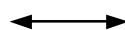
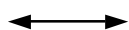
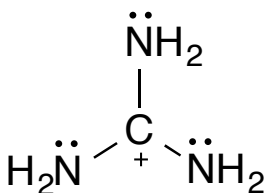


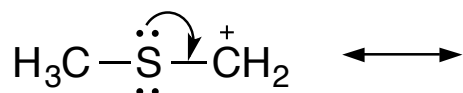


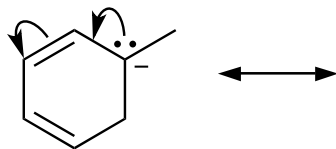
1. A) Provide the Lewis structure for the tetrafluoroborate anion,  $\text{BF}_4^-$ . Show unshared electrons and formal charges. (3 pts)

B) Draw three reasonable resonance structures for the following molecule. Show unshared electrons and formal charges. (9 pts)

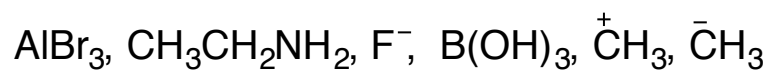


C) Draw the resonance structure indicated by the arrow. (6 pts)





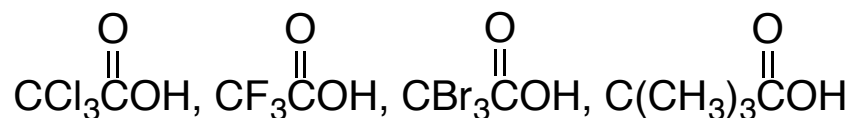
2. A) Which of the following are likely to act as Lewis acids and which as Lewis bases. (6 pts)



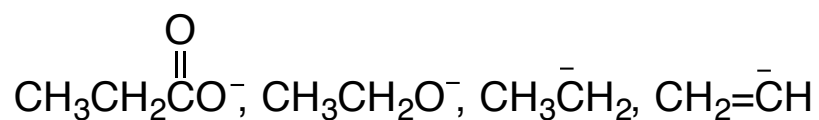
Lewis acids:

Lewis bases:

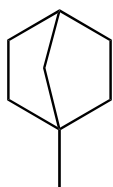
B) Rank the following acids in strength from weakest acid to strongest acid. (3 pts)



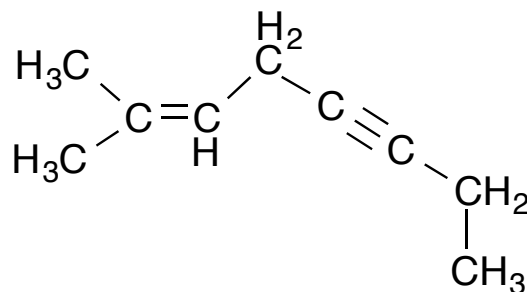
C) Rank the following bases in strength from weakest base to strongest base. (3 pts)



3. A) How many primary, secondary, tertiary, and quaternary carbons does the following compound have? (4 pts)



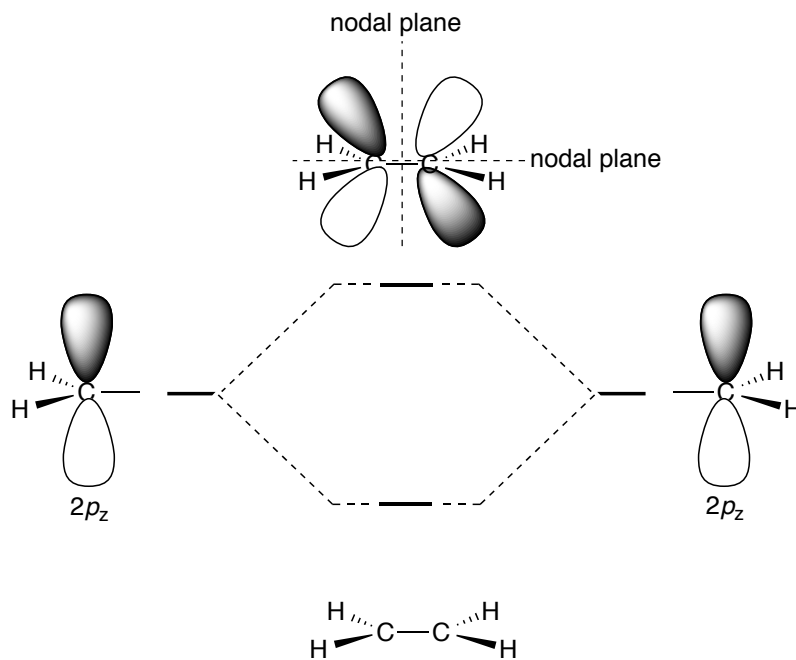
- B) What is the hybridization of each carbon atom in the following molecule? (3 pts) Circle the longest C-C bond. (3 pts)



4. Draw an energy diagram for rotation about the C—C bond in 1,2-dibromoethane. Draw the Newman projections for the dihedral angles 60°, 120°, 180°, 240° and 360°. (18 pts)

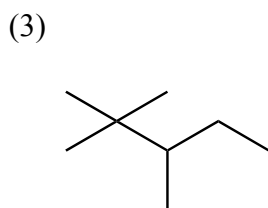
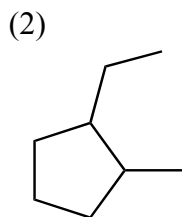
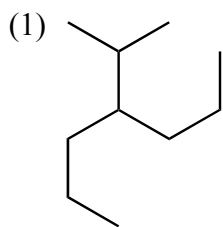


5. The following is an orbital interaction diagram showing the overlap of  $2p$  orbitals to form bonding and antibonding  $\pi$  molecular orbitals of ethene. Complete the molecular orbital diagram of by showing the two lobes and nodal plane of the bonding molecular orbital and adding electrons to the atomic and molecular orbitals. (6 pts)

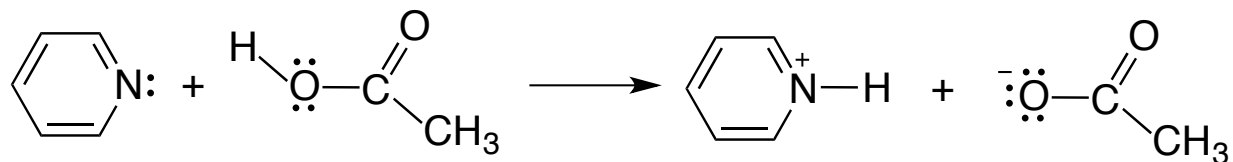


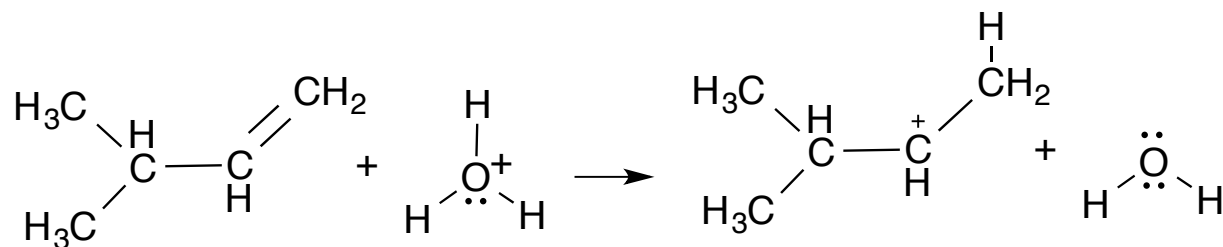
7. A) Draw the skeletal structures for all the isomers of an alkene with the molecular formula  $C_5H_{10}$  and provide the IUPAC name for each isomer. (15 pts)

B) Provide the correct name for the following compounds. (9 pts)



8. A) Provide a curved-arrow notation for each of the following reactions in the left-to-right direction. (6 pts)





B) Provide the product(s) for the following reactions. (6 pts)

