CH 221 Worksheet Chapters 8,9

1. Explain the difference between a covalent bond and an ionic bond.

A covalent bond is one in which the 2 electrons that make up the bond are shared equally by each atom involved in the bond. This happens only when the electronegativity of the two elements involved in the bond are equal. Ideally covalent bonds only exist between 2 atoms of the same element like with H_2 or I_2 or Carbon in diamonds. Many times, though when the elements have similar electronegativity, the sharing is very equal, so the bond is still referred to as a covalent bond, only it is then called a Polar covalent bond since the two ends of the bond appear to have slightly less electron density at one end compared to the other. The driving force for forming these bonds with shared valence electrons comes from the apparent stability of a full outer shell of electrons.

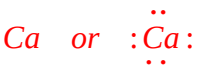
An ionic bond is where the electron pair are not shared equally at all. One atom has both of them and the other atom gets neither of them. This is the case when metals and non metals react. The metal loses one or more electrons, and the non metal gains one or more electrons. The reason that they stick together in a compound at all is more due to the attraction of oppositely charged ions. The driving force for forming these kinds of electron sharing relationships is also related to the added stability of a full outer shell. The atom that loses the electron does so to expose the full shell under the valence shell--a much more stable situation for that atom.

2. Write the Lewis symbol for each of the following atoms or ions:

C 

Na 

S 

Ca^{2+} 

O^{2-} 

Br- 

3. Predict whether the following molecules have ionic, covalent or polar covalent bonds:

If you want to be really specific (and anal) about this, a difference in electronegativity of the two atoms in the bond less than 0.5 is considered a nonpolar covalent bond. If the difference is 0.5 up to around 1.9, then it is considered polar, or "a polar covalent bond." If the difference is greater than 2.0, then the bond is Ionic. Note that among the Top Ten most electronegative elements, F O N Cl Br I S C H P range in e-negativity from 4.1 to 2.1, so the worst case here, an F-P bond (diff of 2.0) would still be a polar covalent bond, not ionic.

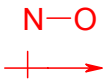
NaCl very different electronegativities! Na will want to give up an electron to form the +1 ion so that it can expose its full inner shell, while Cl, #4 in the big electronegativity scheme will take one to fill out its outer shell, and form a -1 ion. Ionic bond! (3.0-0.9=2.1, ionic)

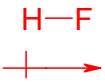
Cl_2 Identical electronegativities! Equal sharing! a completely Covalent bond! (3.0-3.0= 0, nonpolar)

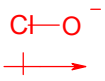
NO Very similar electronegativities, (#3 and #2 on the list of the top 10). Both will be good at attracting electrons to itself, so the bond will be a Polar Covalent one. (3.5-3.0=0.5, polar bond, or a "polar covalent bond")

$MgCl_2$ Again, very different electronegativities. Ionic Bond. (3.0 - 1.2=1.8 very polar covalent, to Ionic bond considering that $MgCl_2$ is soluble in water and forms ions, it is strong evidence for its ionic nature.

4. For the following compounds indicate whether the bonds are polar or not using an arrow with the + sign above the least electronegative atom in the bond: THESE AS DRAWN ARE NOT LEWIS STRUCTURES! THEY JUST SHOW THE SKELETON OF THE MOLECULE.

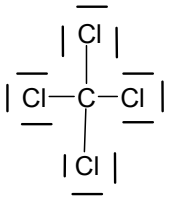
NO 

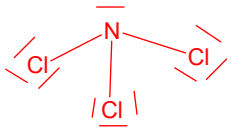
HF 

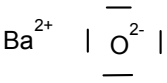
ClO^- 

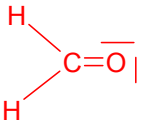
I_2 Not polar.

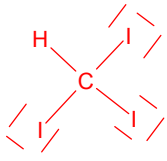
5. Write Lewis electron dot structures for the following molecules:

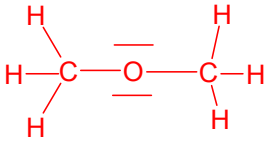
CCl_4 

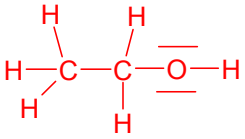
NCl_3 

BaO 

H_2CO 

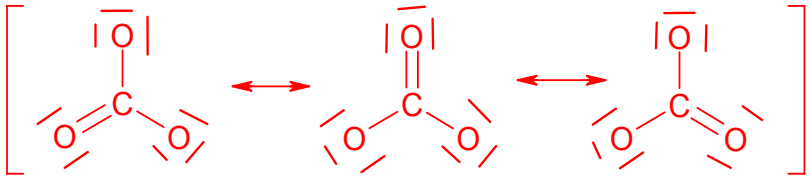
CHI_3 

C_2H_6O 

or 

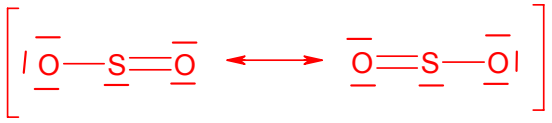
6. Draw all possible resonance structures for

CO_3^{2-}

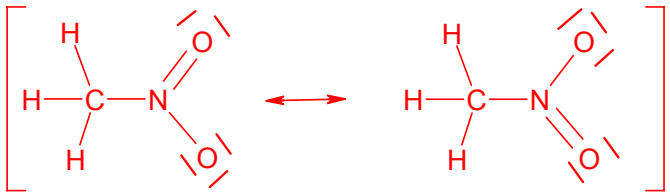


-2

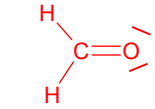
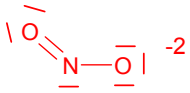
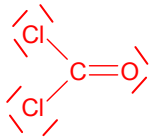
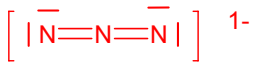
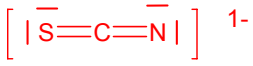
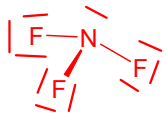
SO_2



CH_3NO_2.

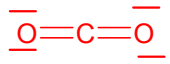


7. Draw Lewis electron dot structures for each of the following molecules. Give the electron-domain geometry and the molecular geometry around each central atom. Note the values of the ideal bond angles.

Lewis Structure	Electron Domain Geometry	Molecular Geometry	Ideal Bond Angles
H_2CO 	Trigonal Planar	Trigonal Planar	120°
NO_2^- 	Trigonal Planar	Bent	120°
$COCl_2$ 	Trigonal Planar	Triogonal Planar	120°
N_3^- 	Linear	Linear	180°
SCN^- 	Linear	Linear	180°
NF_3 	Tetrahedral	Trigonal Pyramid	109°

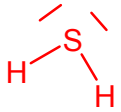
8. The human nose has an almost unbelievable ability to distinguish odors. Most small molecules that reach the nostrils only have a strong odor if they are polar (there are some notable exceptions). Determine the molecular geometry of the following molecules and indicate which are polar. Based on polarity, predict which of these molecules have a strong odor.

CO_2

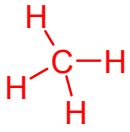


Linear,
no dipole,
no odor

H_2S Bent, polar, smells (rotten eggs)

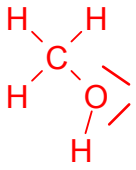


CH_4



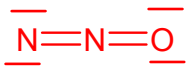
Tetrahedral, no dipole, no odor.

CH_3OH



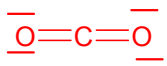
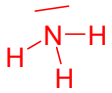
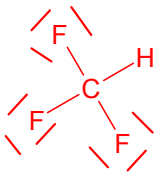
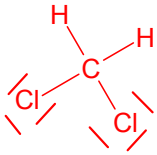
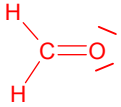
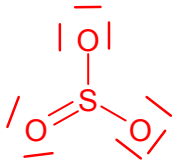
Electron domain is tetrahedral around both O and C, polar, C-O-H bond is BENT, Smells!

N_2O



Linear! And polar! and it smells.

9. Draw the Lewis dot structures for each of the following molecules and give the hybridization of the central atom. List the number of sigma and pi bonds that are in each molecule.

	Hybridization	σ bonds	π bonds
CO_2 	sp	2	2
NH_3 	sp^3	3	0
CF_3H 	sp^3	4	0
CH_2Cl_2 	sp^3	4	0
H_2CO 	sp^2	3	1
SO_3 	sp^2	3	1