

3.17: Summary of Elementary Steps

The reactions of carbonyls can become very complicated, involving many steps. In essence, though, the steps involve only a few, different elementary reactions.

- [Donation to the carbonyl.](#)
- A lone pair is donated from a nucleophile to the carbonyl carbon, forming a bond.

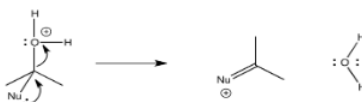


- [Proton transfer.](#)
- Protons are most often transferred from a positively charged atom to a neutral atom with a lone pair.
- Protons are also easily transferred from a positively charged atom to a negatively charged atom.
- Sometimes, a proton might be transferred from a neutral atom to a negatively charged one.



In many of the reactions of anionic and semi-anionic nucleophiles, these two steps complete the entire reaction mechanism. However, if an additional lone pair can be revealed at the nucleophilic atom (often by transferring a proton away from this site), additional steps occur.

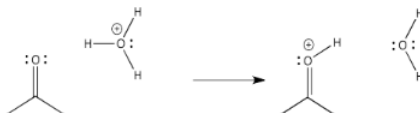
- [Pi donation.](#)
- In pi donation, two heteroatoms, both with lone pairs, are attached to the same carbon. A lone pair is donated to the carbon, and one of the heteroatoms is pushed off.



Many mechanisms involve a number of proton transfers and pi donations. These steps occur over and over, inching the molecule along step by step towards the product. Usually, each proton transfer helps to prepare an atom for eventual removal via pi donation.

Occasionally, if the nucleophile is neutral, these steps are preceded by an initial activation step.

- [Carbonyl activation.](#)
- Usually makes the reaction faster.
- Is especially helpful when the nucleophile is uncharged, and hence less reactive.
- The carbonyl is often activated by a proton (from a protic acid) but it can also be activated by a Lewis acid (such as a metal ion).



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