1. Show the Lewis structures of all important resonance forms for the following. Suggest the relative energies of orbitals (like Csp2-C sp2 or CO \*, or CO \*) occupied by valence electrons within each. Determine the hybridization of P, S, C, N, O, and B and explain what determines the hybridization.
   1. CH2P(CH3)3
   2. BCl3
   3. SO2
   4. SO3
   5. CH3NC
   6. CO
   7. NH2CONH2
   8. CNO-
2. Order the following columns or rows of compounds according to pKa’s and explain the order.



1. Which compound is more acidic? Explain all relevant effects: field, inductive, any other effect?



1. Show a derivation of an analytical expression that relates pKa to pKb and does not depend on the concentration of any acid or base.
2. Estimate the pKa’s of the most acidic proton on each following compounds and explain your reasoning.



1. Show all resonance structures for the intermediate cation that is formed when benzene is protonated.



1. Three isomeric cations are formed when furan is protonated. A) Show the three isomers and all of their resonance structures. B) Which isomer is most stable and explain.



1. Explain why A is a stronger acid.



1. A) Show all tautomers (isomers where only the position of protons change) of the following ketone. As for the ketone, no atom should have a formal charge. (Hint: this ketone has two inequivalent isomers). B) Of the three isomers which is most stable and explain.

