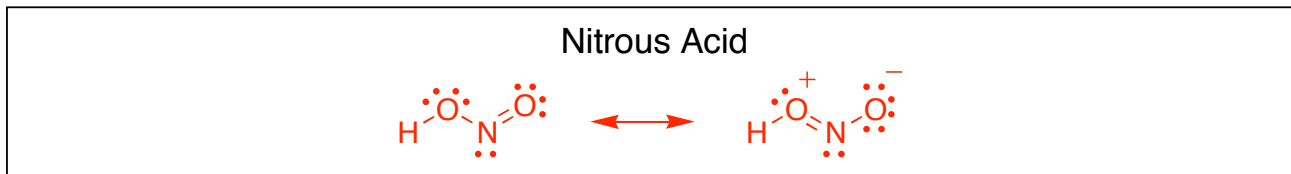


Name: _____

CHEM116L Section 1 Mini-Test ANSWER KEY (50 pts total)
September 15, 2006

- 1a) In the box below, draw the two resonance structures (showing all lone pairs of electrons and formal charges) that have the greatest contribution to the structure of nitrous acid (HONO, connected in that order). Then answer the questions that follow. (6 points)

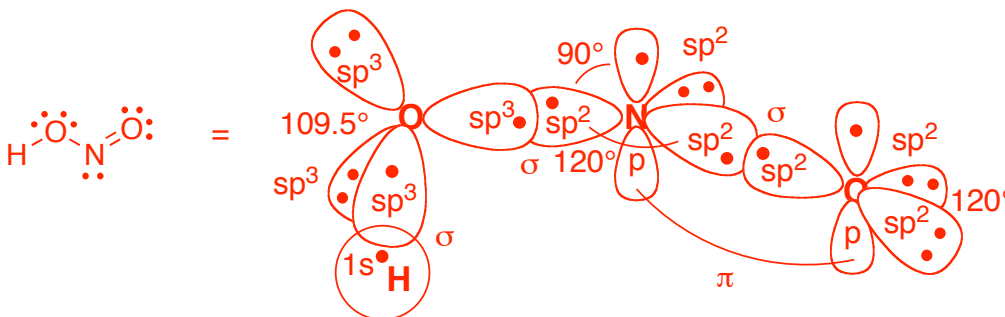


- 1b) Are the two oxygen atoms in nitrous acid equally basic? If not, indicate which oxygen atom in the molecule is *more* basic (by circling it). Provide a rationale for your choice below. (4 points)

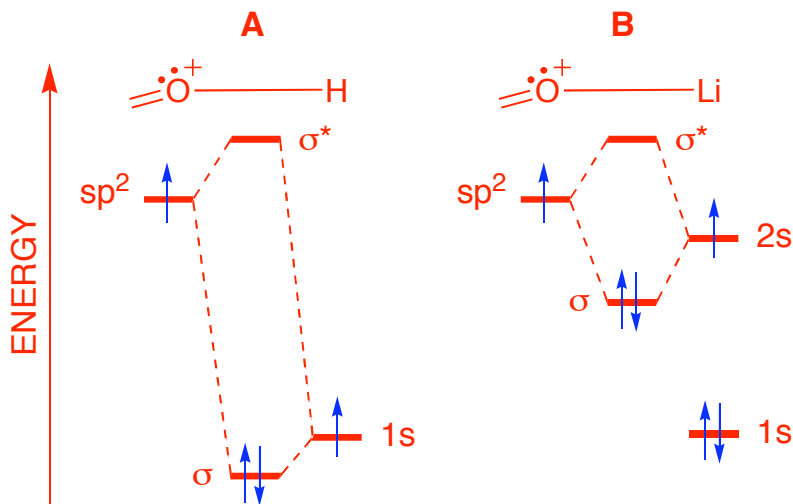
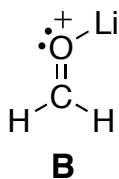
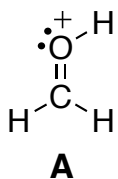


More basic because 1) it has more electron density, thanks to the contribution of an extra lone pair of electrons in the minor resonance structure and 2) it has more negative character, which (because opposite charges attract) makes it more attracted to H^+ .

- 1c) Draw an orbital picture of the major contributor of nitrous acid. In your illustration, be sure to label all orbitals and bonds, indicate bond angles, and show where lone pairs of electrons reside. (5 points)



- 2) Use MO theory to determine whether cation **A** is more or less stable than cation **B**. Explain your choice through the use of a properly labeled MO energy diagram. (10 points)

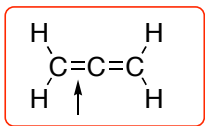


Because lithium uses the 2s orbital to bond, its resulting s bond is higher in energy, and less stable, than the bond formed with hydrogen.

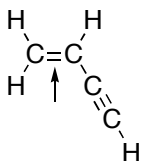
Name: _____

- 3) For each pair shown below, select the one that best fits the accompanying description by circling it. Provide a concise but thorough rationale for each of your decisions using words and pictures. *Note: a picture is required to receive full credit on most of these. Do not exceed the space provided.* (18 points)

A. The shorter bond?

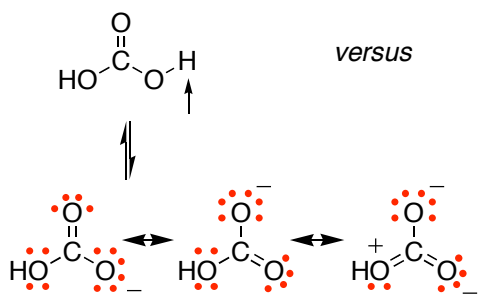


versus

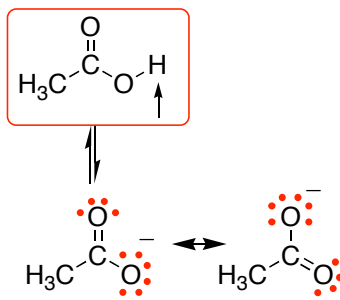


One bond involves bonding between two sp^2 hybridized carbons, while the other involves an sp^2 hybridized carbon and an sp hybridized carbon. sp hybridized orbitals are smaller than sp^2 orbitals owing to the greater s character in the sp orbitals (and because electrons in s orbitals are held closer to the nucleus), so the bond involving the sp orbital will be shorter.

B. The most acidic proton?



versus



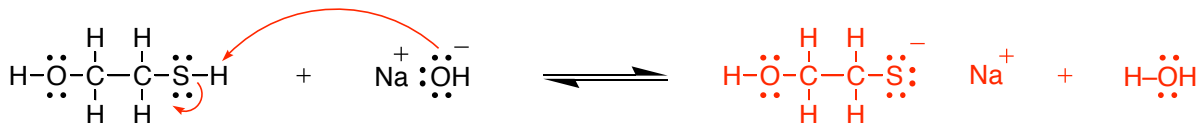
Both conjugate bases have a resonance structure that delocalizes the neg. charge, but hydrogen carbonate has a resonance structure that actually *localizes* negative charge in one part of the molecule. This resonance structure also places two negative charges near each other, creating a repulsive effect since like charges repel. This 3rd resonance contributor destabilizes the conjugate base altogether, and makes it less likely for the acid to give up its proton.

C. The ion with the greater dipole moment (the most polar ion)?

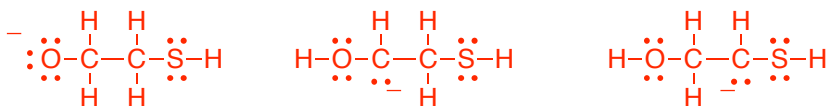


Disregard this question

- 4) The organic molecule shown below contains several protons. Determine which proton is most acidic and provide a rationale for your choice. Then provide a mechanism (curved arrow notation) for the reaction of this compound with sodium hydroxide and provide the products of the reaction to the right of the arrow. (7 points)



other possibilities...



Oxygen is more electronegative than carbon and therefore can better handle having a neg. charge than carbon can. When comparing O to S, size is more important, as sulfur has electrons in its 3rd shell, allowing greater delocalization of charge around sulfur because the 3rd shell orbitals take up a greater amount of space. This makes the sulfur anion more stable than the oxygen anion.