

Chapter 8 & 9 Questions

Sections 8.1, 8.7, 8.10, 8.12

- 1a) What are valence electrons?
- b) An atom has the electron configuration $1s^2 2s^2 2p^5$. How many valence electrons does it have?
- c) What is the octet rule?
- d) How many electrons must the atom in (b) gain in order to receive an octet?

- 2a) What is meant by the term covalent bonding?
- b) How is the bonding in Cl_2 different from that in NaCl ?

3) Use Lewis symbols and Lewis structures to diagram the formation of

- a) PF_3
- b) SiCl_4
- c) O_2

4) Draw Lewis structures for the following:

- a) SiH_4
- b) CO
- c) SF_2
- d) H_2SO_4 (H is bonded to O)
- e) ClO_2^-

Section 8.2, 8.8

7) Using only the periodic table, arrange the members of each set in order of increasing electronegativity:

- a) O, P, S
- b) Mg, Al, Si
- c) Be, C, Mg
- d) Br, In, Te

8) Which of the following bonds are polar? Also, identify the more electronegative atom.

- a) P—O
- b) S—F
- c) Br—Br
- d) O—Cl
- e) N—N
- f) C—Cl

- f) NH_2OH (N and O are bonded to one another)
- g) PCl_3
- h) O_2^{2-}
- i) NO_2^+
- j) PO_3^{3-}
- k) CH_2O
- l) C_2H_2 (the C atoms are bonded together)

5) Write Lewis structures that obey the octet rule for each of the following, and assign formal charges to each atom:

- a) NO^+
- b) POCl_3 (P is the central atom)
- c) ClO_4^-
- d) HClO_3 (H is bonded to O)

6) For each of the following molecules of sulfur and oxygen, write a single Lewis structure that obeys the octet rule and calculate the formal charges on all atoms of the molecule:

- a) SO_2
- b) SO_3
- c) SO_3^{2-}
- d) SO_4^{2-}

9) Arrange the bonds in each of the following sets in order of increasing polarity:

- a) C—F , O—F , Be—F
- b) N—Br , P—Br , O—Br
- c) C—S , B—F , N—O
- d) Cl—F , S—Br , S—Cl

10) The C—S bond lengths in carbon disulfide are shorter than would be expected for C—S single bonds. Use Lewis structure to rationalize this observation.

b) The bond in O_2 is shorter than the O—O single bond in compounds that contain an O—O single bond. Explain this observation.

11a) Predict the order of C—O bond lengths in CO , CO_2 and CO_3^{2-} .

b) Predict the order of N—O bond lengths in NO_2^- , NO_3^- and NO^+ .

Section 8.11

12) Draw the Lewis structures for each of the following ions or molecules. Identify those that do not obey the octet rule and explain why they do not.

- | | |
|---------------------|---------------------|
| a) BH_3 | f) ICl_2^- |
| b) I_3^- | g) TeF_4 |
| c) GeF_4 | h) BCl_3 |
| d) AsF_6^- | i) XeF_4 |
| e) NO_2 | j) COBr_2 |

13) In the vapor phase, BeCl_2 exists as a discrete molecule.

Sections 8.13(a)

15a) What is meant by the term electron domain?
b) Explain why electron domains behave like the balloons in figure 9.3.
c) How does one determine the number of electron domains in a molecule or ion?
d) What is the difference between a bonding electron domain and a non-bonding electron domain?

16) Describe the characteristic electron domain geometry of each of the following numbers of electron domains about a central atom:

- | | |
|------|------|
| a) 3 | c) 5 |
| b) 4 | d) 6 |

17) Indicate the number of electron domains about a central atom, given the following angles between them:

- | | |
|----------------|------------------|
| a) 120° | c) 109.5° |
| b) 180° | d) 90° |

18a) Can a molecule have a tetrahedral electron domain and a bent geometry? Explain.

b) An AB_3 molecule is described as having a trigonal bipyramidal electron domain geometry. How many non-bonding domains are on atom A?

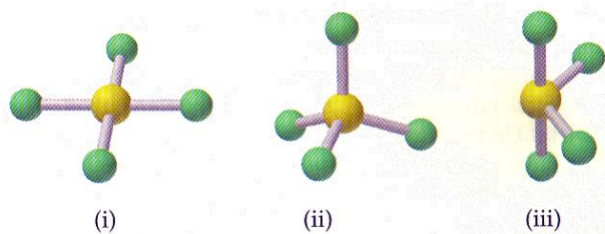
a) Draw a Lewis structure for this molecule, using only single bonds. Does the Lewis structure satisfy the octet rule?
b) What other resonance forms are possible that satisfy the octet rule?
c) Using formal charges, select the resonance form that is most important.

14a) Describe the molecule ClO_2 in terms of three possible resonance structures.

b) Do any of these resonance structures satisfy the octet rule? Why or why not?

c) Using formal charges, select the resonance structure(s) that is/are more important.

19) The following figure shows ball-and-stick drawings of three possible shapes for an AF_4 molecule.



a) For each shape, give the electron domain geometry on which the molecule geometry is based.

b) For each shape, how many nonbonding electron domains are there on atom A?

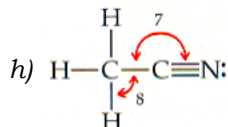
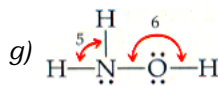
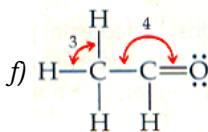
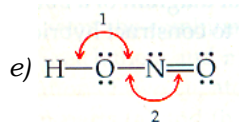
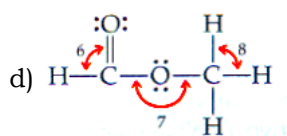
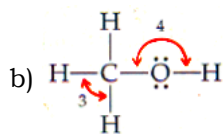
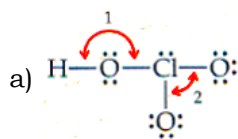
c) Which of the following element or elements will lead to an AF_4 molecule like that in (iii): Be, C, S, Se, Si, Xe?

d) Name an element A that is expected to lead to the AF_4 structure shown in (i).

20) Give the electron domain and molecular geometries of molecules that have the following electron domains on their central atom:

- | | |
|-----------------------|---------------------------|
| a) PBr_3 | g) H_3O^+ |
| b) CH_3^+ | h) KrF_2 |
| c) BH_4^{1-} | i) CO_3^{2-} |
| d) SO_3 | j) SF_6 |
| e) AsCl_5 | k) ClO_3^{1-} |
| f) BrF_5 | l) TeF_4 |

21) Give the approximate values for the indicated bond angles in the following molecules:



Section 8.13(b)

22) Consider the three possible shapes for an AF_3 molecule. Which shapes could be a polar molecule with polar bonds (nonzero dipole moment)? Explain.

23) Under what circumstances will an AB_n molecule have a zero dipole moment (nonpolar molecule)?

Section 9.1

25) What is the designation for the hybrid orbitals formed in each of the following situations?

- tetrahedral molecule
- combining one s and two p orbitals
- trigonal bipyramidal electron domain geometry
- combining one s, three p and 2 d orbitals

24) Will the following molecules be polar or nonpolar?

- | | |
|------------|-------------|
| a) CCl_4 | g) $SiCl_4$ |
| b) CS_2 | h) IF |
| c) SO_3 | i) SO_2 |
| d) SF_4 | j) PCl_3 |
| e) NF_3 | k) SF_6 |
| f) PF_5 | l) IF_5 |

26) Indicate the hybrid orbital set used by the central atom in each of the following molecules or ions:

- | | |
|-----------------|-----------------|
| a) SiH_4 | f) SO_2 |
| b) CH_3^+ | g) AlH_4^{-1} |
| c) ICl_2^{-1} | h) CS_2 |
| d) $MgCl_2$ | i) XeF_2 |
| e) PF_6^{-1} | j) BrF_4^{-1} |

27a) How many S and D bonds generally part of a single bond?

b) How many S and D bonds generally part of a double bond?

c) How many S and D bonds generally part of a triple bond?

d) How do multiple bonds introduce rigidity to the molecule?

Review

1) Write net ionic equations for the following reactions:

- a) sodium reacting with water
- b) mixing of solutions of calcium chloride and silver nitrate
- c) combustion of methane in air

2) Determine the pH of a buffer solution in which 10.0 grams of NH_4Cl is dissolved in 300 mL of 0.150 M NH_3 solution.

3) Of the atoms Na, Cl, Se, and Ba, which would have the greatest

- a) ionic radius
- b) atomic radius
- c) electronegativity
- d) ionization energy

4) A 4.00 L flask is filled with a mixture of hydrogen gas and oxygen gas at standard temperature. The partial pressure of the hydrogen is 1.40 atm and the partial pressure of oxygen is 0.900 atm. How many grams of water will form when a spark is added to the interior of the flask?

5) For each of the following reactions, write a net ionic equation;

- a) solid zinc oxidized by aqueous copper (II) nitrate
- b) gaseous sulfur dioxide reacting with liquid water
- c) dissociation of chloric acid
- d) mixing of aqueous solutions of sodium chromate and zinc sulfate

6) A 2.50 g Tums®, made up of 100% calcium carbonate, is placed in 250 mL of 0.080 M HNO_3 . What volume of carbon dioxide gas is made if the pressure and temperature of the gas is 1.1 atm and 19 °C, respectively?

7) The rusting of iron undergoes the following reaction: $4 \text{Fe (s)} + 3 \text{O}_2 \text{(g)} \rightarrow 2 \text{Fe}_2\text{O}_3 \text{(s)}$. At 298 K, determine the standard

- a) enthalpy
- b) entropy
- c) free energy
- d) and for each, explain why the sign on each is what it is.