Chapter 12

Understanding Strategies for Assessing Leaving Groups and Nucleophiles

(Illustrated by Reactions of Carbonyl Compounds)

Key Concepts

The more electron shells an atom has, the longer and weaker its bond. That means if carbon has four sigma bonds, but must form a new bond during a reaction, it usually breaks its bond to the atom with the most shells. Since any atom with only two shells makes a fairly short, strong bond, it must have assistance to become an acceptable leaving group atom even if it is highly electronegative. Factors such as relative electronegativity, electron-withdrawing atoms, resonance, and charge may be important additional features to assess when selecting the leaving group.

The characteristics that make an atom want to break its bond make it less effective at forming a bond to carbon. In other words, when there isn't significant interference from the solvent, a good leaving group is a bad nucleophile and vice versa.

What You Need to Learn, Understand, and Apply

1. **How to tell when a reaction requires a leaving group.**
2. **How to determine the leaving group of a reaction, and how to determine the relative strengths of nucleophiles when the solvent doesn't interfere significantly.**
3. **The options for creating a leaving group when an electronegative atom attached to carbon has only two shells.**
4. **How to label the Re and the Si face of a carbonyl group.**
5. **How to predict the stereochemistry of a product when a chirality center is created during the reaction of a carbonyl carbon.**
6. **The skills needed to apply the material and to avoid common errors. Also, the ability to define and recognize a Schiff base, hemi-acetal, acetal, hemi-ketal, and ketal.**