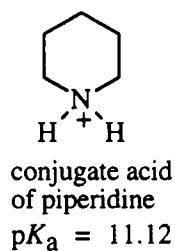
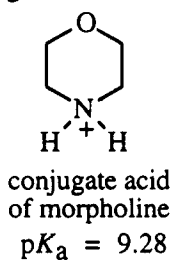


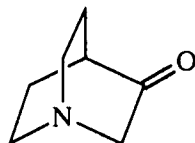
Solutions to Problems

1. a. 2,2-dimethylaziridine d. 2-methylthiacyclopropane
 b. 4-ethylpiperidine e. 2,3-dimethyltetrahydrofuran
 c. 3-methylazacyclobutane f. 2-ethyloxacyclobutane

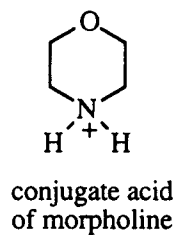
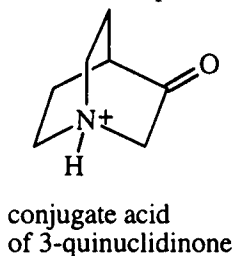
2. The electron-withdrawing oxygen atom of morpholine decreases the strength of the nitrogen-hydrogen bond, making it easier for the proton to dissociate from the compound.



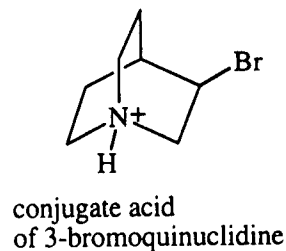
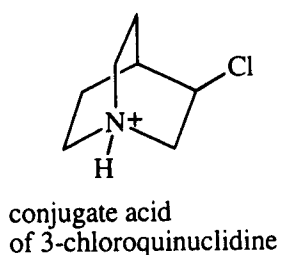
3. a.



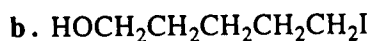
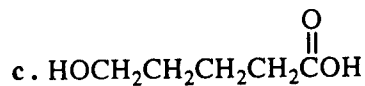
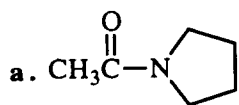
- b. The conjugate acid of 3-quinuclidinone has a lower pK_a than the conjugate acid of morpholine ($pK_a = 9.28$) because the electron-withdrawing oxygen atom in 3-quinuclidinone is closer to the site of the acidic proton.



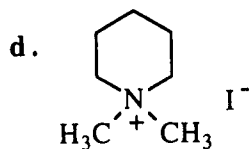
- c. The conjugate acid of 3-chloroquinuclidine has a lower pK_a than the conjugate acid of 3-bromoquinuclidine because chlorine is more electronegative than bromine. This means that 3-bromoquinuclidine is a stronger base than 3-chloroquinuclidine.



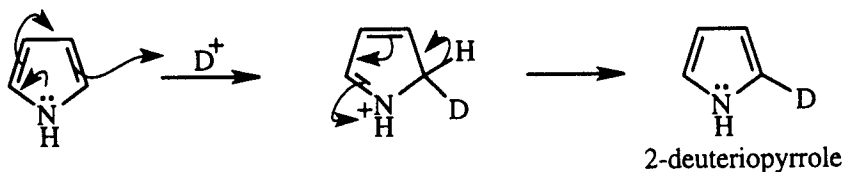
4.



↓ if excess HI
is used

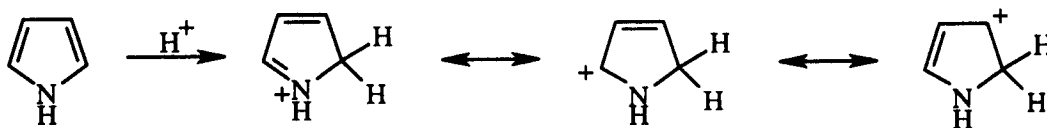


5.

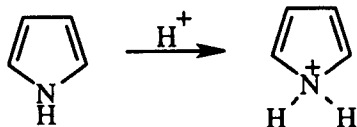


6. Protonation on C-2 leads to a cation with three resonance contributors. Protonation on nitrogen leads to a cation with no resonance contributors. (The positively charged nitrogen cannot accept electrons by resonance, because that would put ten electrons around the nitrogen.)

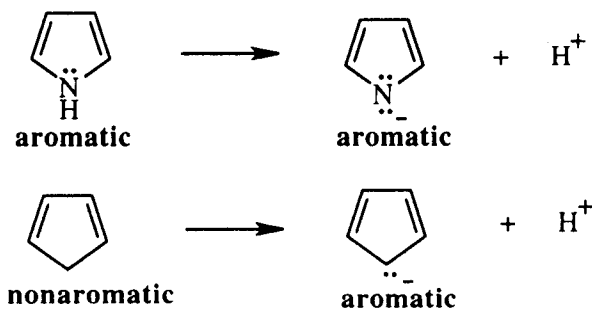
protonation on C-2



protonation on nitrogen

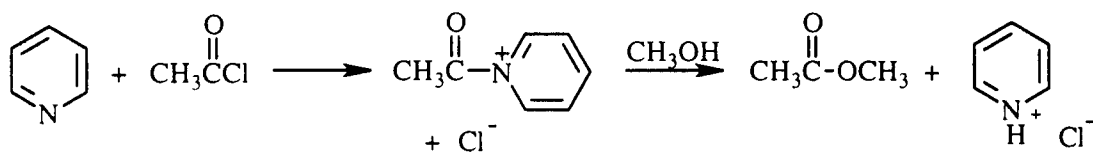


7. Pyrrole is aromatic in both its acidic and basic forms. Cyclopentadiene does not become aromatic until it loses a proton. It is the drive to become a stable aromatic compound that causes cyclopentadiene to be more acidic than pyrrole.

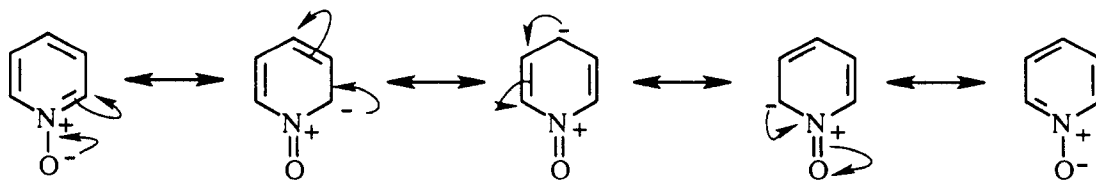


8. Solved in the text.

9. Pyridine will act as an amine with the acid chloride. However, the amide that is formed is very reactive because of its positively charged nitrogen atom. Therefore, it will undergo a nucleophilic acyl substitution reaction with methanol, forming an ester as the final product of the reaction.

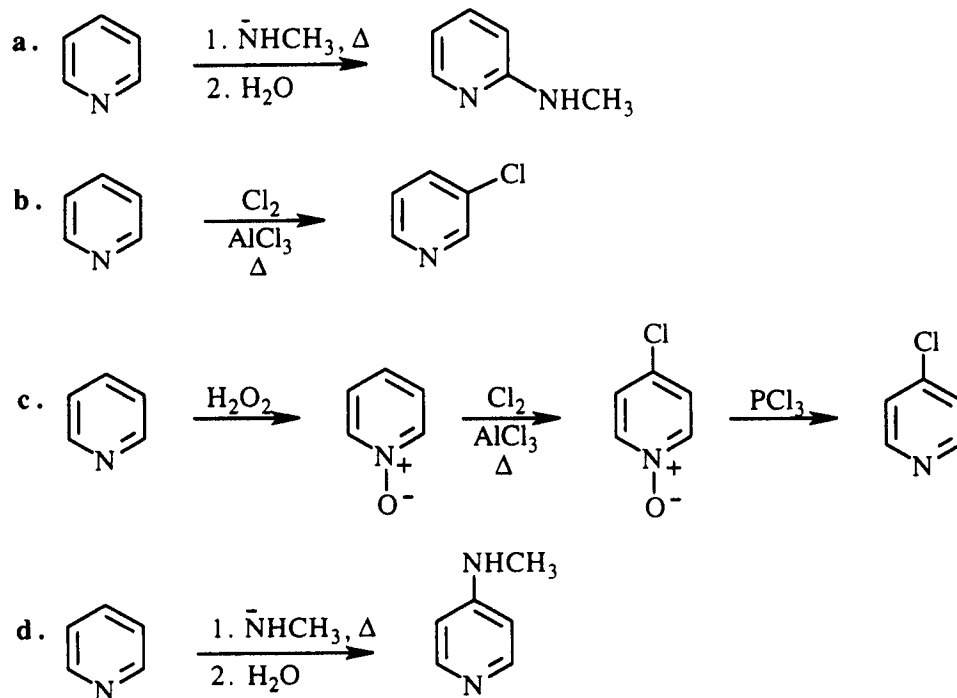


10. The increase in the electron density of the ring as a result of resonance donation of electrons by oxygen causes pyridine-*N*-oxide to be more reactive toward electrophilic substitution than pyridine.



From the resonance structures you can see that the increased electron density is at the #2 and #4 positions. Because the #2 position is somewhat sterically hindered, pyridine-*N*-oxide undergoes electrophilic substitution primarily at the #4 position.

13.



14. It is easiest to remove a proton from the *N*-alkylated pyridine because the electrons left behind when the proton is removed can be delocalized onto the positively charged nitrogen atom. It is easier to remove a proton from 4-methylpyridine than from 3-methylpyridine because in the former, the electrons left behind when the proton is removed can be delocalized onto the electronegative nitrogen atom. In 3-methylpyridine, the electrons can be delocalized only onto carbon atoms.

