CHM 111 Chapters 7 and 8 Worksheet and Study Guide

Purpose: This is a guide for your as you work through the chapter. The major topics are provided so that you can write notes on each topic and work the corresponding problems.

This should serve a s a study guide as you go on to do the problems in Sapling and take the quizzes and exams.

The Problems are embedded in the Topics and Space for Notes

Section 7.1 Ionic Bonding:

Explain the formation of cations, anions, and ionic compounds
Predict the charge of common metallic and nonmetallic elements, and write their electron configurations
Write Lewis symbols for neutral atoms and ions

Draw the correct number of Lewis Dots

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Na	Mg	Al	Si	P	S	Cl	Ar

(A) Write the electron configuration for each neutral atom and then for each ion.

a. Na _____ Na^+ _____

b. I _____ I^- _____

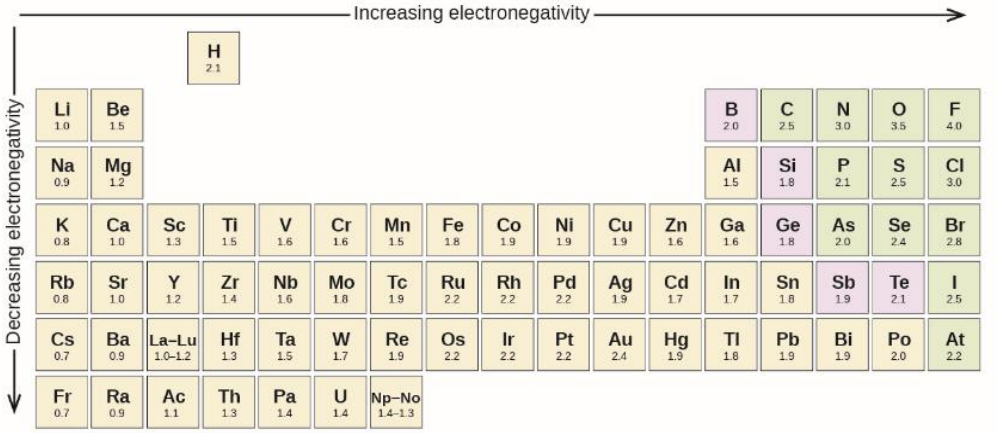
(B) Write the Lewis Dot Structure for the neutral atom and the ion for each:

Atom	Ion	Atom	Ion
Na•	**(no dot) Na^+**	**Al**	
O		**I**	
N		**Ca**	

(C) Use the Lewis Dot Structures to explain the bonding between Na and O.

Section 7.2 Covalent Bonding:

Describe the formation of covalent bonds
Define electronegativity and assess the polarity of covalent bonds



(A) Rank from least polar to most polar.

C-N C-H C-O C-C C-F

(B) Define purely covalent bond, ionic bond and polar covalent bond using Electronegativities.

Section 7.3: Lewis Symbols and Structures:

(A) Write Lewis symbols for neutral atoms and ions

(B) Draw Lewis structures depicting the bonding in simple molecules

Draw Lewis structures depicting the bonding in simple molecules

What are the rules!!??

Draw the Lewis Structures:

Cl_2		CH_2O	
N_2		NH_3	
C_3H_8		NO_3^-	

Section 7.4: Formal Charge and Resonance:

Compute formal charges for atoms in any Lewis structure
Use formal charges to identify the most reasonable Lewis structure for a given molecule
Explain the concept of resonance and draw Lewis structures representing resonance forms for a given molecule

Formal Charge:

Resonance:

(A) Draw 2 Lewis structures for CH_3NCO. Use formal charges to determine the best structure. (attach as C N C O)

(B) Draw 2 resonance structures each for OCN^- and CNO^-. Use formal charges to explain which is the best structure.

7.5 Strength of Ionic and Covalent Bonds:

(A) Describe the energetics of covalent and ionic bond formation and breakage

$$\Delta H_{lattice} = \frac{C(Z+)(Z-)}{R_o}$$

(B) Use average covalent bond energies to estimate enthalpies of reaction

$\Delta H_{rxn} = \sum [\Delta H(\text{bonds broken})] - \sum [\Delta H(\text{bonds formed})]$

$$\Delta H_{lattice} = \frac{C(Z+)(Z-)}{R_o}$$

Bond	Bond Length (Å)	Bond Energy (kJ/mol)
C–C	1.54	345
C=C	1.34	611
C≡C	1.20	837
C–N	1.43	290
C=N	1.38	615
C≡N	1.16	891
C–O	1.43	350
C=O	1.23	741
C≡O	1.13	1080

Compare the bond strength of NaF and MgO.

What is the enthalpy (ΔH) of reaction for: $C_2H_2(g) + 5/2\ O_2(g) \rightarrow 2CO_2(g) + H_2O(g)$. You will need to draw the Lewis Structures and Look up the bond energies!

7.6 Molecular Structure and Polarity:

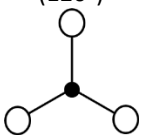
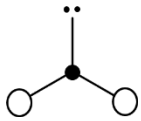
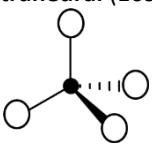
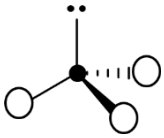
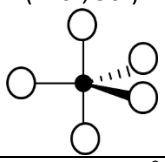
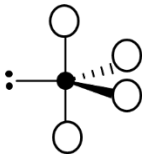
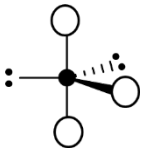
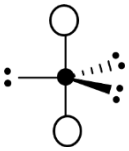
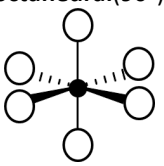
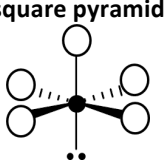
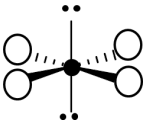
(A) Predict the structures of small molecules using valence shell electron pair repulsion (VSEPR) theory

(B) Explain the concepts of polar covalent bonds and molecular polarity

(C) Assess the polarity of a molecule based on its bonding and structure.

VSEPR

(Define electron pair!!)

Electron Groups	Hybridization	0 Lone Pairs	1 Lone Pair	2 Lone Pairs	3 Lone Pairs	4 Lone Pairs
2	sp	**linear** (180^{o}) 				
3	sp^2	**trigonal planar** (120^{o}) 	**bent** 			
4	sp^3	**tetrahedral** (109^{o}) 	**trigonal pyramid** 	**bent** 		
5	sp^3d	**trigonal bipyramid** (120^{o}, 90^{o}) 	**seesaw** 	**T-shaped** 	**linear** 	
6	sp^3d^2	**octahedral**(90^{o}) 	**square pyramid** 	**square planar** 	**T-shaped** 	**linear** 

Which are always polar?

For a tetrahedral (or other symmetrical molecule), when is the molecular polar?

Fill in the Table for the following molecules/ions

Molecular Formula	Lewis Structure	Total number of electron groups on central atom	Number of lone pairs on central atom	Molecular Geometry	Bond angle(s)	Polar? Yes or No	Hybrid-ization
PF_5							
SO_3^{2-}						Ions are ions! They can't be polar.	
XeF_2							
CBr_2F_2							
SO_2							
CH_3COOH Answer for each central atom.							

For the Following Molecules or Ions

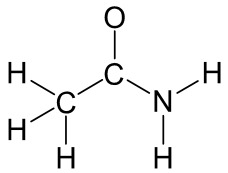
A) Draw all possible resonance Lewis structures.

B) Assign formal charges for all atoms in each resonance structure.

C) Circle the favored resonance form; if all forms are equivalent, circle none.

a) SO_2

b) CH_3CONH_2 (connectivity as shown below)



c) C_6H_6 (ring of Carbons!)

8.1 Describe the formation of covalent bonds in terms of atomic orbital overlap

(A) Define and give examples of σ and π bonds

8.2 Hybrid Atomic Orbitals

(A) Explain the concept of atomic orbital hybridization

(B) Determine the hybrid orbitals associated with various molecular geometries

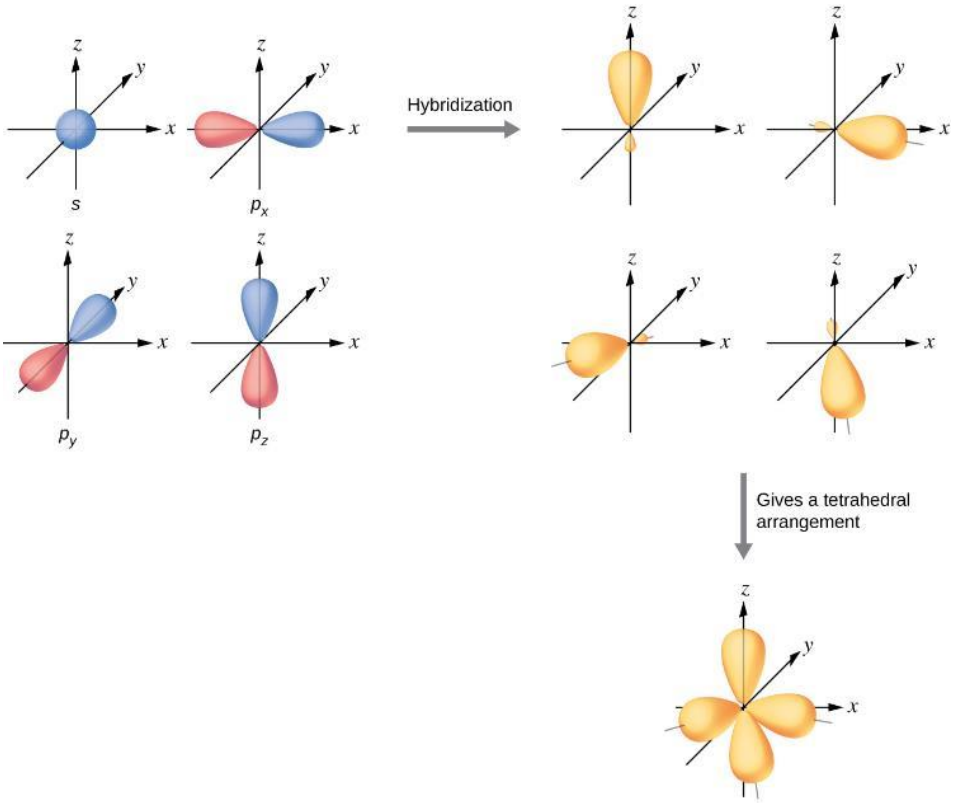
8.3 Multiple Bonds

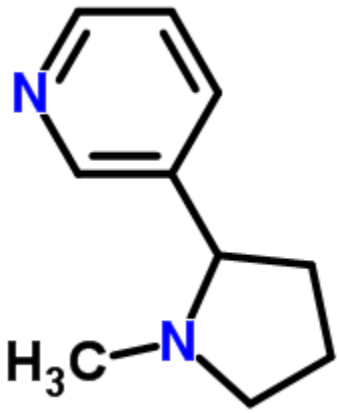
(A) Describe multiple covalent bonding in terms of atomic orbital overlap

(B) Relate the concept of resonance to π-bonding and electron delocalization

8.1 Explain sigma bonds, pi bonds and electron delocalization

8.2. Explain hybrid orbital Theory. Why can't C have 5 bonds?





(A) Redraw the structure for nicotine. Add all the bonds and the Hydrogens. ($C_{10}H_{14}N_2$)

(B) Predict the geometry and hybridization around every central atom.

(C) How many π and σ bonds are in the molecule?