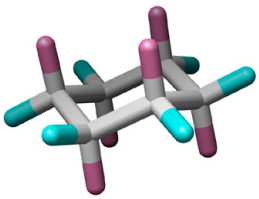


Chem 341 • Organic Chemistry I

Lecture Summary 31 • November 07, 2007

Chapter 11 - Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations

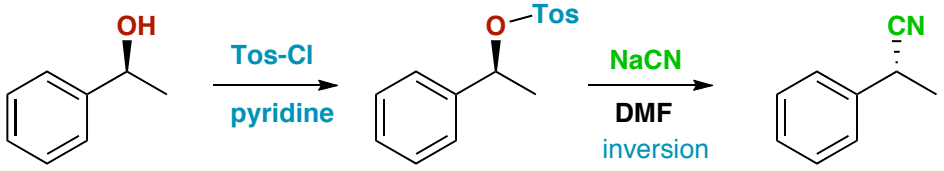
S_N1 and S_N2 Comparison

Below is a table comparing the features important for each mechanism for substitution. The substrate type is probably the most important factor.

	S_N1	S_N2
SUBSTRATE	3° >> 2° > 1°	1° > 2° >> 3°
NUCLEOPHILE	Weak OK	Strong
LEAVING GROUP	Stable Anions	Stable Anions
SOLVENT	Polar Protic	Polar Aprotic
STEREOCHEM	Racemic	100% inversion

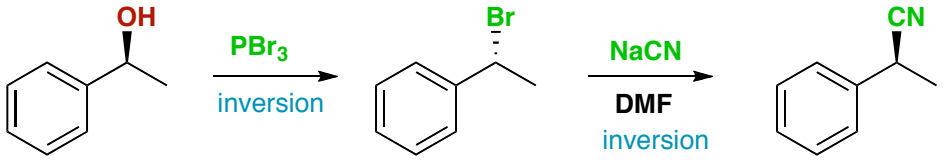
Stereochemistry of Substitution Reactions

Alcohols can be activated two ways to make them into good leaving groups for S_N2 reactions. Making a tosylate does not change the original stereochemistry of the alcohol. Thus subsequent substitutions result in overall inversion of the configuration. If, however, the alcohol is converted to a bromide with PBr_3 then reacted with a nucleophile, two S_N2 reactions take place resulting in overall the same stereochemistry as the starting alcohol.



Note: - this modifies the O-H bond and does not affect the stereochemistry of the C-O bond.

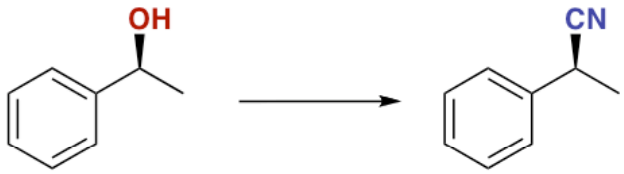
Note: - overall only one inversion has taken place so the final product is opposite that of the starting alcohol.



Note: - this changes the stereochemsitry of the C-O bond to the new C-Br bond.

Note: - overall two inversions result in the same stereochemistry as the starting alcohol.

Quiz of the day

Q:	Which set of conditions shown on the right will lead to successful completion of the following reaction?  	☐ 1:	1) HCl 2) NaCN, DMSO
		☑ 2:	1) PBr_3 2) NaCN, DMSO
		☐ 3:	1) PBr_3 2) HCN, Methanol
		☐ 4:	NaCN, DMF

In number 1, the first step would result in a racemic mixture of chlorides (SN1 reaction). Thus, a racemic product would result.

In number 2, two inversions take place to give overall the cyanide with the same stereochemistry as the starting material.

In number 3, the first step will go with clean inversion to give the bromide, but the second step under protic solvent and HCN will go by SN1 reaction to give racemic products.

In number 4, the nucleophile cannot do substitution directly on the alcohol.