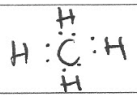
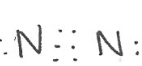
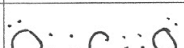
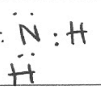
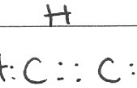
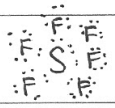
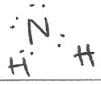
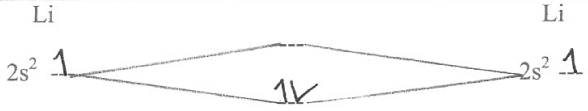
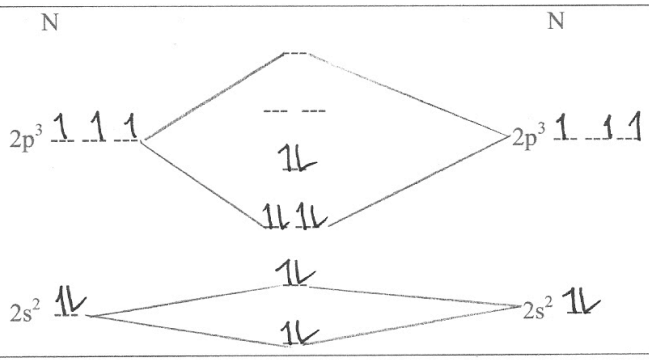
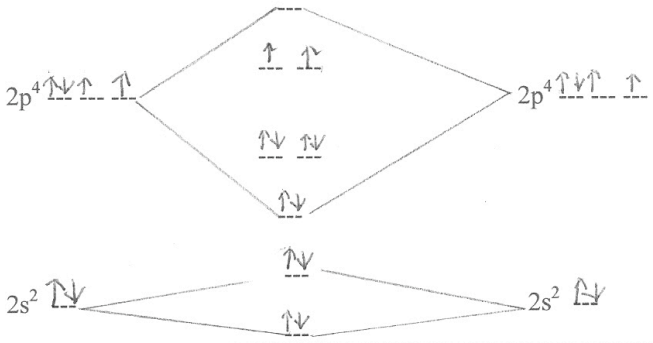
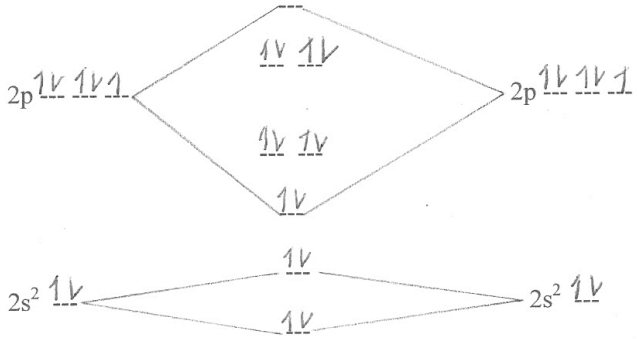
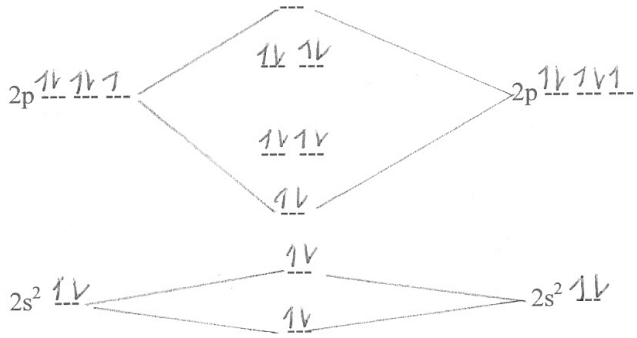
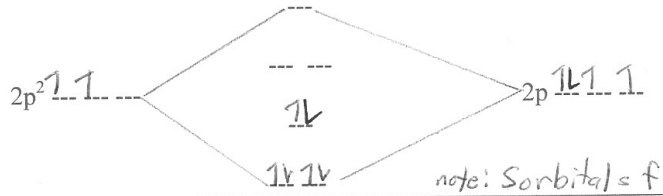
Laude's CH301 Worksheet 7: VB and MO

1. Use valence-bond theory to predict the hybridization and other properties of these compounds

Cmpd	Lewis structure	Hybridization of central atom	# of σ bonds	# of π bonds	Atomic orbits that form the σ and π bonds: Example: $\sigma_{sp2\text{-}1s}$
CH_4		sp^3	4	0	$\sigma sp^3 - 1s$
N_2		sp	1	2	σ sp - sp π 2p - 2p
CO_2		sp	2	2	σ sp - 2p π 2p - 2p
NH_3		sp^3	3	0	$\sigma sp^3 - 1s$
C_2H_2		sp	3	1	σ sp - 1s σ sp - sp π 2p - 2p
SF_6		sp^3d^2	6	0	$\sigma sp^3d^2 - 2p$
NH_2^-		sp^3	2	0	$\sigma sp^3 - 1s$

2. Build these compound using molecular orbital theory and predict

Compound	MO building	Bond order	Para or dia-magnetic?
Li_2		1	dia
N_2		3	dia

O_2	O O 	2	para
O_2^{2-}	O- O- 	1	dia
F_2	F F 	1	dia
CN^-	C N-  note: S orbital = filled, not shown	3	dia

3. Rank the bond energy and bond length for the 6 compounds in problem 2 based on bond order

Increasing bond length: $N_2 = CN^- < O_2 < Li_2 = O_2^{2-} = F_2$

Increasing bond energy: $Li_2 = O_2^{2-} = F_2 < O_2 < N_2 = CN^-$