

Nucleophilic Substitution vs Elimination Reaction

The reaction of an alkyl halide or tosylate with a nucleophile/base results either in substitution or in elimination. The resultant nucleophilic substitution and base-induced elimination reactions are two of the most widely occurring and versatile reaction types in organic chemistry, both in the laboratory and in biological pathways.

Nucleophilic substitutions are of two types: SN2 reactions and SN1 reactions. In the SN2 reaction, the entering nucleophile approaches the halide from a direction 180° away from the leaving group, resulting in an umbrella-like inversion of configuration at the carbon atom. The reaction is kinetically second-order and is strongly inhibited by increasing steric bulk of the reactants. Thus, SN2 reactions are favored for primary and secondary substrates.

In the SN1 reaction, the substrate spontaneously dissociates to a carbocation in a slow rate-limiting step, followed by a rapid reaction with the nucleophile. As a result, SN1 reactions are kinetically first-order and take place with substantial racemization of configuration at the carbon atom. They are most favored for tertiary substrates. Both SN1 and SN2 reactions occur in biological pathways, although the leaving group is typically a diphosphate ion rather than a halide.