

Chapters 7 and 8: Chemical Bonding: Lewis Theory, Molecular shapes and hybridization
Extra Credit Worksheet

Name: Key

1. Write the Lewis symbols of the following

a) P^{3-}

b) Cl

c) Si $\cdot \overset{\cdot}{\underset{\cdot}{\text{Si}}} \cdot$

d) He $\cdot \overset{\cdot}{\text{He}} \cdot$

e) Ba^{2+}

f) O^{2-}

Ba^{2+}
no e^-

2. Predict which of the following compounds are ionic and which are covalent, based on the location of their constituent atoms in the periodic table:

(a) Cl_2CO

(b) MnO ionic

(c) NCl_3

(d) CoBr₂ ionic

(e) CaF_2

(g) HI covalent

3. Identify the more polar bond in each of the following pairs of bonds:

(a) HF or HCl

(b) NO or CO

(c) SH or OH

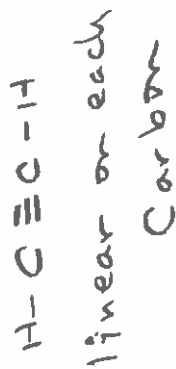
(d) PCl or SCI

(e) CH or NH

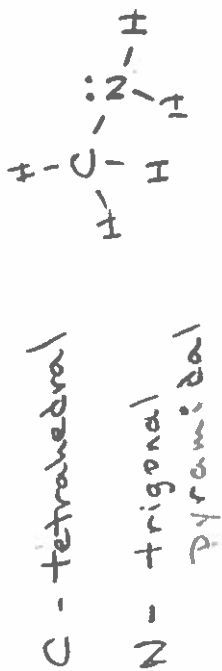
(f) SO or PO

4. What will be the geometry about each central atom in the following molecules? Draw a sketch of the molecule. The skeletal structure for each molecule is listed in parentheses.

a) C_2H_2 (HCCH)



c) CH_3NH_2 (H_3CNH_2)



b) N_2H_4 (H_2NNH_2)

d) CF_3COOH

(both O atoms are attached to the second C, H atom is attached to O)

5. Write resonance forms that describe the distribution of electrons in each of these molecules or ions.

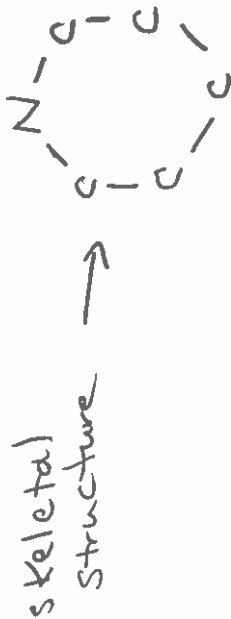
(a) selenium dioxide, $OSeO$

$$6(3) = 18e^-$$



(b) nitric acid, HNO_3 (N is bonded to an OH group and two O atoms)

(c) C_5H_5N (all Carbons and the Nitrogen are in a ring.)

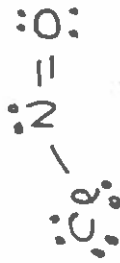


6. Fill in the Table:

Molecule	Lewis Structure	# of Electron groups on central atom	Electron geometry	Molecular geometry	Expected Bond angle (s)	Hybridization	Polar? Yes or No
COCl ₂		3	trigonal planar	trigonal planar	120°	sp ²	Yes
NH ₃							
CH ₂ F ₂		4	Tetrahedral	tetrahedral	109.5°	sp ³	Yes
HCN							
BF ₄ ⁻ 7 + 4(7) + 1 = 36e ⁻		6	octahedral	6e ⁻ pairs 2 lone pairs square planar	90°	sp ³ d ²	ionic
OF ₂							

7. Based on formal charge considerations, which of the following would likely be the correct arrangement of atoms in nitrosyl chloride: ClNO or ClON?

$$7 + 5 + 6 = 18e^-$$



1 possibility

8. Based on formal charge considerations, which of the following would likely be the correct arrangement of atoms in hypochlorous acid: HOCl or OClH?

$$\text{f.c.} \quad -1 \quad +1 \quad \emptyset$$



1 possibility
(not the best)

9. Which bond in each of the following pairs of bonds is the strongest?

(a) C-C or C=C

(b) C-N or C≡N

(c) C-H or O-H

10. Using the tabulated bond energies, determine the approximate enthalpy change for each of the following reactions:

(a) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$

Bonds broken - bonds made		Bond Energy
1 H-H	1 Br-Br	436 kJ/mole
2 H-Br		190 kJ/mole

$$\Delta H = 1(436) + 1(190) - (2(370)) = -114 \text{ kJ}$$

11. Using the tabulated bond energies, determine the approximate enthalpy change for each of the following reactions:



$$\Delta H = -1320 \text{ kJ}$$

(using the values in the text)

12. Which compound in each of the following pairs has the larger lattice energy? Note: Ba^{2+} and K^+ have similar radii; S^{2-} and Cl^- have similar radii. Explain your choices.

(a) K_2O or Na_2O

(b) K_2S or BaS

13. Draw all possible resonance Lewis structures for NO_2^+ . Use Formal Charges to identify the best Lewis structure amongst them.

14. Methionine, $CH_3SCH_2CH_2CH(NH_2)CO_2H$, is an amino acid found in proteins. Draw a Lewis structure of this compound. What is the hybridization type of each carbon, oxygen, the nitrogen, and the sulfur?

