

S_N2 Displacement At sp^3 Centers

from chapter(s) _____ in the recommended text

A. Introduction

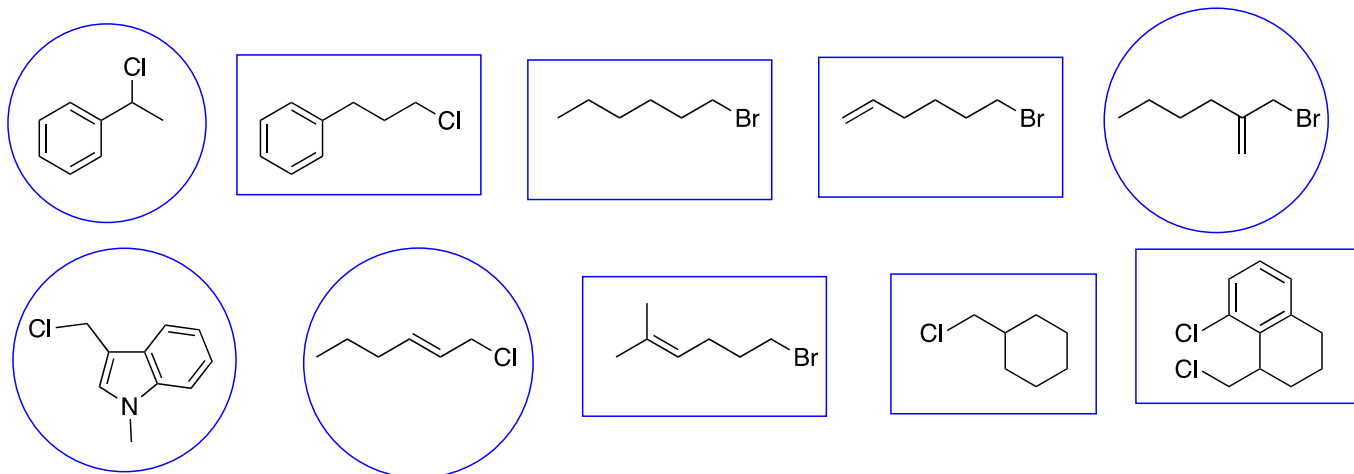
B. Differentiating S_N1 and S_N2

S_N2 describes reactions in which one *replaces another* and *with second order kinetics*.

Inversion of configuration is observed in S_N2 processes whereas S_N1

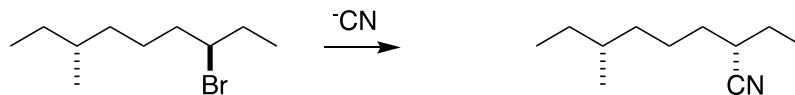
unstable carbocations tend to proceed via S_N2 pathways.

tertiary carbocations often proceed via S_N1 mechanisms.

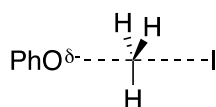


Stereochemical Inversion In S_N2 Reactions





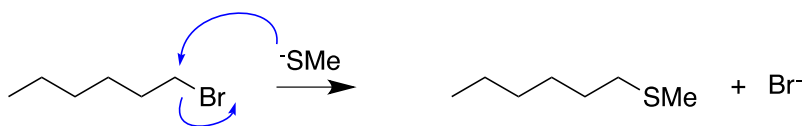
Transition states in $\text{S}_{\text{N}}2$ displacement processes have geometries that resemble *trigonal bipyramidal*



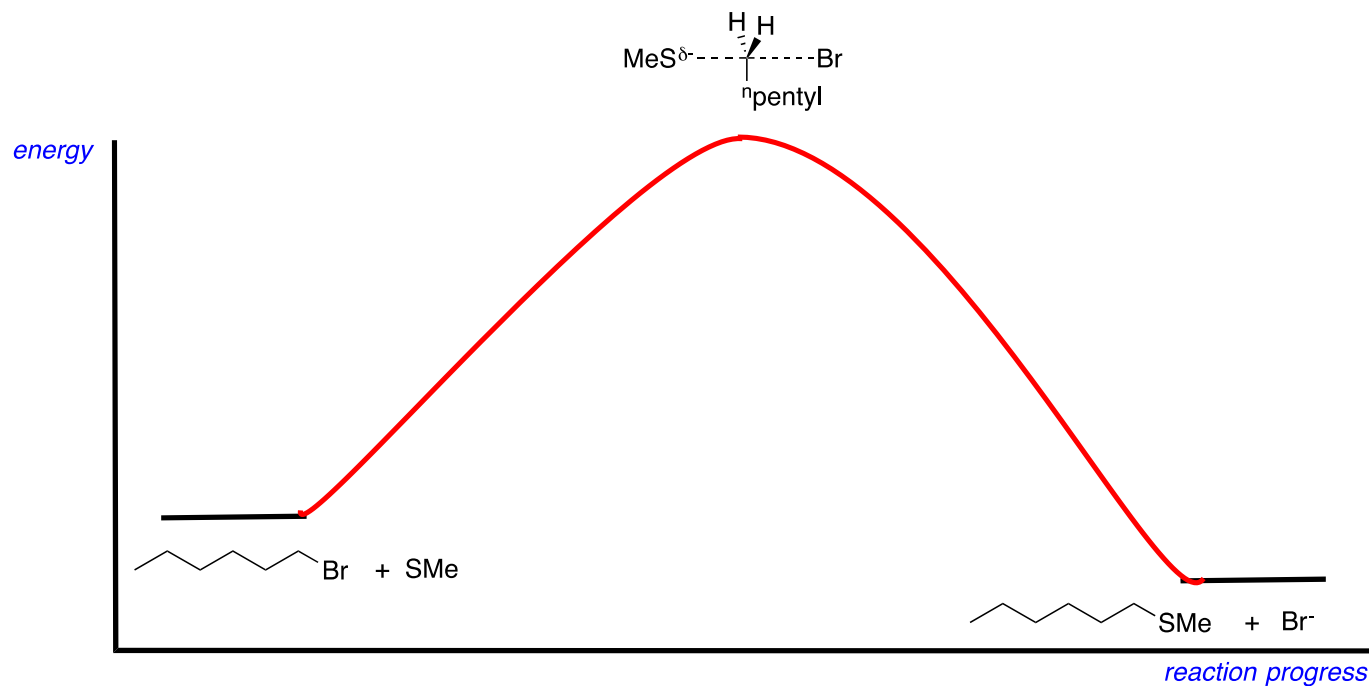
we might call that $\text{S}_{\text{B}}2$.

her classmate Kurt Donothurt had a $\text{S}_{\text{C}}1$

Kinetics And $\text{S}_{\text{N}}2$ Pathways



product plus by-product



Note: This process does not include an intermediate, and the simultaneous substitution is the slow or rate determining step.

concentration of the nucleophile *doubles*

Reaction of methyl iodide with azide is *accelerated*

A substrate that might react via both S_N1 and S_N2 pathways is *more*

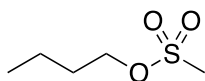
The transition state in a S_N2 reaction is *less*

C. Interconversion Of Enantiomers And Diastereomers

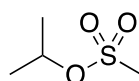
Conversion Of Alcohols Into Leaving Groups

Hydroxyl groups *are not* good leaving groups

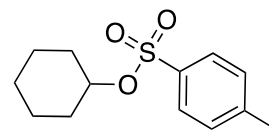
tosylates or mesylates makes them into much *better*



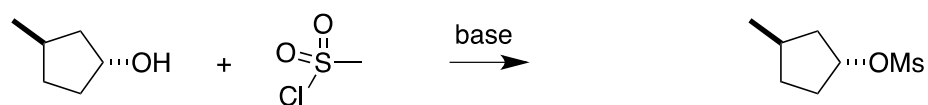
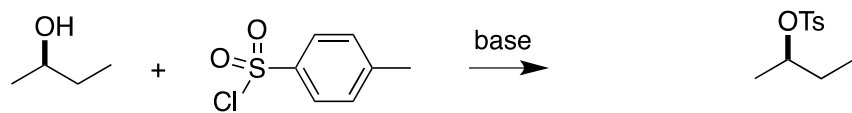
*n*butyl mesylate



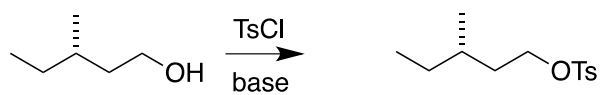
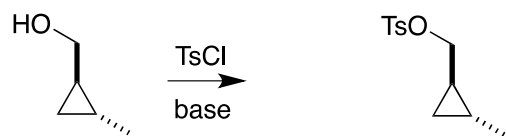
*i*propyl mesylate



cyclohexyl tosylate



^sbutyl tosylate



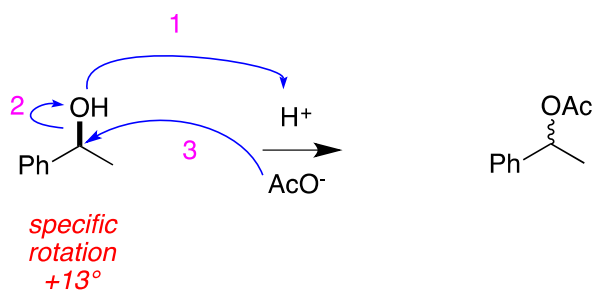
Mesyl is an $-S(O)_2Me$ group, and mesylate is $-O-SO_2Me$.

Tosyl is an $-S(O)_2Ar$ group, and tosylate is $-O-SO_2Ar$ (where Ar is $-C_6H_4-4-Me$).

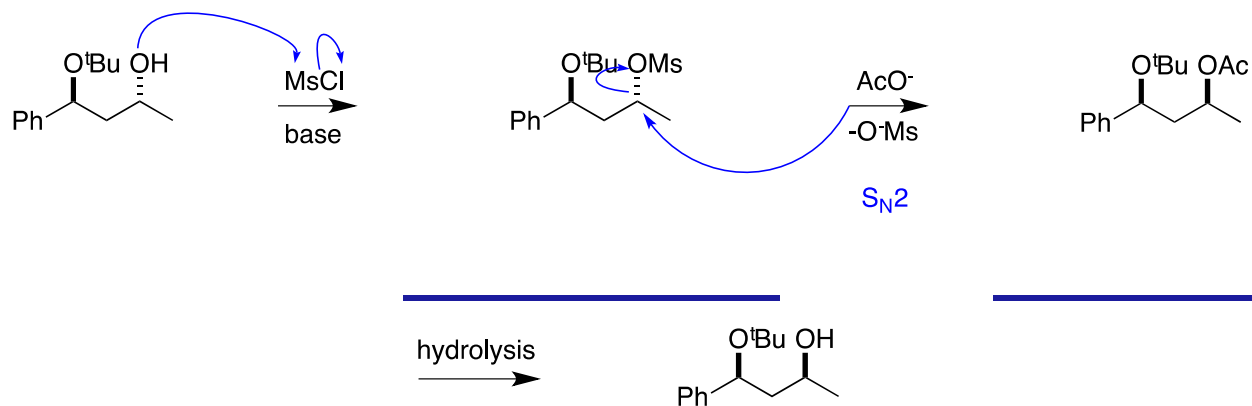


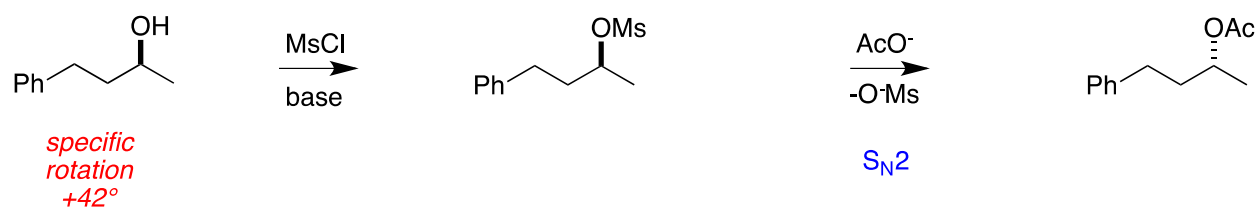
Mesylates and tosylates are *better* leaving groups than hydroxide formed with *retention* of configuration
 S_N2 processes with complete *inversion* stereochemistry.

The first reaction is most like S_N1 .

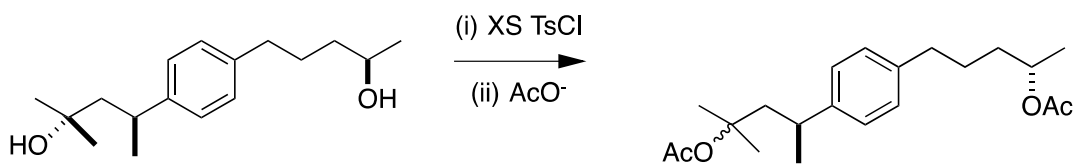
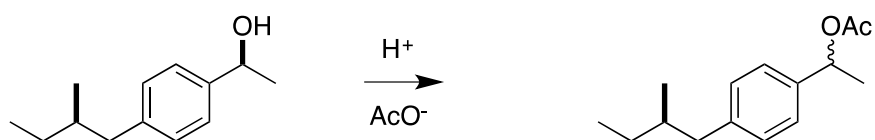


specific rotation $= 0^\circ$





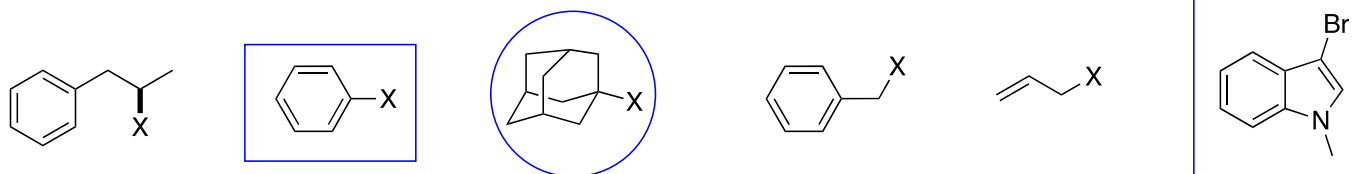
specific rotation = -42°



product of one $\text{S}_{\text{N}}1$ and one $\text{S}_{\text{N}}2$ reaction

Stereoelectronic Effects

S_N2 reactions occur via approach of a nucleophile in a trigonal bipyramidal *transition state* cannot readily undergo bimolecular nucleophilic

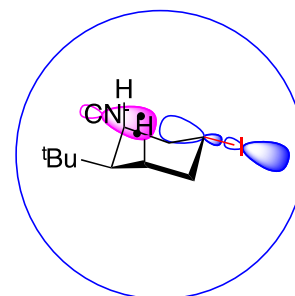
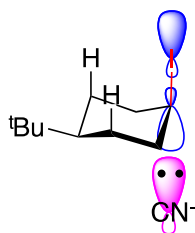


S_N1 displacements involve interaction of a LUMO on the substrate with a nucleophile *HOMO*.

In S_N1 reactions the LUMO is *the empty p-orbital of the carbocation*.

S_N2 displacements involve interaction of a LUMO on the substrate with a nucleophile *HOMO*.

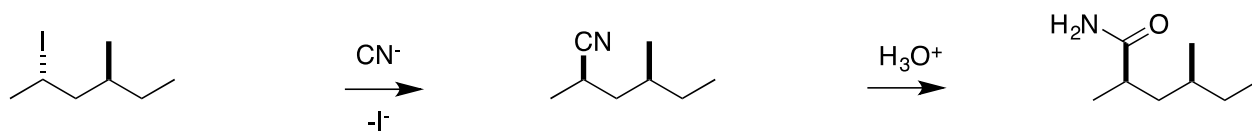
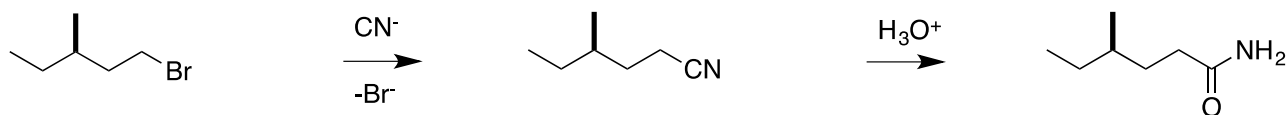
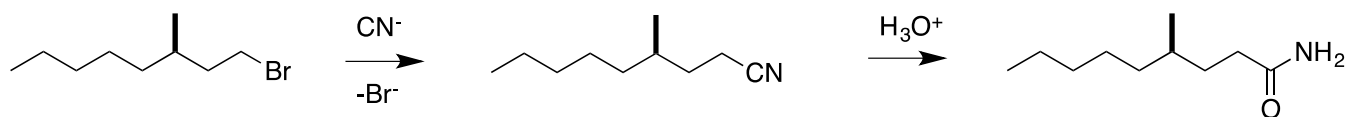
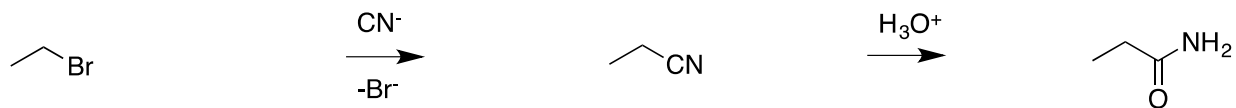
In S_N2 reactions the LUMO is a σ^* orbital.

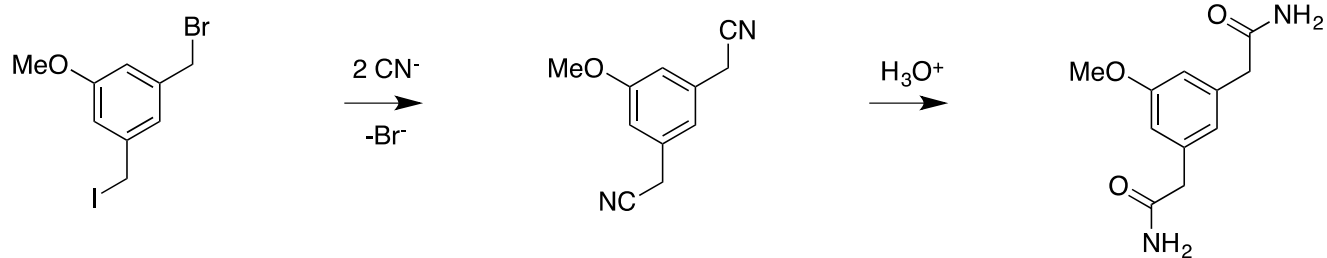


draw C - I σ^ -orbitals and orientation of S_N2 displacement by CN^-*

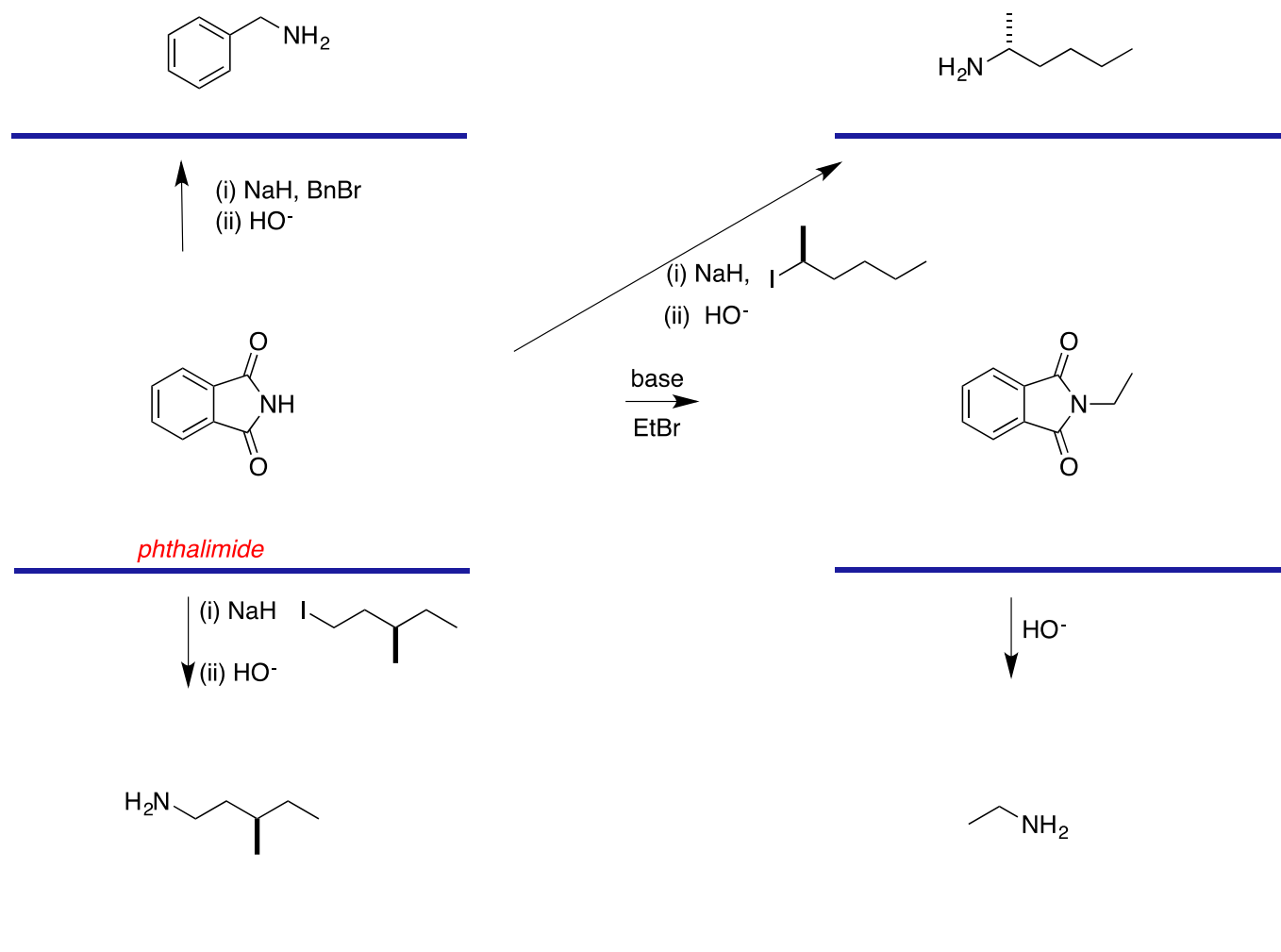
D. S_N2 Reactions Applied To Make Amides And Amines

Cyanide: A Useful C-Nucleophile





This type of transformation (nitrile displacement then hydrolysis) works for MeI / BnI / allyl bromide
Phthalimide: Useful N-Nucleophile For Syntheses Of Primary Amines



Using this reaction it is possible to make *primary amines*
This so called *Gabriel* synthesis is a *better*