Name: _____ Date: _____ CHEM 1A

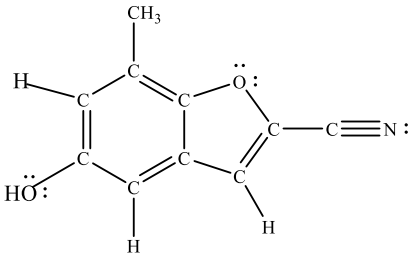
Monday/Tuesday, December 2 & 3, 2019- Covalent Bonding & Orbitals (All Chapter 14)

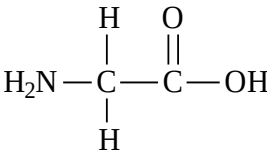
I. Local Electron Model

Sigma Bond – Any single bond made with hybridized orbitals.

Pi Bond – Any double or triple bond made from unhybridized p orbitals.

1. **Sigma & Pi Bonding -** Determine the number of sigma (σ) and pi (π) bonds in the following structures.

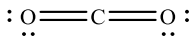


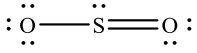


16 single bonds ⇒ 16 sigma; 4 double bonds ⇒ 4 sigma + 4 pi ; 1 triple bond ⇒ 1 sigma + 2 pi; 21 σ + 6 π

2. **Hybridization** - . Label the hybridization of the central atoms for the following:

a. sp

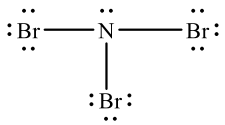




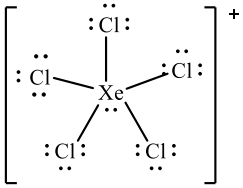
c. sp^2

e. I_3^- dsp^3

b. sp^3



d. sp^3d^2



f. C_2H_4 sp^2

3. **The Shapes of Molecules -** How many of the following molecules have all of their atoms in the same plane?

a. F_2O b. H_2CO c. NH_3 d. CO_2 e. C_2H_4
f. $BeCl_2$ g.H_2O_2

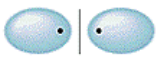
5. For the following will all of the atoms in lie in the same plane?

a. $H_2C=C=CH_2$ b. $H_2C=C=C=CH_2$ c. $H_2C=CH-C\equiv N$

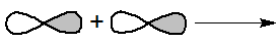
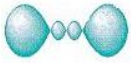
II. Molecular Orbital Theory

4. **Orbital Overlap/Local vs. Molecular Orbitals -** Draw and label the molecular orbitals for each of the following combinations of atomic orbitals. State whether the potential energy of the molecular orbitals is higher or lower than the atomic orbitals.

a.  sigma bonding σ 

b.  sigma antibonding σ* 

c.  sigma bonding σ 

d.  sigma antibondingσ* 

There are three things which Lewis Theory/VSEPR and the LE Model cannot explain –

1.

2.

3.

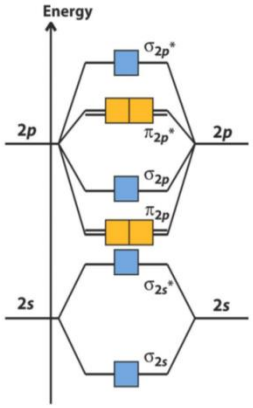
Molecular Orbital Theory–

Paramagnetic *⇒ attracted to amagnetic field due to unpaired electrons*

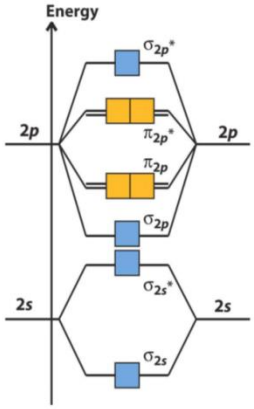
Diamagnetic *⇒ repelled by a magnetic field due to a lack of unpaired electrons*

e.  pi antibonding π*

f.  pi bonding π



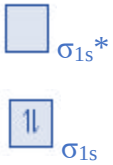
MO diagram for homonuclear molecules in Groups 1-5

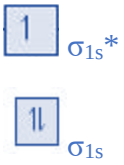


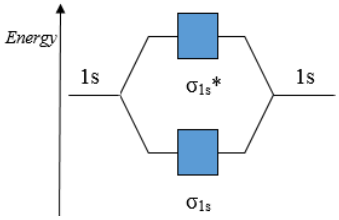
MO diagram for homonuclear molecules in Groups 6-8

7. For the following draw the *valence* molecular orbital energy diagram and determine if they're diamagnetic or paramagnetic:

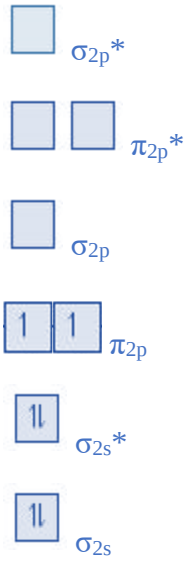
a. H_2 diamagnetic b. He_2^+ paramagnetic

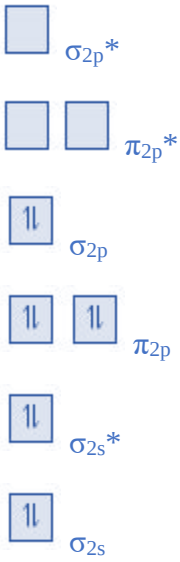


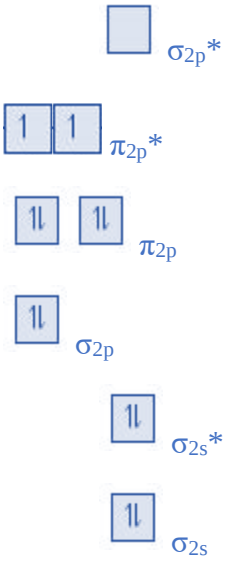




c. B_2 paramagnetic d. CN^- diamagnetic e. O_2 paramagnetic







8. Which of the following will have a stronger bond if an electron is added?

(A) H_2 (B) C_2 (C) N_2 (D) O_2 (E) F_2

b. C_2⇒goes from 8 to 9 valence electrons therefore the bond order goes from 2 to 2½ therefore the bond gets stronger

9. According to the MO model predict the relative bond energies for the following:

a. F_2 b. F_2^- c. F_2^+

F_2^- (BO = 0.5) < F_2 (BO = 1) < F_2^+ (BO = 1.5)

10. According to the MO model predict the relative bond lengths for the following:

a. H_2 b. B_2 c. C_2 d. N_2

(period 1) < N_2 (period 2 and BO of 3) < C_2 (period 2 and BO of 2) < B_2 (period 2 and BO of 1)