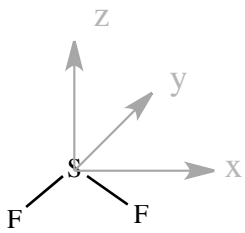
Name _____ Test 3 (12/1)
CHEM 0211 (Adv. Inorganic) Fall 2021

1. In its gaseous state SF_2 is an unstable molecular compound in the C_{2v} point group.
   a. (4 pts.) Determine the symmetry (the irreducible representations) of the 3s and the three 3p orbitals on S.
   b. (4 pts.) Determine the symmetry (irreducible representations) of the group orbitals formed from the two F atom's 2s orbitals.
   c. (4 pts.) Determine the symmetry (irreducible representations) of the group orbitals formed from the two F atom's $2p_y$ orbitals.
   d. (4 pts.) Which atomic orbitals on S (identify them using the appropriate 3s or 3p designations) can from molecular orbitals with the group orbitals (SALCs) that form from the F atom's $2p_y$ orbitals. If any of the SALCs formed from the F atoms' $2p_y$ orbitals do not interact with orbitals on the S atom, identify them using their Mulliken label (the symmetry label).



C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

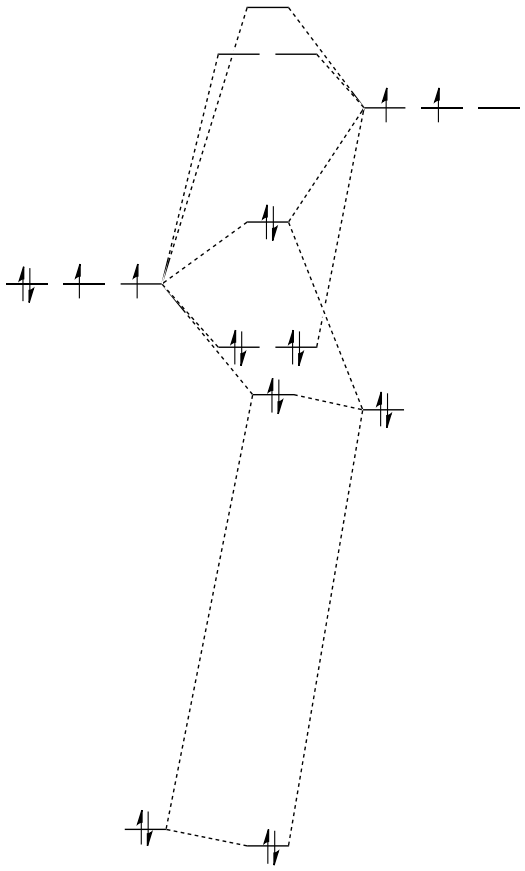
2. An MO diagram for CO is drawn to the right.

a. (3 pts.) Label the O and C atoms.

b. (4 pts.) Label the σ and π orbitals.

c. (2 pts.) Label the HOMO and LUMO.

d. (3 pts.) Based on the MO diagram, which end of the CO molecule is more electrophilic (willing to accept electrons), the C or O?

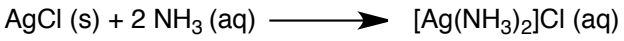


3. (10 pts.) Explain how methanol can act as both a Brønsted-Lowry base and a Brønsted-Lowry acid. In the explanation provide examples of methanol acting in both ways.

4. (10 pts.) Explain why $HClO_4$ is a stronger acid than $HClO_3$.

5. (10 pts.) Lithium amide, $LiNH_2$, and lithium diisopropylamide, $LiN(CH(CH_3)_2)_2$ are both bases. Ignoring any possible solvent effects, determine which is the stronger base and explain your choice.

6. Sliver chloride can be made to dissolve in water if ammonia is added to the water. A balanced chemical equation describing the reaction is drawn below.



a. (5 pts.) Is the ammonia acting as a Lewis acid or a Lewis base? Explain your response.

b. (5 pts.) Is the metal acting as a Lewis acid or a Lewis base? Explain your response.

7. (10 pts.) What is the strongest acid that can exist in water? Explain.

8. (8 pts.) Determine the oxidation numbers for the transition metals in the following coordination complexes

fac-$[Re(CO)_3(H_2O)_3]Cl$

$Na[TcO_4]$

$Ni(CO)_4$

trans-$[Co(H_2O)_2(NH_3)_4]Cl_3$

9. (8 pts.) Using the hard-soft acid-base concept, explain why AgF is more soluble in water than AgI.

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr