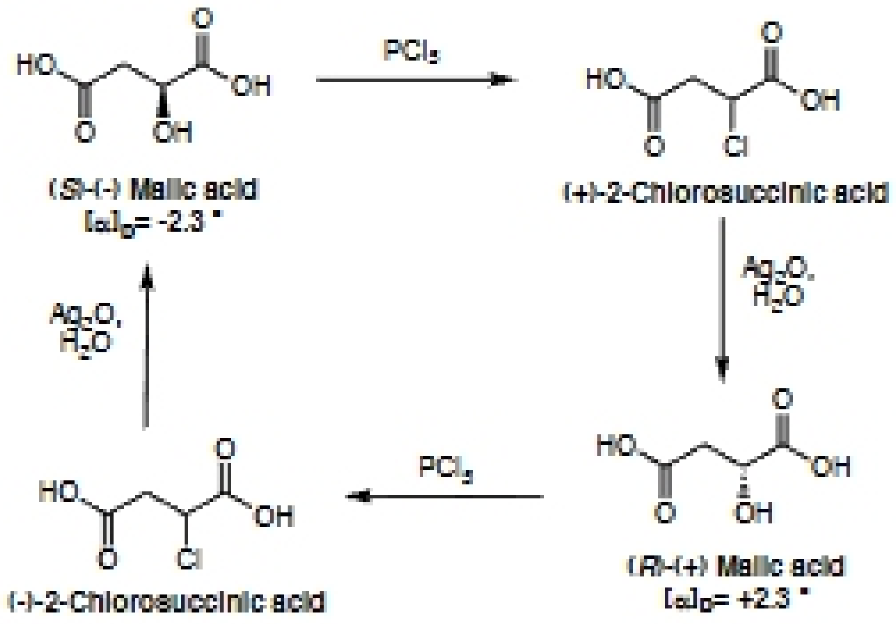
Chapter 11: Nucleophilic Substitution and Elimination

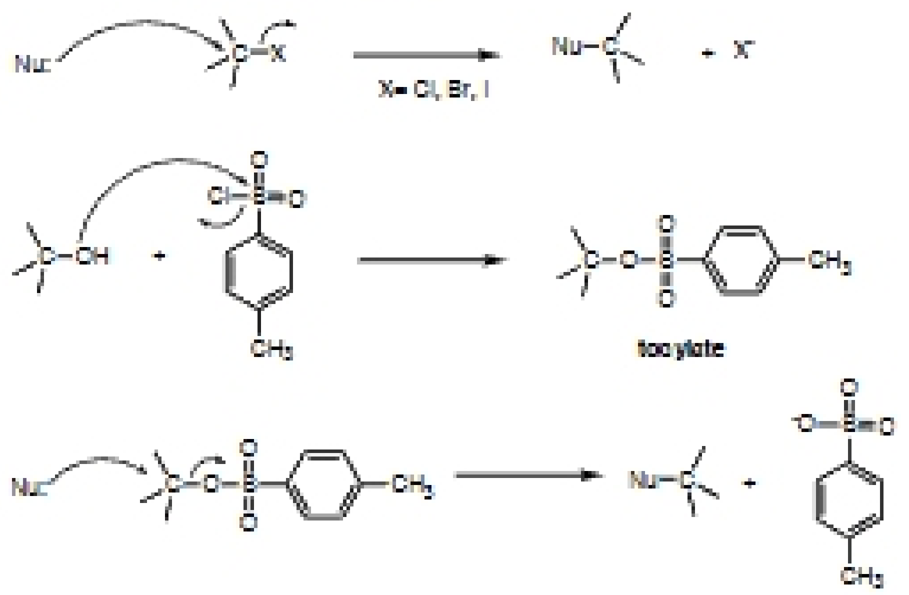
Walden Inversion

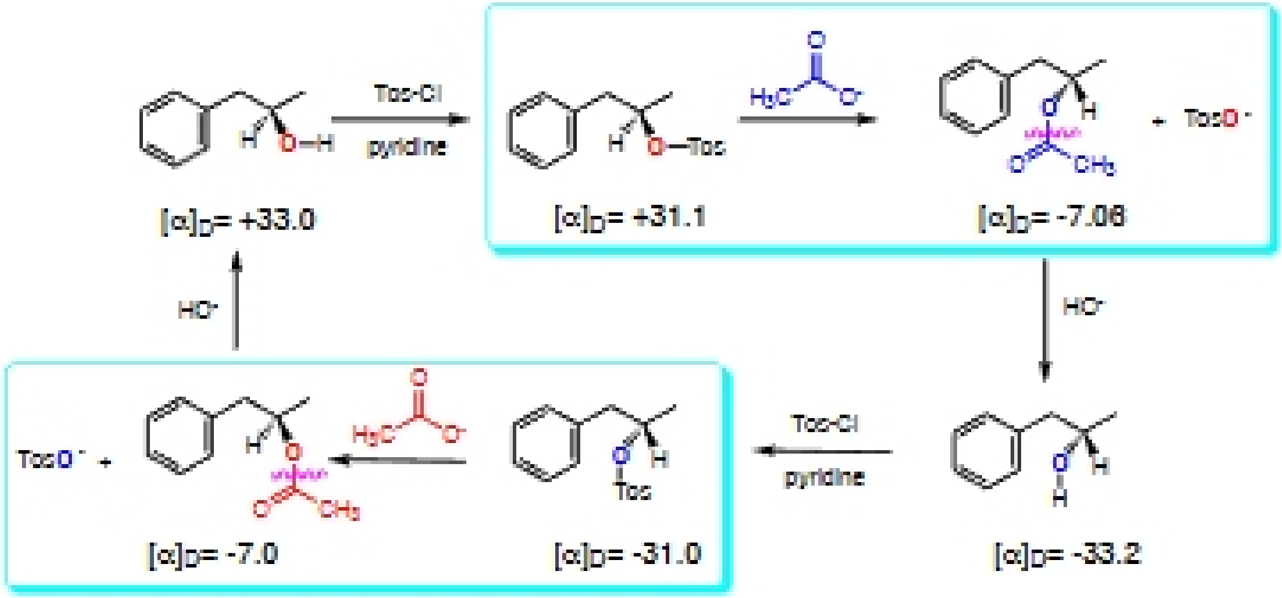


The displacement of a leaving group in a nucleophilic substitution reaction has a defined stereochemistry

Stereochemistry of nucleophilic substitution

p-toluenesulfonate ester (tosylate): converts an alcohol into
a leaving group; tosylate are excellent leaving groups.
abbreviates as Tos





The nucleophilic substitution reaction "inverts" the Stereochemistry of the carbon (electrophile)- Walden inversion

Kinetics of nucleophilic substitution

Reaction rate: how fast (or slow) reactants are converted into product (kinetics)

Reaction rates are dependent upon the concentration of the reactants. (reactions rely on molecular collisions)

Consider:

At a given temperature:

If [OH^-] is doubled, then the reaction rate may be doubled
If [CH_3-Br] is doubled, then the reaction rate may be doubled

A linear dependence of rate on the concentration of two reactants is called a second-order reaction (molecularity)

Reaction rates (kinetic) can be expressed mathematically:
reaction rate = disappearance of reactants (or appearance of products)

For the disappearance of reactants:

rate = k $[CH_3Br]$ $[OH^-]$

$[CH_3Br]$ = CH_3Br concentration

$[OH^-]$ = OH^- concentration

k= constant (rate constant) $\frac{L}{mol \bullet sec}$

For the reaction above, product formation involves a collision between both reactants, thus the rate of the reaction is dependent upon the concentration of both.

Nucleophilic Substitution comes in two reaction types:

S_N2	**S_N1**
S= substitution N= nucleophilic 2= biomolecular	S= substitution N= nucleophilic 1= unimolecular
rate = k [R-X] [Nu:]	rate = k [R-X]