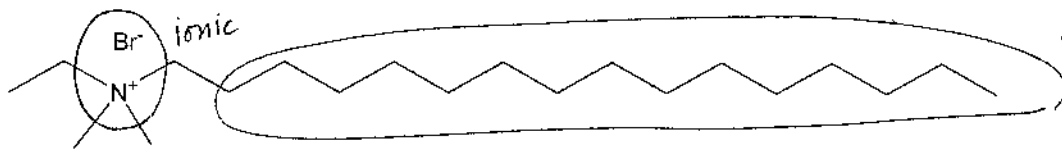


KEY

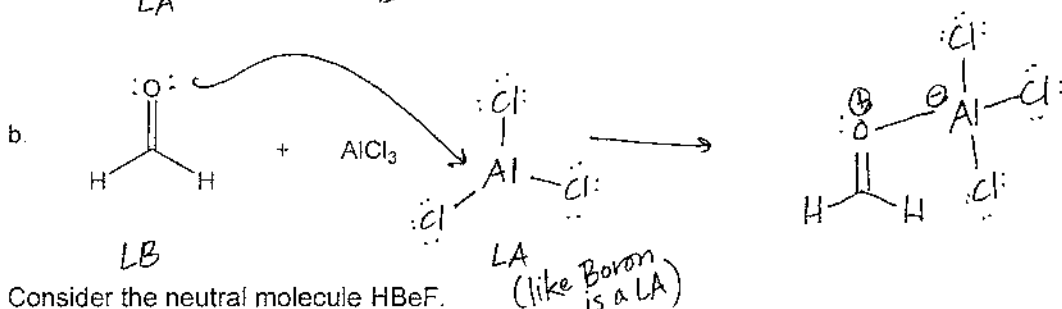
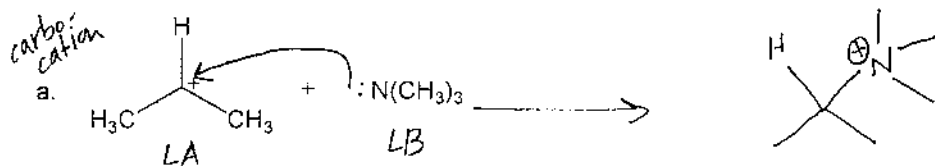
1. (8 pts) Cetyldimethylammonium bromide is shown below. Predict its solubility behavior in water and in hexane $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$. Explain your predictions.



ionic so soluble in H_2O
 long nonpolar chain of CH_2 's can interact with hexane via dispersion forces so soluble in hexane.

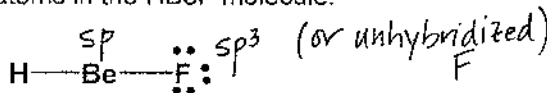
nonpolar or hydrophobic
 see Solomons Q2.39

2. (10 pts) For each reaction do the following. Use the curved arrow notation to show how the reaction occurs. Draw the structure of the product(s). Show all lone pairs and formal charges.



OR
 can use pi bond to react with the Al

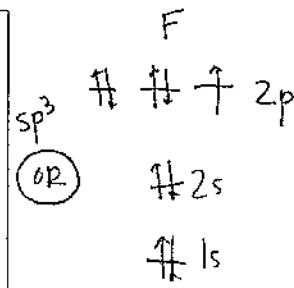
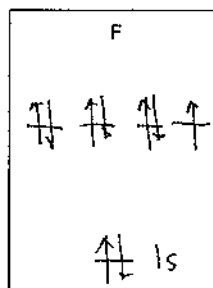
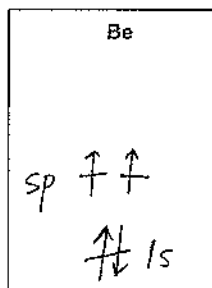
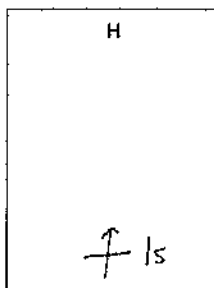
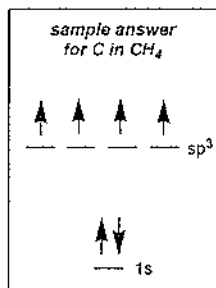
3. Consider the neutral molecule HBeF .
 a. (2 pts) Assign the hybridization to the atoms in the HBeF molecule.



- b. (9 pts) In the boxes below, write the approximate orbital energies and electron occupancies for the electrons of each atom in HBeF , using your answer in part (3a) as your guide.

Be: $4e^-$, 2 are valence

F: $9e^-$, 7 are valence



- c. (4 pts) Would you expect HBeF to be Lewis acidic or Lewis basic? Explain.

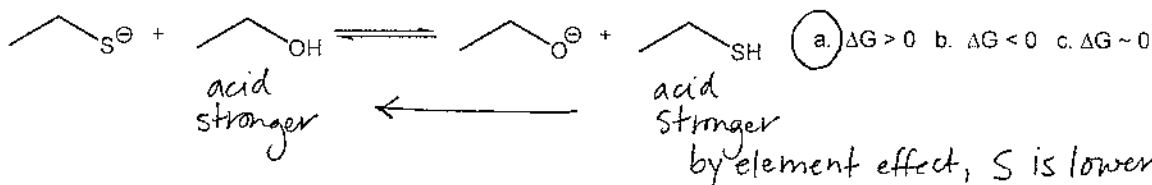
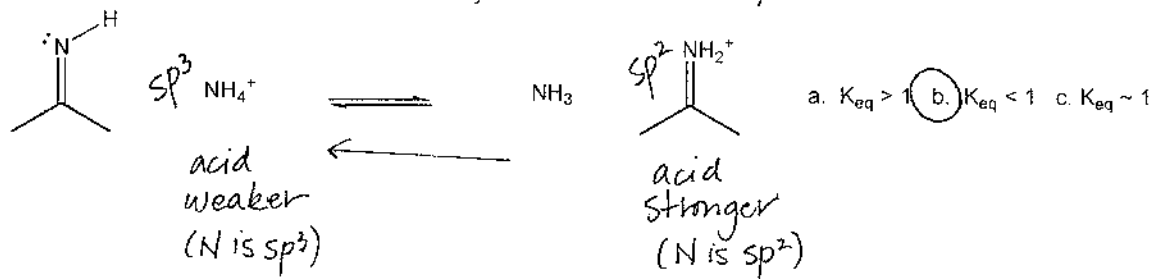
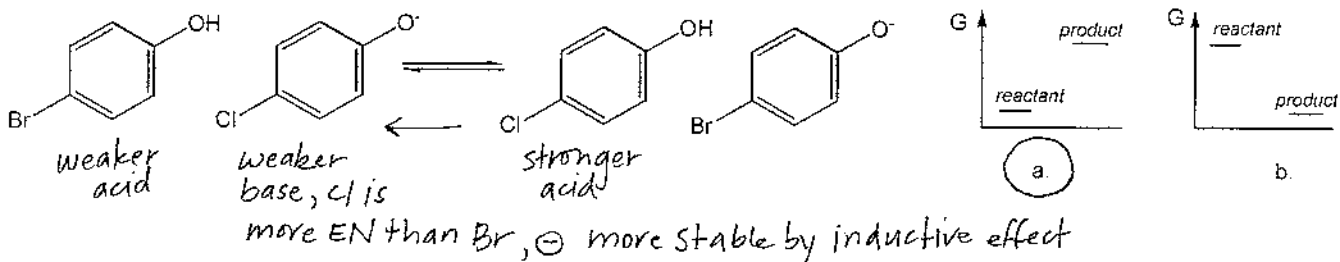
Several acceptable answers:

LA: because an H is available for donation, all B-L acids are also LA's.

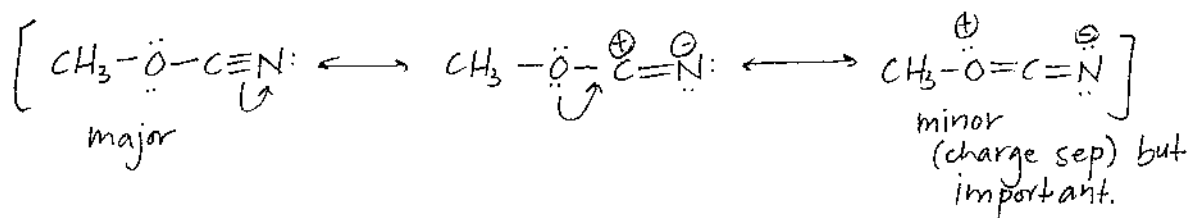
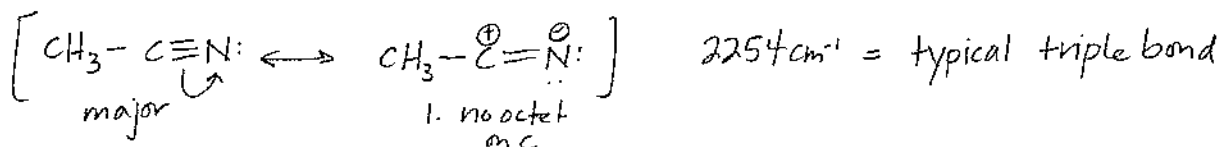
LA: because Be only has $4e^-$ in the compound HBeF , wants to accept e^- to fulfill octet

LB: F has lone pairs available for donation

4. (15 pts) Circle the correct thermodynamic descriptor for each of the following reactions. You must **briefly** explain/annotate your answer to receive credit.

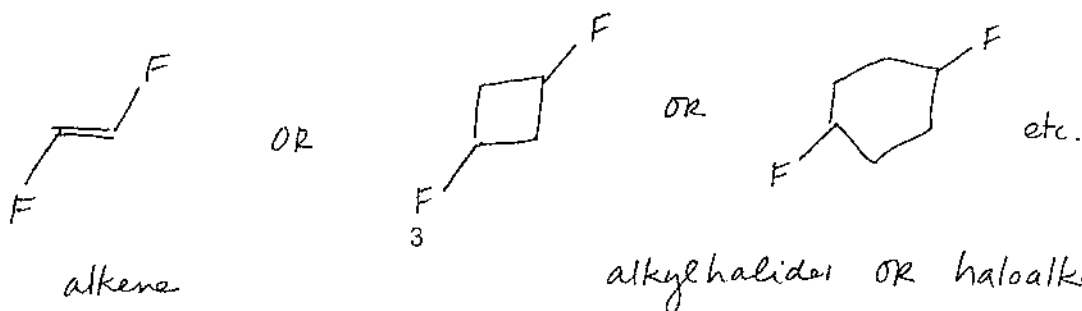


5. (14 pts) An important IR signal for acetonitrile (CH_3CN) is 2254 cm^{-1} . The analogous IR signal for methyl cyanate (CH_3OCN) is 2096 cm^{-1} . Use a combination of words and well drawn resonance structures to explain why acetonitrile vibrates at a higher frequency than methyl cyanate.

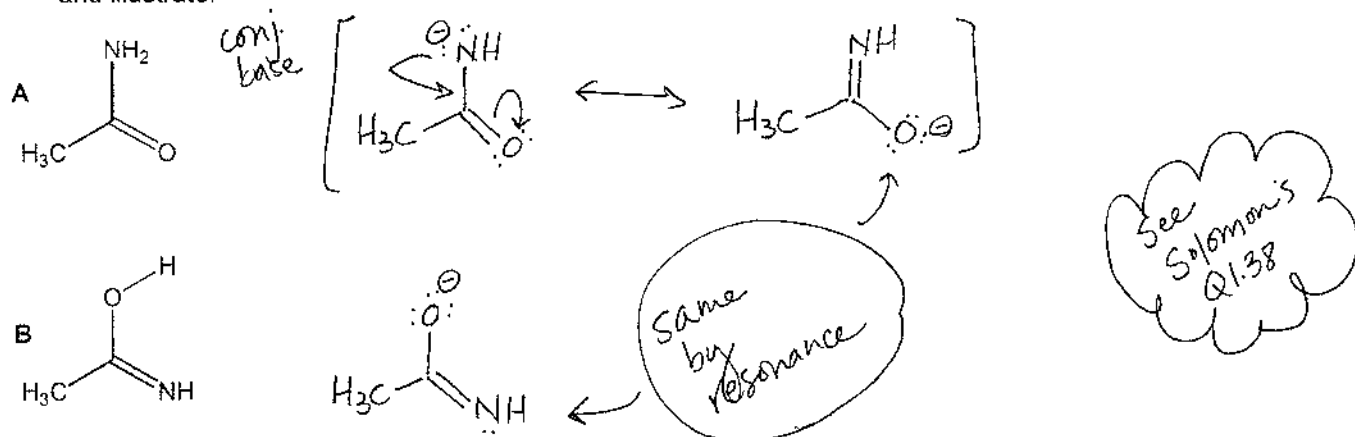


2096 cm^{-1} = the bond between C & N is weaker than a typical triple bond b/c resonance gives double bond character

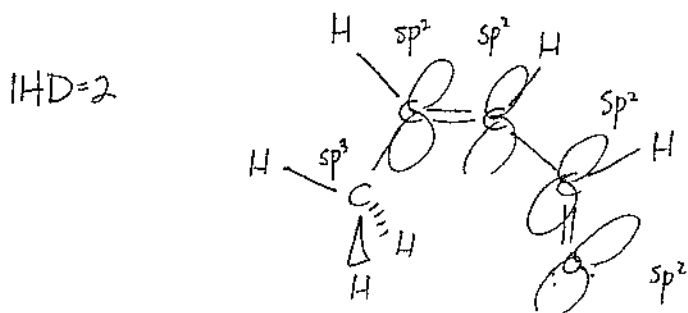
6. (6 pts) (a) Give an example of a molecule with $\text{IHD} = 1$ that contains two fluorine atoms and has a dipole moment of zero. (b) Name a functional group in the molecule you proposed for part a.



7. (10 pts) Deprotonation of compounds **A** and **B** results in the formation of the same conjugate base. Explain and illustrate.



8. (12 pts) For the molecule $\text{CH}_3\text{CHCHCHO}$:
- Draw a three dimensional Lewis structure, including all lone pairs.
 - Label the hybridization of all atoms other than H.
 - On your 3D Lewis structure, clearly draw any orbitals that participate in the formation of π bonding.



9. (10 pts) Use the following IR data to derive a reasonable structure for unknown compound **BLINKY**, $\text{C}_5\text{H}_{10}\text{O}$. IHD=1

