  
C. C. 1s2, 2s2, 2p6, 3s2  
D. D. 1s2, 2s2, 2p6, 3s2, 3p2

1. What is the ground-state electronic configuration of a chlorine anion (Cl—)?

A. 1s2, 2s2, 2p6  
B. 1s2, 2s2, 2p6, 3s2, 3p6  
C. C. 1s2, 2s2, 2p6, 3s2, 3p5  
D. D. 1s2, 2s2, 2p6, 3s2, 3p4

1. Which of the following statements about valence electrons is true?

A. They are the most tightly held electrons.  
B. They do not participate in chemical reactions.  
C. They are the outermost electrons.  
D. They reveal the period number of a second-row element.

1. Which of the following statements about bonding is true?

A. Covalent bonds result from the transfer of electrons from one element to another.  
B. Ionic bonds result from the transfer of electrons from a metal to a non-metal.  
C. Ionic bonds result from the sharing of electrons between two non-metals.  
D. Covalent bonds result from the sharing of electrons between two metals.

1. Which of the following would you expect to have ionic bonds?

A. CO  
B. FBr  
C. NF3  
D. NaCl

1. Which of the following molecules has nonpolar covalent bonds?

A. HCl  
B. N2  
C. CHCl3  
D. NO

1. Which of the following molecules contain both covalent and ionic bonds?

A. I, II  
B. I, IV  
C. II, III  
D. II, IV

1. Arrange the following bonds in decreasing order of ionic character, putting the most ionic first.

A. I > II > III > IV  
B. IV > II > I > III  
C. IV > III > II > I  
D. IV > II > III > I

1. Which of the following statements correctly describes the typical number of bonds for carbon, nitrogen, and oxygen in most neutral organic molecules?

A. Carbon forms 4 covalent bonds, nitrogen forms 2 covalent bonds, and oxygen forms 3 covalent bonds.  
B. Carbon forms 4 covalent bonds, nitrogen forms 3 covalent bonds, and oxygen forms 2 covalent bonds.  
C. Carbon forms 4 covalent bonds, nitrogen forms 5 covalent bonds, and oxygen forms 2 covalent bonds.  
D. Carbon forms 4 covalent bonds, nitrogen forms 5 covalent bonds, and oxygen forms 4 covalent bonds.

12.  Which is not an acceptable Lewis structure for the anion CH2NCO—?

A. I  
B. II  
C. III  
D. IV

13.  Which of the following Lewis structures is correct?

A. I  
B. II  
C. III  
D. IV

14.  Which of the following Lewis structures is correct?

A. I, II  
B. I, III  
C. II, III  
D. III, IV

15.  Which is the correct Lewis structure for acetic acid (CH3CO2H)?

A. I  
B. II  
C. III  
D. IV

16.  In which of the following ions does carbon have a formal charge?

A. I  
B. II  
C. III  
D. None of these

17.  In which of the following ions does carbon have a formal charge?

A. I  
B. II  
C. III  
D. None of these

18. What is the formal charge of carbon in carbon monoxide (CO) when drawn with a triple bond?

A. 0  
B. -2  
C. -1  
D. +1

19. Which of the following statements about constitutional isomers is true?

A. Constitutional isomers are different molecules having the different molecular formula.  
B. Constitutional isomers are different molecules having the same molecular formula.  
C. Constitutional isomers are same molecules having the different molecular formula.  
D. Constitutional isomers are same molecules having the same molecular formula.

20. How many constitutional isomers are there for a molecule having the molecular formula C2H6O?

A. 1  
B. 2  
C. 3  
D. 4

21. How many constitutional isomers are there for a molecule having the molecular formula C3H8O?

A. 1  
B. 2  
C. 3  
D. 4

22. How many constitutional isomers are there for a molecule having the molecular formula C3H6?

A. 1  
B. 2  
C. 3  
D. 4

23. How many constitutional isomers are there for a molecule having the molecular formula C2H4Cl2?

A. 1  
B. 2  
C. 3  
D. 4

24. How many different isomers are there for a compound having the molecular formula C3H6O?

A. 4  
B. 5  
C. 6  
D. 7

25.  Which of the following molecules are constitutional isomers?

A. I, II, IV  
B. II, III, IV  
C. I, III, IV  
D. I, II, III

26. Which of the following compounds has an atom with an unfilled valence shell of electrons?

A. H2O  
B. BCl3  
C. CH4  
D. CO2

27. Which of the following statements about resonance structures is true?

A. Resonance structures have the same placement of electrons but different arrangement of atoms.  
B. Resonance structures have the same placement of atoms but different arrangement of electrons.  
C. Resonance structures have the same placement of atoms and the same arrangement of electrons.  
D. Resonance structures have different placement of atoms and different arrangement of electrons.

28. Which of the following statements about resonance structures is *not* true?

A. There is no movement of electrons from one form to another.  
B. Resonance structures are not isomers.  
C. Resonance structures differ only in the arrangement of electrons.  
D. Resonance structures are in equilibrium with each other.

29.  Which of the following pair does not represent resonance structures?

A. I  
B. II  
C. III  
D. IV

30. What 2 things will change between two resonance structures?

A. The position of multiple bonds and non-bonded electrons.  
B. The position of multiple bonds and single bonds.  
C. The placement of atoms and single bonds.  
D. The placement of atoms and non-bonded electrons.

31.  Which of the following is a resonance structure of the compound below?

A. I  
B. II  
C. III  
D. IV

32.  Which of the following resonance structures is the least important contributor to the resonance hybrid of the formate anion, HCOO—?

A. I  
B. II  
C. III  
D. IV

33.  Rank the following in order of decreasing importance as contributing structures to the resonance hybrid of formaldehyde, H2CO.

A. I > II > III  
B. I > III > II  
C. II > I > III  
D. III > II > I

34.  Follow the curved arrows to draw the second resonance structure for the ion below.

A. I  
B. II  
C. III  
D. IV

35.  Which is more important in each pair of contributing resonance structures?

A. II, IV, V  
B. II, III, V  
C. II, III, VI  
D. I, IV, V

36. What is the approximate value of the H-C-H bond angle in methane, CH4?

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

37. What is the approximate C-C-C bond angle in propene, CH3CH = CH2?

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

38. What is the approximate H-C-O bond angle in formaldehyde, H2CO?

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

39.  Determine the geometry around the indicated atom in each species.

A. I = Linear; II = tetrahedral; III = trigonal planar; IV = tetrahedral  
B. I = Linear; II = tetrahedral; III = trigonal planar; IV = linear  
C. I = Trigonal planar; II = linear; III = tetrahedral; IV = trigonal planar  
D. I = Tetrahedral; II = trigonal planar; III = linear; IV = tetrahedral

40. What is the approximate bond angle for the C-C-N bond in acetonitrile, CH3CN?

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

41.  Which of the following is the appropriate conversion of the condensed structure, CH3COCH3, to a Lewis structure?

A. I  
B. II  
C. III  
D. IV

42.  Which of the following is the appropriate conversion of (CH3)2CHCH2CHClCH3 to a skeletal structure?

A. I  
B. II  
C. III  
D. IV

43.  Which of the following is the appropriate conversion of (CH3)4C to a skeletal structure?

A. I  
B. II  
C. III  
D. IV

44.  What is the condensed formula of the compound below?

A. I  
B. II  
C. III  
D. IV

45.  Which of the following is the appropriate conversion of (CH3)2CHOCH2CH2CH2OH to a skeletal structure?

A. I  
B. II  
C. III  
D. IV

46.  Convert the following skeletal structure to a condensed structure.

A. I  
B. II  
C. III  
D. IV

47.  Avobenzone is an active ingredient in some common sunscreens. Which of the following is the correct molecular formula for avobenzone?

A. C22O22O3  
B. C20H22O3  
C. C21H23O3  
D. C20H24O3

48.  In which structure is the hybridization incorrect?

A. I  
B. II  
C. III  
D. IV

49.  What is the hybridization for each of the indicated atoms in the following compound?

A. I = *sp2*; II = *sp2*; III = *sp2*.  
B. I = *sp2*; II = *sp3*; III = *sp3*.  
C. I = *sp*; II = *sp2*; III = *sp3*.  
D. I = *sp2*; II = *sp2*; III = *sp3*.

50. What is the hybridization of the carbon atom in the methyl cation, (CH3+)?

A. *sp3*  
B. *sp2*  
C. *sp*  
D. *p*

51. What is the hybridization of the nitrogen atom in the ammonium cation, NH4+?

A. *sp3*  
B. *sp2*  
C. *sp*  
D. *p*

52. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethane, CH3CH3?

A. C*sp2* + H1*s*  
B. C*sp3* + H1*s*  
C. C2*p* + H1*s*  
D. C*sp* + H1*s*

53. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethylene, H2C=CH2?

A. C2*p* + H1*s*  
B. C*sp* + H1*s*  
C. C*sp3* + H1*s*  
D. C*sp2* + H1*s*

54. Which atomic orbitals overlap to form the carbon-carbon s and p bonding molecular orbitals of ethylene, H2C=CH2?

A. C*sp3* + C*sp3*, and C2*p* + C2*p*  
B. C*sp3* + C*sp3*, and C*sp2* + C*sp2*  
C. C*.* C*sp2* + C*sp2*, and C2*p* + C2*p*  
D. D*.* C*sp2* + C*sp2*, and C*sp2* + C*sp2*

55. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of acetylene, C2H2?

A. C*sp* + H1*s*  
B. C2*p* +H1*s*  
C. C*sp3* + H1*s*  
D. C*sp2* + H1*s*

56. Which atomic orbitals overlap to form the carbon-carbon s bonding molecular orbital of acetylene, C2H2?

A. C*sp2* + C*sp2*  
B. C*sp* + C*sp*  
C. C*sp3* + C*sp3*  
D. C2*p* + C2*p*

57. When forming molecular orbitals from atomic orbitals, what is the order of increasing C-H bond strength for the following set?

A. II < I < III  
B. III < I < II  
C. III < II < I  
D. I < II < III

58. What is the order of decreasing bond length for a C-C bond composed of the following molecular orbitals?

A. I > III > II  
B. I > II > III  
C. III > II > I  
D. II > III > I

59. Which of the following statements about electronegativity and the periodic table is true?

A. Electronegativity decreases across a row of the periodic table.  
B. Electronegativity increases down a column of the periodic table.  
C. Electronegativity increases across a row of the periodic table.  
D. Electronegativity does not change down a column of the periodic table.

60.  Rank the following atoms in order of increasing electronegativity, putting the least electronegative first.

A. I < II < III < IV  
B. I < IV < II < III  
C. III < II < IV < I  
D. I < II < IV < III

61.  Rank the following atoms in order of decreasing electronegativity, putting the most electronegative first.

A. I > IV > II > III  
B. II > III > IV > I  
C. III > IV > II > I  
D. III > II > IV > I

62. Which molecule has the greatest difference in electronegativity (DE) between the two different elements?

A. CO2  
B. H2S  
C. NH3  
D. H2O

63.  Which compound contains the most polar bond?

A. I  
B. II  
C. III  
D. IV

64.  Which of the following compounds are non-polar?

A. I, IV  
B. I, II  
C. II, III  
D. II, IV

65. Which of the following molecules has non-polar covalent bonds?

A. CO2  
B. N2  
C. CCl4  
D. HF

66. Which of the following molecules has polar covalent bonds?

A. MgO  
B. NH3  
C. Cl2  
D. NaBr

67. Which of the following covalent bonds has the largest dipole moment?

A. C-H  
B. C-C  
C. C-O  
D. H-F

68. Which of the following molecules has the smallest dipole moment?

A. CO2  
B. HCl  
C. H2O  
D. NH3

69. Which of the following molecules does *not* have a net dipole moment of zero?

A. CCl4  
B. BF3  
C. CO2  
D. NH3

70.  Which of the following molecules has a net dipole moment of zero?

A. I  
B. II  
C. III  
D. IV

71.  Consider compounds which contain both a heteroatom and a double bond. For which compound is no additional Lewis structure possible?

A. I  
B. II  
C. III  
D. IV

Chapter 01 Test Bank: Structure and Bonding Key

1. What is the ground-state electronic configuration of a carbon atom?

A. 1s2, 2s2, 2p5  
**B.** 1s2, 2s2, 2p2  
C. 1s2, 2s2, 2p6  
D. 1s2, 2s2, 2p4

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.01  
Subtopic: Periodic Table Trends  
Topic: Structure and Bonding*

1. What is the ground-state electronic configuration of a fluorine atom?

A. 1s2, 2s2, 2p2  
B. 1s2, 2s2, 2p3  
C. 1s2, 2s2, 2p4  
**D.** 1s2, 2s2, 2p5

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.01  
Subtopic: Periodic Table Trends  
Topic: Structure and Bonding*

1. What is the ground-state electronic configuration of a magnesium cation (Mg2+)?

**A.** 1s2, 2s2, 2p6  
B. 1s2, 2s2, 2p6, 3s1  
C. C. 1s2, 2s2, 2p6, 3s2  
D. D. 1s2, 2s2, 2p6, 3s2, 3p2

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.01  
Subtopic: Periodic Table Trends  
Topic: Structure and Bonding*

1. What is the ground-state electronic configuration of a chlorine anion (Cl—)?

A. 1s2, 2s2, 2p6  
**B.** 1s2, 2s2, 2p6, 3s2, 3p6  
C. C. 1s2, 2s2, 2p6, 3s2, 3p5  
D. D. 1s2, 2s2, 2p6, 3s2, 3p4

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.01  
Subtopic: Periodic Table Trends  
Topic: Structure and Bonding*

1. Which of the following statements about valence electrons is true?

A. They are the most tightly held electrons.  
B. They do not participate in chemical reactions.  
**C.** They are the outermost electrons.  
D. They reveal the period number of a second-row element.

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.01  
Subtopic: Periodic Table Trends  
Topic: Structure and Bonding*

1. Which of the following statements about bonding is true?

A. Covalent bonds result from the transfer of electrons from one element to another.  
**B.** Ionic bonds result from the transfer of electrons from a metal to a non-metal.  
C. Ionic bonds result from the sharing of electrons between two non-metals.  
D. Covalent bonds result from the sharing of electrons between two metals.

*Accessibility: Keyboard Navigation  
Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.02  
Subtopic: Bond Properties  
Subtopic: Types of Bonds  
Topic: Structure and Bonding*

1. Which of the following would you expect to have ionic bonds?

A. CO  
B. FBr  
C. NF3  
**D.** NaCl

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.02  
Subtopic: Bond Properties  
Subtopic: Types of Bonds  
Topic: Structure and Bonding*

1. Which of the following molecules has nonpolar covalent bonds?

A. HCl  
**B.** N2  
C. CHCl3  
D. NO

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.12  
Subtopic: Bond Properties  
Subtopic: Types of Bonds  
Topic: Structure and Bonding*

1. Which of the following molecules contain both covalent and ionic bonds?

A. I, II  
B. I, IV  
C. II, III  
**D.** II, IV

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.02  
Subtopic: Bond Properties  
Subtopic: Types of Bonds  
Topic: Structure and Bonding*

1. Arrange the following bonds in decreasing order of ionic character, putting the most ionic first.

A. I > II > III > IV  
B. IV > II > I > III  
**C.** IV > III > II > I  
D. IV > II > III > I

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.12  
Subtopic: Bond Properties  
Subtopic: Types of Bonds  
Topic: Structure and Bonding*

1. Which of the following statements correctly describes the typical number of bonds for carbon, nitrogen, and oxygen in most neutral organic molecules?

A. Carbon forms 4 covalent bonds, nitrogen forms 2 covalent bonds, and oxygen forms 3 covalent bonds.  
**B.** Carbon forms 4 covalent bonds, nitrogen forms 3 covalent bonds, and oxygen forms 2 covalent bonds.  
C. Carbon forms 4 covalent bonds, nitrogen forms 5 covalent bonds, and oxygen forms 2 covalent bonds.  
D. Carbon forms 4 covalent bonds, nitrogen forms 5 covalent bonds, and oxygen forms 4 covalent bonds.

*Accessibility: Keyboard Navigation  
Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.02  
Subtopic: Bond Properties  
Topic: Structure and Bonding*

12.  Which is not an acceptable Lewis structure for the anion CH2NCO—?

A. I  
B. II  
**C.** III  
D. IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.03  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

13.  Which of the following Lewis structures is correct?

A. I  
B. II  
C. III  
**D.** IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.03  
Subtopic: Drawing Lewis Structures  
Topic: Structure and Bonding*

14.  Which of the following Lewis structures is correct?

A. I, II  
B. I, III  
**C.** II, III  
D. III, IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.03  
Subtopic: Drawing Lewis Structures  
Topic: Structure and Bonding*

15.  Which is the correct Lewis structure for acetic acid (CH3CO2H)?

A. I  
B. II  
C. III  
**D.** IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.03  
Subtopic: Drawing Lewis Structures  
Topic: Structure and Bonding*

16.  In which of the following ions does carbon have a formal charge?

A. I  
B. II  
C. III  
**D.** None of these

*Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.03  
Subtopic: Formal Charges  
Topic: Structure and Bonding*

17.  In which of the following ions does carbon have a formal charge?

A. I  
**B.** II  
C. III  
D. None of these

*Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.03  
Subtopic: Formal Charges  
Topic: Structure and Bonding*

18. What is the formal charge of carbon in carbon monoxide (CO) when drawn with a triple bond?

A. 0  
B. -2  
**C.** -1  
D. +1

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.03  
Subtopic: Drawing Lewis Structures  
Subtopic: Formal Charges  
Topic: Structure and Bonding*

19. Which of the following statements about constitutional isomers is true?

A. Constitutional isomers are different molecules having the different molecular formula.  
**B.** Constitutional isomers are different molecules having the same molecular formula.  
C. Constitutional isomers are same molecules having the different molecular formula.  
D. Constitutional isomers are same molecules having the same molecular formula.

*Accessibility: Keyboard Navigation  
Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

20. How many constitutional isomers are there for a molecule having the molecular formula C2H6O?

A. 1  
**B.** 2  
C. 3  
D. 4

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

21. How many constitutional isomers are there for a molecule having the molecular formula C3H8O?

A. 1  
B. 2  
**C.** 3  
D. 4

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

22. How many constitutional isomers are there for a molecule having the molecular formula C3H6?

A. 1  
**B.** 2  
C. 3  
D. 4

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

23. How many constitutional isomers are there for a molecule having the molecular formula C2H4Cl2?

A. 1  
**B.** 2  
C. 3  
D. 4

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Easy  
Difficulty: Medium  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

24. How many different isomers are there for a compound having the molecular formula C3H6O?

A. 4  
B. 5  
C. 6  
**D.** 7

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

25.  Which of the following molecules are constitutional isomers?

A. I, II, IV  
B. II, III, IV  
C. I, III, IV  
**D.** I, II, III

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.04  
Subtopic: Constitutional Isomers  
Topic: Structure and Bonding*

26. Which of the following compounds has an atom with an unfilled valence shell of electrons?

A. H2O  
**B.** BCl3  
C. CH4  
D. CO2

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.05  
Subtopic: Octet Rule  
Subtopic: Octet Rule Exception  
Topic: Structure and Bonding*

27. Which of the following statements about resonance structures is true?

A. Resonance structures have the same placement of electrons but different arrangement of atoms.  
**B.** Resonance structures have the same placement of atoms but different arrangement of electrons.  
C. Resonance structures have the same placement of atoms and the same arrangement of electrons.  
D. Resonance structures have different placement of atoms and different arrangement of electrons.

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.06  
Subtopic: Constitutional Isomers  
Subtopic: Resonance  
Topic: Structure and Bonding*

28. Which of the following statements about resonance structures is *not* true?

A. There is no movement of electrons from one form to another.  
B. Resonance structures are not isomers.  
C. Resonance structures differ only in the arrangement of electrons.  
**D.** Resonance structures are in equilibrium with each other.

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.06  
Subtopic: Constitutional Isomers  
Subtopic: Resonance  
Topic: Structure and Bonding*

29.  Which of the following pair does not represent resonance structures?

A. I  
B. II  
**C.** III  
D. IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

30. What 2 things will change between two resonance structures?

**A.** The position of multiple bonds and non-bonded electrons.  
B. The position of multiple bonds and single bonds.  
C. The placement of atoms and single bonds.  
D. The placement of atoms and non-bonded electrons.

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.06  
Subtopic: Resonance  
Topic: Structure and Bonding*

31.  Which of the following is a resonance structure of the compound below?

A. I  
B. II  
C. III  
**D.** IV

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

32.  Which of the following resonance structures is the least important contributor to the resonance hybrid of the formate anion, HCOO—?

A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Hard  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

33.  Rank the following in order of decreasing importance as contributing structures to the resonance hybrid of formaldehyde, H2CO.

**A.** I > II > III  
B. I > III > II  
C. II > I > III  
D. III > II > I

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Hard  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

34.  Follow the curved arrows to draw the second resonance structure for the ion below.

A. I  
B. II  
**C.** III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

35. Which is more important in each pair of contributing resonance structures?

A. II, IV, V  
**B.** II, III, V  
C. II, III, VI  
D. I, IV, V

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

36. What is the approximate value of the H-C-H bond angle in methane, CH4?

A. 90°  
**B.** 109.5°  
C. 120°  
D. 180°

*Accessibility: Keyboard Navigation  
Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.07  
Subtopic: Hybridization  
Subtopic: VSEPR Theory  
Topic: Molecular Shape*

37. What is the approximate C-C-C bond angle in propene, CH3CH = CH2?

A. 90°  
B. 109.5°  
**C.** 120°  
D. 180°

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.07  
Subtopic: Hybridization  
Subtopic: VSEPR Theory  
Topic: Molecular Shape*

38. What is the approximate H-C-O bond angle in formaldehyde, H2CO?

A. 90°  
B. 109.5°  
**C.** 120°  
D. 180°

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.07  
Subtopic: Hybridization  
Subtopic: VSEPR Theory  
Topic: Molecular Shape*

39.  Determine the geometry around the indicated atom in each species.

**A.** I = Linear; II = tetrahedral; III = trigonal planar; IV = tetrahedral  
B. I = Linear; II = tetrahedral; III = trigonal planar; IV = linear  
C. I = Trigonal planar; II = linear; III = tetrahedral; IV = trigonal planar  
D. I = Tetrahedral; II = trigonal planar; III = linear; IV = tetrahedral

*Bloom's Level: 1. Remember  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.07  
Subtopic: Hybridization  
Subtopic: VSEPR Theory  
Topic: Molecular Shape*

40. What is the approximate bond angle for the C-C-N bond in acetonitrile, CH3CN?

A. 90°  
B. 109.5°  
C. 120°  
**D.** 180°

*Accessibility: Keyboard Navigation  
Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.07  
Subtopic: Drawing Lewis Structures  
Subtopic: Hybridization  
Subtopic: VSEPR Theory  
Topic: Molecular Shape*

41.  Which of the following is the appropriate conversion of the condensed structure, CH3COCH3, to a Lewis structure?

A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Drawing Lewis Structure  
Topic: Drawing Organic Molecules*

42.  Which of the following is the appropriate conversion of (CH3)2CHCH2CHClCH3 to a skeletal structure?

A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

43.  Which of the following is the appropriate conversion of (CH3)4C to a skeletal structure?

A. I  
B. II  
C. III  
**D.** IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

44.  What is the condensed formula of the compound below?

**A.** I  
B. II  
C. III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

45.  Which of the following is the appropriate conversion of (CH3)2CHOCH2CH2CH2OH to a skeletal structure?

A. I  
B. II  
C. III  
**D.** IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Easy  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Drawing Lewis Structure  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

46.  Convert the following skeletal structure to a condensed structure.

**A.** I  
B. II  
C. III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

47.  Avobenzone is an active ingredient in some common sunscreens. Which of the following is the correct molecular formula for avobenzone?

A. C22O22O3  
**B.** C20H22O3  
C. C21H23O3  
D. C20H24O3

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.08  
Subtopic: Condensed Formula  
Subtopic: Skeletal/Bond-Line Structures  
Topic: Drawing Organic Molecules*

48.  In which structure is the hybridization incorrect?

A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.09  
Subtopic: Hybridization  
Subtopic: Valence Bond Theory  
Topic: Molecular Shape*

49.  What is the hybridization for each of the indicated atoms in the following compound?

A. I = *sp2*; II = *sp2*; III = *sp2*.  
B. I = *sp2*; II = *sp3*; III = *sp3*.  
C. I = *sp*; II = *sp2*; III = *sp3*.  
**D.** I = *sp2*; II = *sp2*; III = *sp3*.

*Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.09  
Subtopic: Hybridization  
Subtopic: Valence Bond Theory  
Topic: Molecular Shape*

50. What is the hybridization of the carbon atom in the methyl cation, (CH3+)?

A. *sp3*  
**B.** *sp2*  
C. *sp*  
D. *p*

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.09  
Subtopic: Hybridization  
Subtopic: Valence Bond Theory  
Topic: Molecular Shape*

51. What is the hybridization of the nitrogen atom in the ammonium cation, NH4+?

**A.** *sp3*  
B. *sp2*  
C. *sp*  
D. *p*

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.09  
Subtopic: Hybridization  
Subtopic: Valence Bond Theory  
Topic: Molecular Shape*

52. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethane, CH3CH3?

A. C*sp2* + H1*s*  
**B.** C*sp3* + H1*s*  
C. C2*p* + H1*s*  
D. C*sp* + H1*s*

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.10  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Valence Bond Theory  
Topic: Molecular Shape*

53. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethylene, H2C=CH2?

A. C2*p* + H1*s*  
B. C*sp* + H1*s*  
C. C*sp3* + H1*s*  
**D.** C*sp2* + H1*s*

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.10  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

54. Which atomic orbitals overlap to form the carbon-carbon s and p bonding molecular orbitals of ethylene, H2C=CH2?

A. C*sp3* + C*sp3*, and C2*p* + C2*p*  
B. C*sp3* + C*sp3*, and C*sp2* + C*sp2*  
**C.** C*.* C*sp2* + C*sp2*, and C2*p* + C2*p*  
D. D*.* C*sp2* + C*sp2*, and C*sp2* + C*sp2*

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.10  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

55. Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of acetylene, C2H2?

**A.** C*sp* + H1*s*  
B. C2*p* +H1*s*  
C. C*sp3* + H1*s*  
D. C*sp2* + H1*s*

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.10  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

56. Which atomic orbitals overlap to form the carbon-carbon s bonding molecular orbital of acetylene, C2H2?

A. C*sp2* + C*sp2*  
**B.** C*sp* + C*sp*  
C. C*sp3* + C*sp3*  
D. C2*p* + C2*p*

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.10  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

57. When forming molecular orbitals from atomic orbitals, what is the order of increasing C-H bond strength for the following set?

A. II < I < III  
B. III < I < II  
C. III < II < I  
**D.** I < II < III

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.11  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

58. What is the order of decreasing bond length for a C-C bond composed of the following molecular orbitals?

A. I > III > II  
**B.** I > II > III  
C. III > II > I  
D. II > III > I

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.11  
Subtopic: Atomic Orbitals  
Subtopic: Hybridization  
Subtopic: Molecular Orbital Theory  
Topic: Molecular Shape*

59. Which of the following statements about electronegativity and the periodic table is true?

A. Electronegativity decreases across a row of the periodic table.  
B. Electronegativity increases down a column of the periodic table.  
**C.** Electronegativity increases across a row of the periodic table.  
D. Electronegativity does not change down a column of the periodic table.

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

60.  Rank the following atoms in order of increasing electronegativity, putting the least electronegative first.

A. I < II < III < IV  
**B.** I < IV < II < III  
C. III < II < IV < I  
D. I < II < IV < III

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

61.  Rank the following atoms in order of decreasing electronegativity, putting the most electronegative first.

Picture

A. I > IV > II > III  
B. II > III > IV > I  
C. III > IV > II > I  
**D.** III > II > IV > I

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

62. Which molecule has the greatest difference in electronegativity (DE) between the two different elements?

A. CO2  
B. H2S  
C. NH3  
**D.** H2O

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

63.  Which compound contains the most polar bond?

A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

64.  Which of the following compounds are non-polar?

Picture

**A.** I, IV  
B. I, II  
C. II, III  
D. II, IV

*Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.13  
Subtopic: Dipole Moments  
Subtopic: Polarity of Molecules  
Topic: Molecular Shape*

65. Which of the following molecules has non-polar covalent bonds?

A. CO2  
**B.** N2  
C. CCl4  
D. HF

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

66. Which of the following molecules has polar covalent bonds?

A. MgO  
**B.** NH3  
C. Cl2  
D. NaBr

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

67. Which of the following covalent bonds has the largest dipole moment?

A. C-H  
B. C-C  
C. C-O  
**D.** H-F

*Accessibility: Keyboard Navigation  
Bloom's Level: 3. Apply  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

68. Which of the following molecules has the smallest dipole moment?

**A.** CO2  
B. HCl  
C. H2O  
D. NH3

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.12  
Subtopic: Dipole Moments  
Topic: Molecular Shape*

69. Which of the following molecules does *not* have a net dipole moment of zero?

A. CCl4  
B. BF3  
C. CO2  
**D.** NH3

*Accessibility: Keyboard Navigation  
Bloom's Level: 2. Understand  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.13  
Subtopic: Dipole Moments  
Subtopic: Polarity of Molecules  
Topic: Molecular Shape*

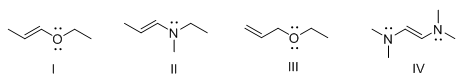
70.  Which of the following molecules has a net dipole moment of zero?



 A. I  
**B.** II  
C. III  
D. IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Medium  
Gradable: automatic  
Section: 01.13  
Subtopic: Dipole Moments  
Subtopic: Polarity of Molecules  
Topic: Molecular Shape*

71.  Consider compounds which contain both a heteroatom and a double bond. For which compound is no additional Lewis structure possible?



A. I  
B. II  
**C.** III  
D. IV

*Bloom's Level: 4. Analyze  
Chapter: 01  
Difficulty: Hard  
Gradable: automatic  
Section: 01.06  
Subtopic: Drawing Lewis Structures  
Subtopic: Resonance  
Topic: Structure and Bonding*

Chapter 01 Test Bank: Structure and Bonding Summary

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