Test Bank for Organic Chemistry 7th Edition by Loudon

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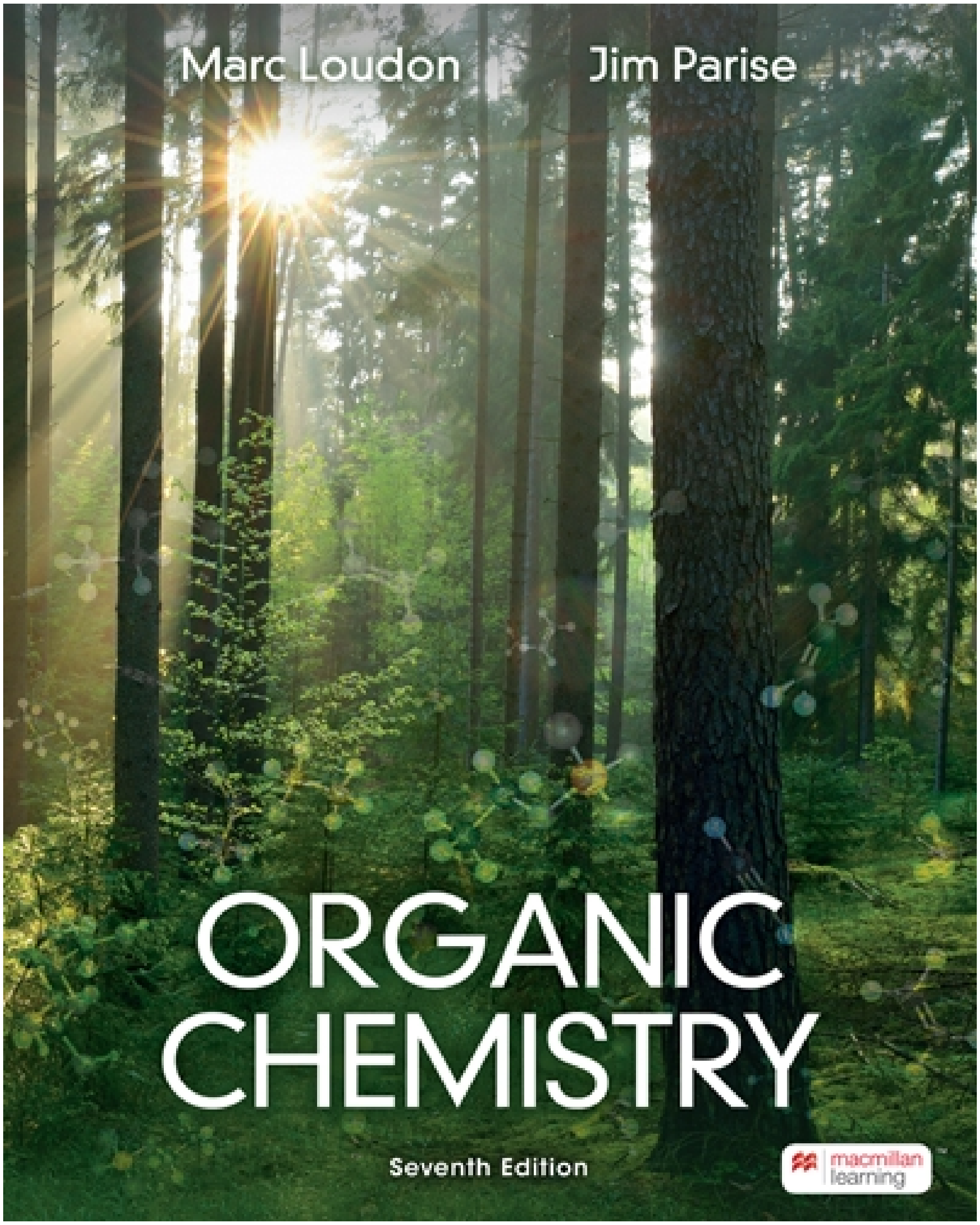
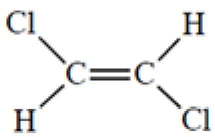


Test Bank

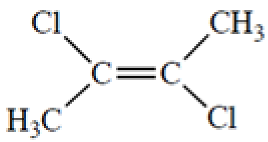
Name:______________________________________ Class:_______________________ Date:____________

Chapter 1

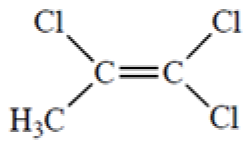
1. Which compound has the largest dipole moment?



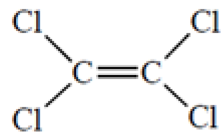
A



B



C



D

a. Compound A
b. Compound B
c. Compound C
d. Compound D

ANSWER: c

2. Which atomic orbital has two nodes?

a. 2p
b. 3p
c. 4s
d. 1s
e. none of these

ANSWER: b

3. Which statement is true about molecular orbitals of any given molecule?

a. A bonding molecular orbital has higher energy and fewer nodes than an antibonding molecular orbital.
b. A bonding molecular orbital can have the same energy as an antibonding orbital.
c. Any antibonding orbital is never populated with electrons.
d. Any bonding molecular orbital always contains two electrons.
e. None of these is true.

ANSWER: e

4. Which **one** of the following statements about the hydrogen molecule cation, H_2^+, is true?

a. This cation is unstable because it does not have two electrons in a bonding molecular orbital.
b. The H—H bond in this cation is stronger than the H—H bond in the dihydrogen molecule H_2.
c. This cation has one electron in the bonding molecular orbital and one electron in an antibonding molecular orbital.
d. This cation is stable relative to a hydrogen atom and a proton (H^+).

ANSWER: d

5. How many valence electrons does aluminum (Al, atomic number = 13) have?

ANSWER: 3

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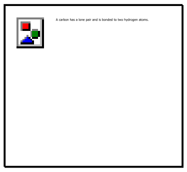
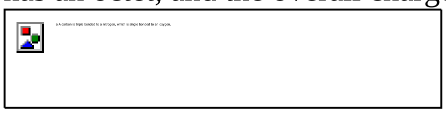
Chapter 1

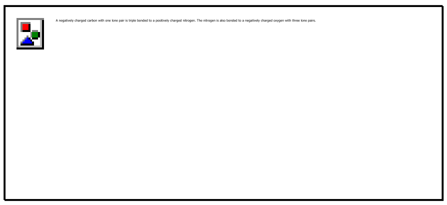
6. What is the formal charge on carbon in this structure? All unshared electrons are shown.



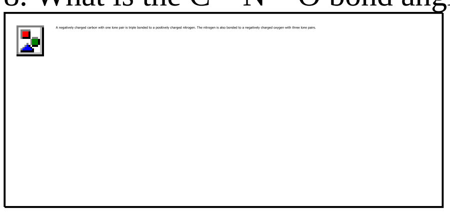
ANSWER: 0

7. Complete the structure for the cyanate ion by adding unshared electron pairs and formal charges. Every atom has an octet, and the overall charge on the ion is −1.



ANSWER: 

8. What is the C—N—O bond angle in the cyanate ion?



ANSWER: 180°

9. The occupied valence orbitals of the chlorine atom are

a. 2s and 2p.

b. 3s.

c. 3s and 3p.

d. 3s and 3p and 3d.

e. 4s and 4p.

ANSWER: c

10. Identify the true statement(s) about molecular orbitals (MOs).

a. Antibonding MOs always have more nodes than bonding orbitals.

b. Antibonding MOs always have higher energy than bonding MOs.

c. All bonding MOs have zero nodes.

ANSWER: a, b

11. Consider this compound:

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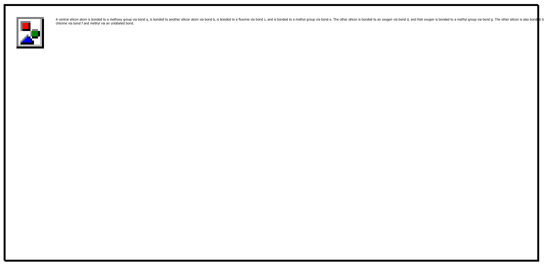
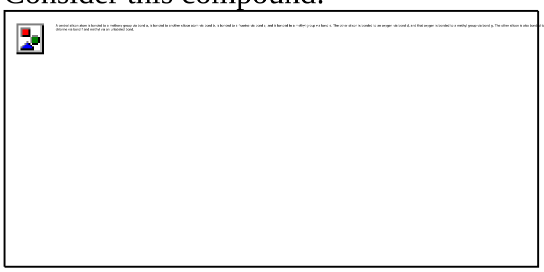
Chapter 1



1. Of the labeled bonds, the longest bond is ________________.
2. The most polar bond is ________________.
3. The bonding geometry at the silicon atoms is ________________.
4. The hybridization of the silicon atoms is ________________.

ANSWER: Consider this compound:



1. Of the labeled bonds, the longest bond is Group 1.
2. The most polar bond is Group 2.
3. The bonding geometry at the silicon atoms is Group 3.
4. The hybridization of the silicon atoms is Group 4.

Answer Groups	**Answers**
Group 1	b
Group 2	c
Group 3	tetrahedral
Group 4	sp3

12. The atomic orbital that **cannot** exist is
   a. 1s.
   b. 1p.
   c. 2s.
   d. 2p.
   e. 3d
   f. All can exist.

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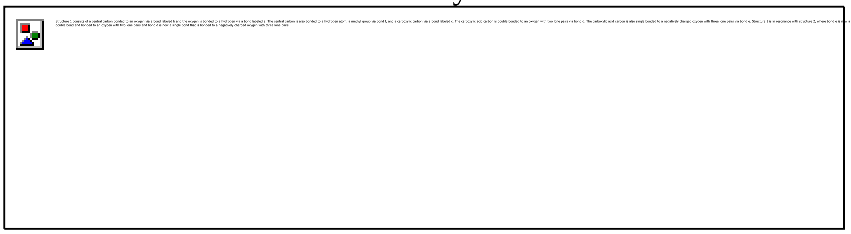
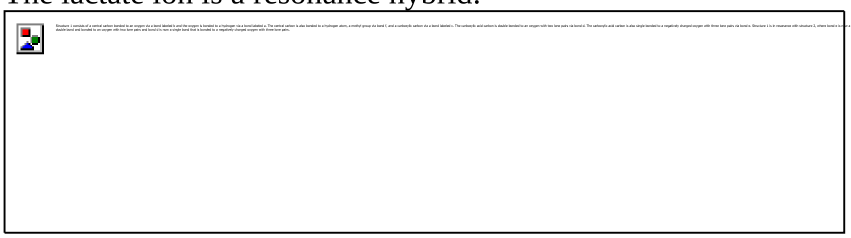
ANSWER: b

13. The lactate ion is a resonance hybrid:



1. Considering only the labeled bonds, the longest carbon–oxygen bond in the lactate ion is ________________.
2. Considering only the labeled bonds, the two bonds that have the same length are ________________ and ________________.

ANSWER: The lactate ion is a resonance hybrid:



1. Considering only the labeled bonds, the longest carbon–oxygen bond in the lactate ion is Group 1.
2. Considering only the labeled bonds, the two bonds that have the same length are Group 2 and Group 3.

Answer Groups	**Answers**
Group 1	b
Group 2	d
Group 3	e

14. According to molecular orbital theory, which **one** of these species does **not** exist?

a. He_2^+
b. H_2^+
c. H_2^-
d. H_2^{2-}
e. CH_4

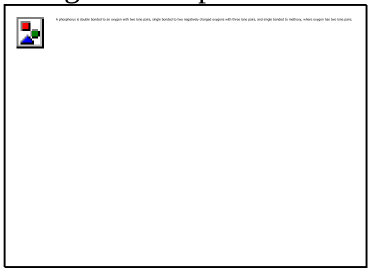
ANSWER: d

15. Select the **two** statements that are true.

a. All polar molecules have a significant dipole moment.
b. All molecules containing polar bonds are polar molecules.
c. The polarity of a bond is accurately indicated in every case by the formal charges of the atoms involved in the bond.
d. All polar molecules contain one or more polar bonds.

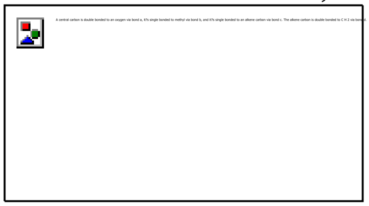
ANSWER: a, d

16. Give the formal charge on the phosphorus atom in this structure. (Phosphorus is in group 5A directly under nitrogen in the periodic table.)



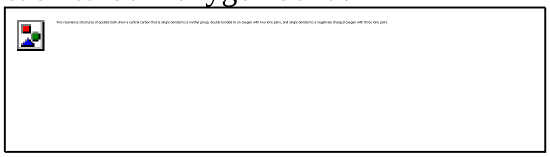
ANSWER: 0

17. Of the bonds marked, which bond is the shortest?



ANSWER: a

18. Given that the acetate anion has the these equally important resonance structures, what is the bond order of each carbon–oxygen bond?



a. The bond order of all carbon–oxygen bonds is ⅓.
b. The bond order of all carbon–oxygen bonds is ½.
c. The bond order of all carbon–oxygen bonds is 1.0.
d. The bond order of all carbon–oxygen bonds is 1.5.
e. The bond order of one carbon–oxygen bond is 1.0, and the bond order of the other carbon–oxygen is ½.
f. The bond order of all carbon–oxygen bonds is 2.0.

ANSWER: d

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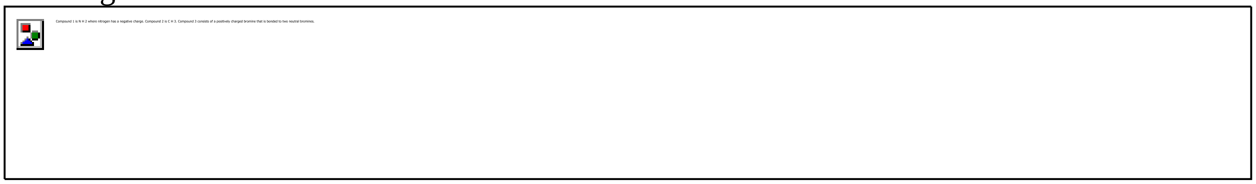
Chapter 1

19. Add valence electrons to the structures so that the formal charge is properly accounted for. Assume that all atoms have no more electrons than allowed by the octet rule. Make your "electron dots" bold enough to be unambiguous.

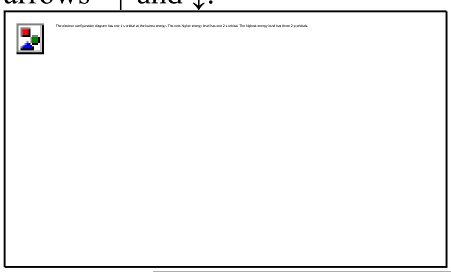


ANSWER:

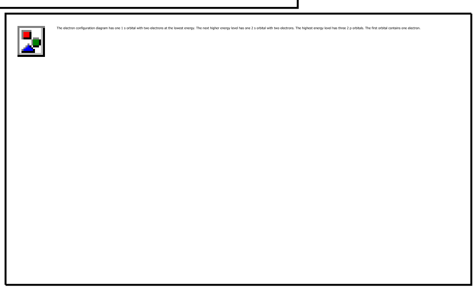
20. What is the geometry of the borohydride ion, $^{-}BH_4$?

ANSWER: tetrahedral

21. Complete the electron configuration diagram below for the element boron (B, atomic number = 5), showing 1s, 2s, 2px, 2py, and 2pz orbitals, their relative energies, and their electron populations indicated by "spin arrows" ↑ and ↓.



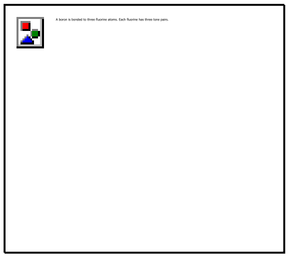
ANSWER:



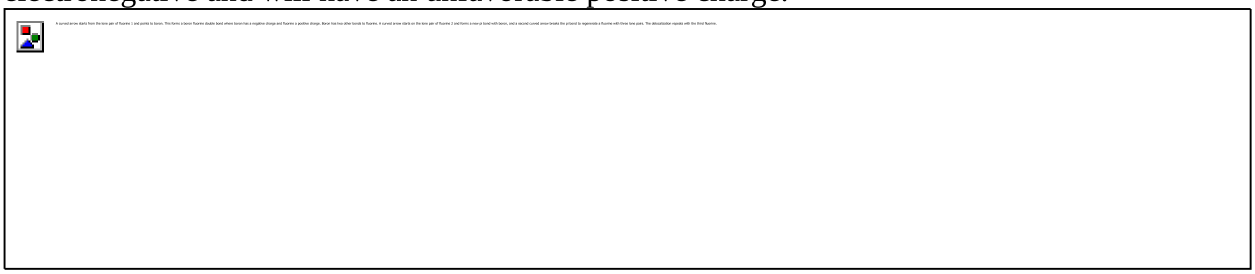
22. Assume that the structure of BF_3 (boron trifluoride, or trifluoroborane) is correctly predicted by the VSEPR rules.

1. What is the predicted structure? (Show all unpaired valence electrons.)
2. The B—F bond is exceptionally strong. This suggests that it has some double-bond character. Draw resonance structures for BF_3 that show that the three B—F bonds share some double-bond character. Be sure to show formal charges and all unshared electrons.
3. What is the polarity of the B—F bond? (In which direction is the bond dipole?) How do you know?

ANSWER: 1. Boron trifluoride consists of a central boron, which has three single bonds to fluorine. Boron has three valence electrons, while fluorine has seven valence electrons. The Lewis structure is

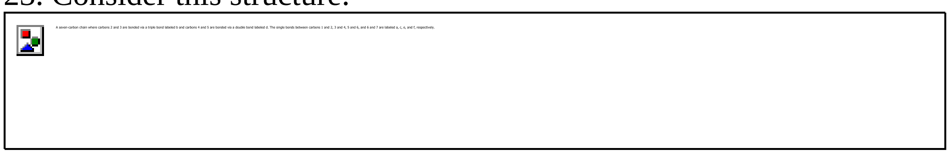


2. Boron has an unoccupied p orbital and can hypothetically form a double bond with each neighboring fluorine. Note, these resonance structures are not stable, as fluorine is very electronegative and will have an unfavorable positive charge.



3. Polarity arrows start from the partial positive atom of a bond and point to the partial negative atom of a bond. Boron has an electronegativity of 2.0, while fluorine has an electronegativity of 4.0. Thus, the B–F bond is a polar covalent bond, and the polarity arrow will point from the boron to the fluorine.

23. Consider this structure:



Which bond represents an sp–sp^2 carbon–carbon bond?

ANSWER: c

24. Consider this structure:

The bond angle between bonds c and d is approximately

a. 109.5°.

b. 120°.

c. 60°.

d. 180°

ANSWER: b

25. In the resonance structures for methyl azide, all unshared electron pairs are indicated. Complete the structures by adding the missing formal charges.

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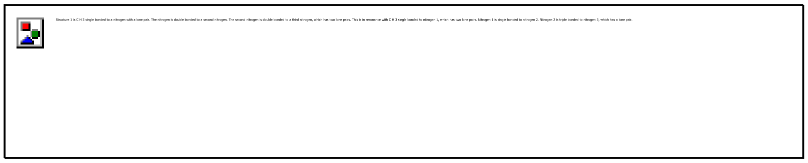
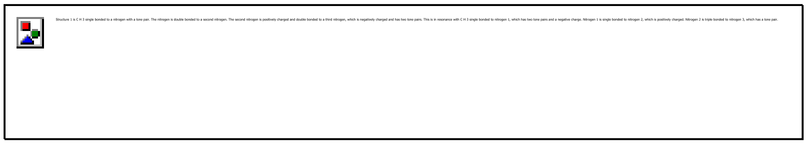
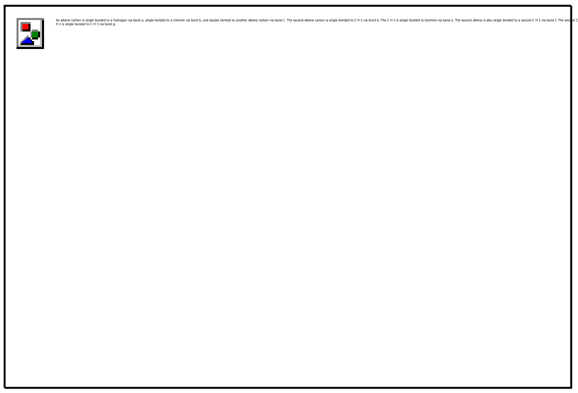
Chapter 1



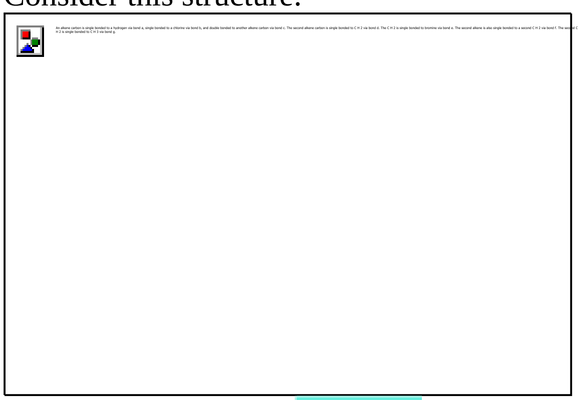
ANSWER: 

26. Consider this structure:



1. The longest bond is ________________.
2. The shortest of the carbon–carbon bonds is ________________.

ANSWER: Consider this structure:



1. The longest bond is Group 1.
2. The shortest of the carbon–carbon bonds is Group 2.

Answer Groups	Answers
Group 1	e
Group 2	c

