Chem 342 Organic Chem II

Lecture Summary 27
27 Mar 2002

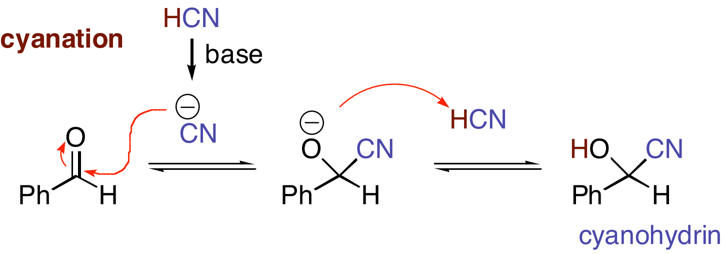
These notes can be obtained at: http://www.ndsu.nodak.edu/instruct/grcook/chem342/notes.shtml

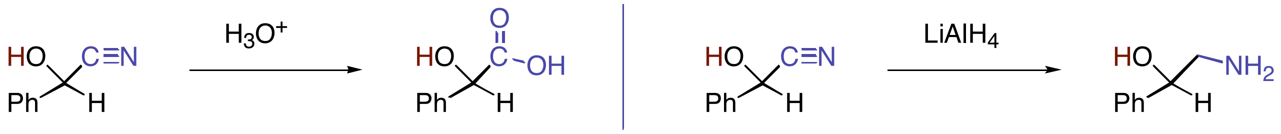
Chapter 19: Aldehydes and Ketones: Nucleophilic Addition Reactions

Hydrocyanation of Aldehydes and Ketones

HCN adds to aldehydes and ketones to afford cyanohydrins. This reaction is best when catalyzed by base. The products can be further manipulated by hydrolysis or reduction. This is a useful method for forming a new carbon-carbon bond.

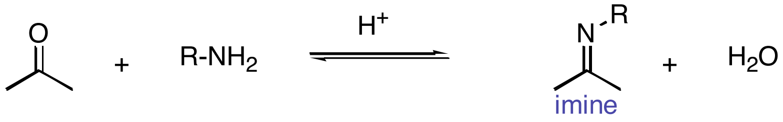
Base Catalyzed Hydrocyanation

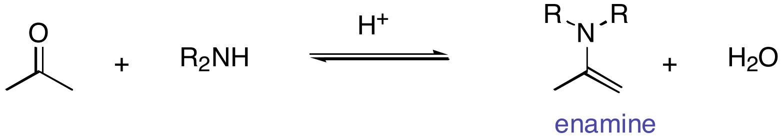




Addition of Amines to make Imines and Enamines

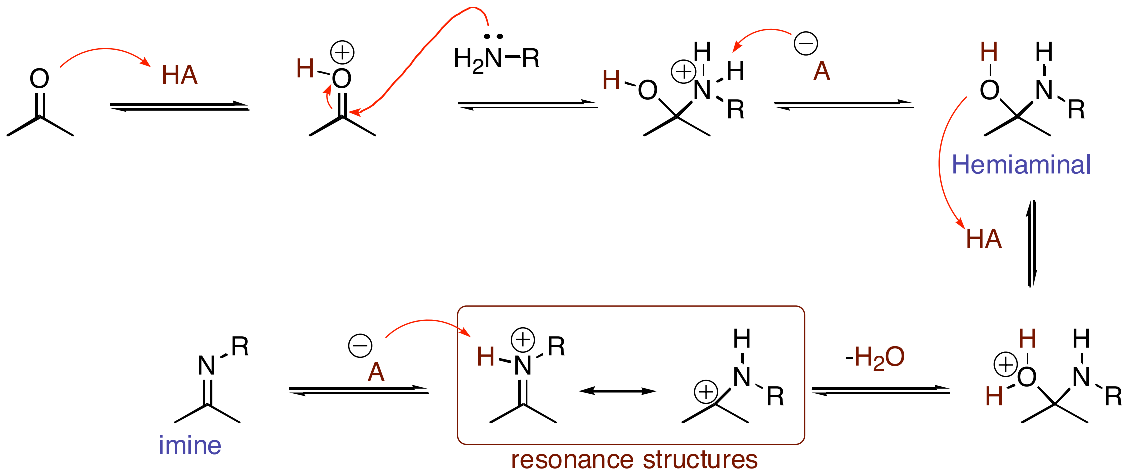
Primary amines (RNH_2) will react with aldehydes and ketones to form Imines. If the amine is a secondary amine (R_2NH) then enamines are formed. This is an acid-catalyzed reaction very similar to acid catalyzed hydration.





Imine formation begins just like the hydration of ketones. The acid protonates the carbonyl making it more electrophilic. The amine attacks the carbonyl carbon and the conjugate base takes the proton off of the nitrogen. This generates a hemiaminal. This is not very stable. If the acid protonates the OH group, it can leave, facilitated by the lone pair on nitrogen. The conjugate base then deprotonates the nitrogen to form the imine.

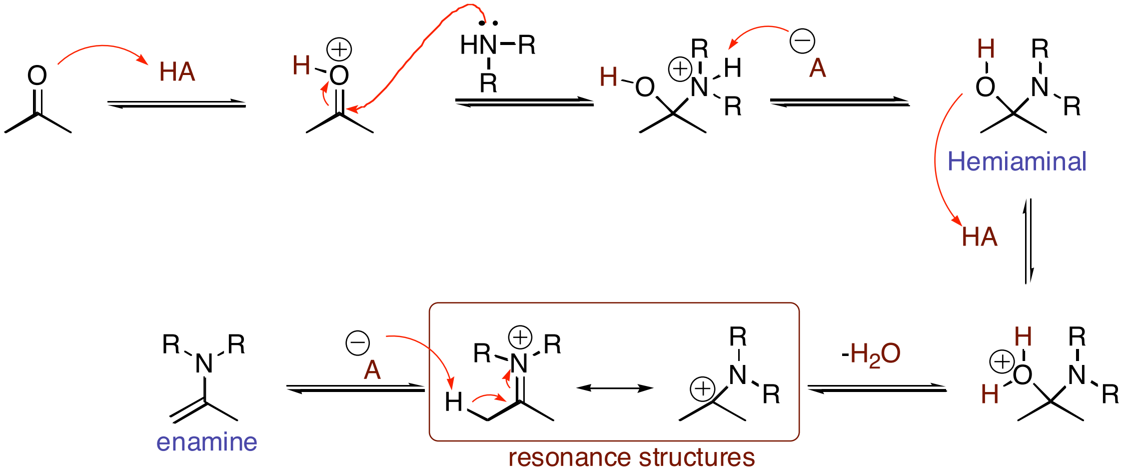
Mechanism for Imine Formation



Up to here this is identical to a hydration with amine as nucleophile instead of water

The mechanism for the formation of an enamine from a secondary amine is exactly the same up to the last deprotonation step. As there is no hydrogen on the nitrogen, the conjugate base deprotonates the alpha carbon instead, neutralizing the intermediate and forming the carbon-carbon double bond.

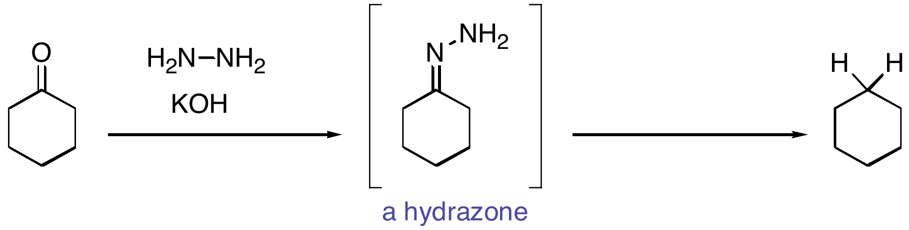
Mechanism for Enamine Formation



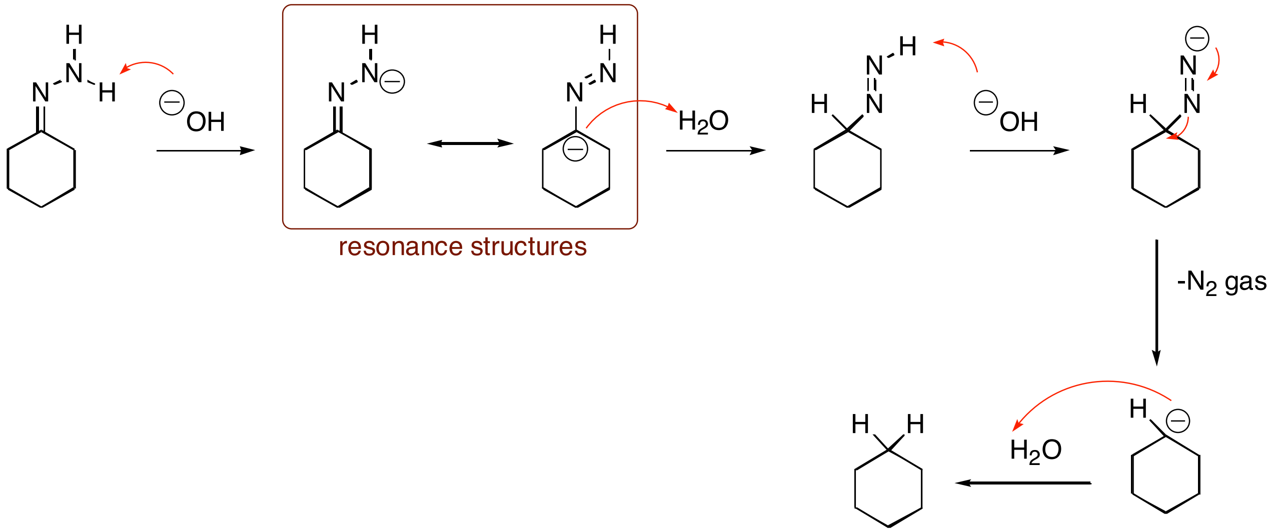
The only difference is this last step. There is no proton on the nitrogen to come off, so a proton is taken off of the alpha carbon

Wolff-Kishner Reduction

A special type of imine called a hydrazone (made from hydrazine) undergoes a reduction in the presence of base. The imine forms exactly as shown above. The mechanism for the reduction involves successive deprotonation from the nitrogen and protonation on the carbon with loss of nitrogen gas.

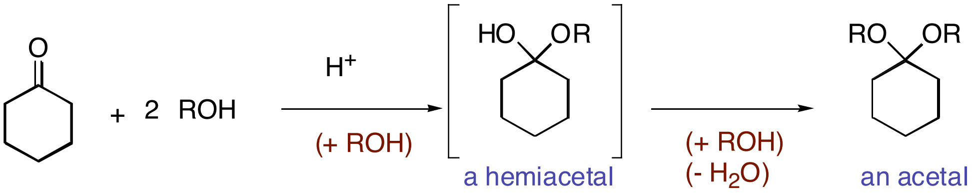


Mechanism for Wolff-Kishner Reduction

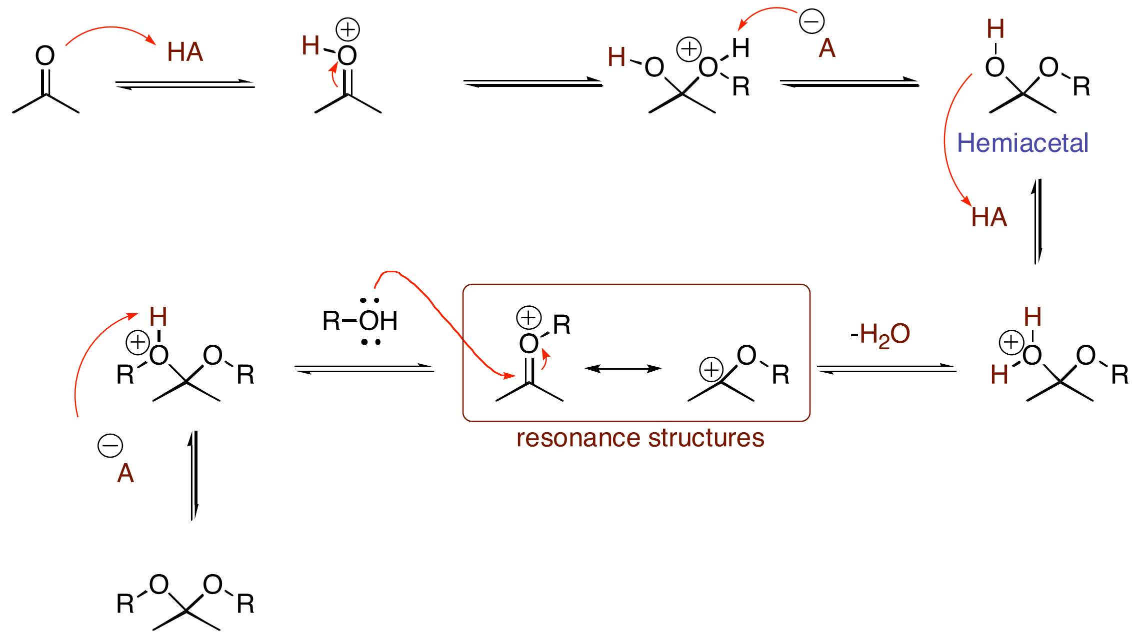


Acetal Formation

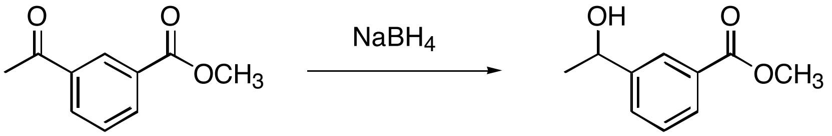
An acetal is similar to a hydrated carbonyl except instead of water adding, an alcohol is added. Acetals are relatively stable and can be used as protecting groups for aldehydes and ketones.



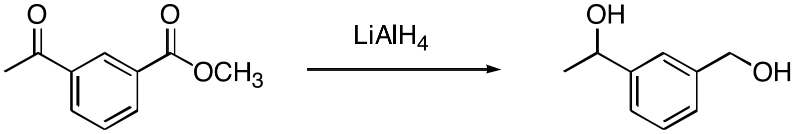
Mechanism for Acetal Formation



Up to here this is identical to a hydration with alcohol as nucleophile instead of water

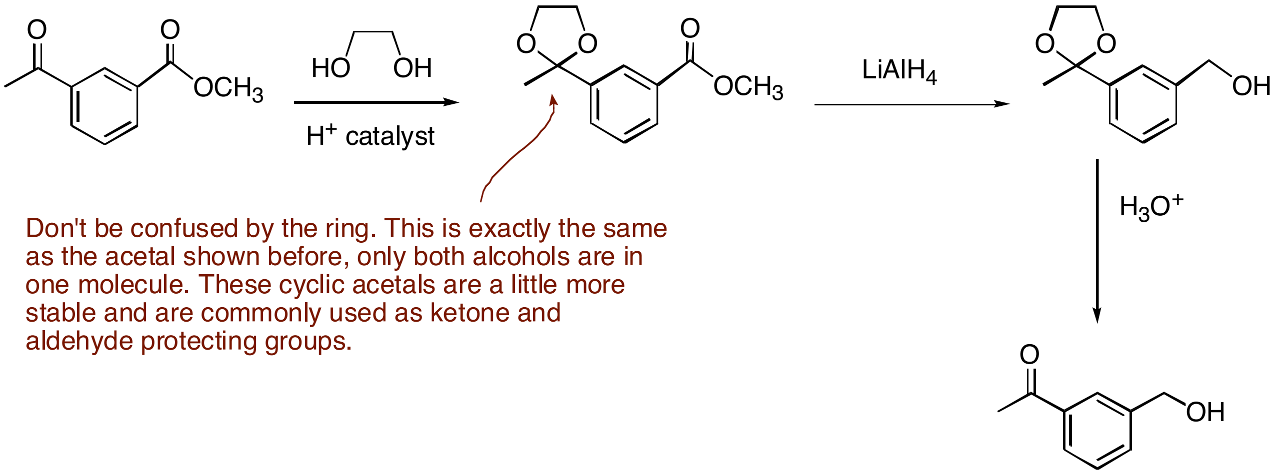


sodium borohydride reduces the ketone



lithium aluminum reduces the ketone and the ester

How do we reduce the ester but not the ketone? Protect the ketone as an acetal first!!



Don't be confused by the ring. This is exactly the same as the acetal shown before, only both alcohols are in one molecule. These cyclic acetals are a little more stable and are commonly used as ketone and aldehyde protecting groups.