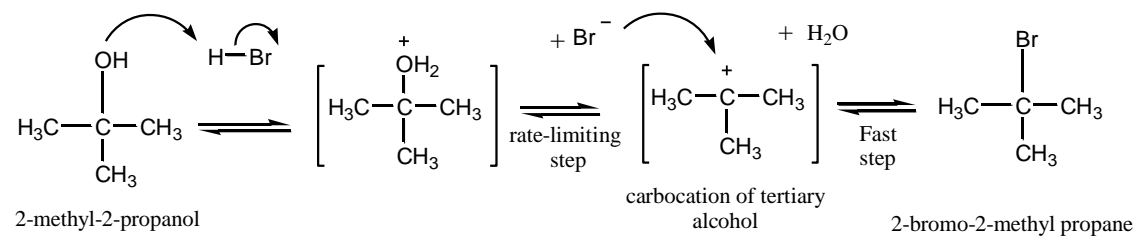


AU Organic Chemistry 360

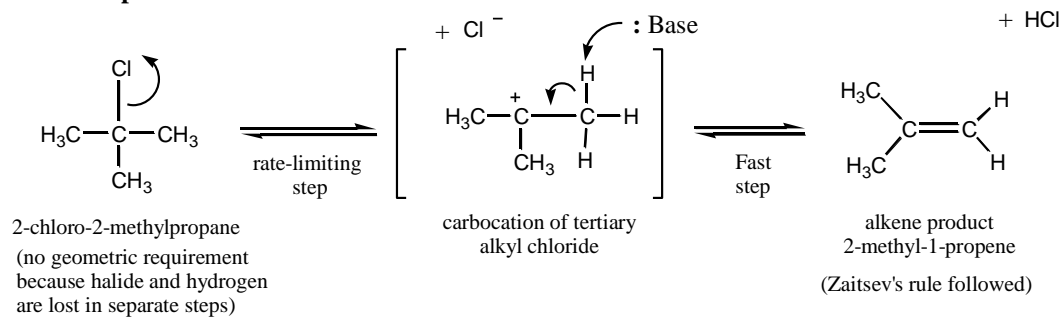
Summary of SN v E reactions

	S_N1:	E1	S_N2	E2
Definition	Substitution, Nucleophilic, unimolecular	Elimination, unimolecular	Substitution, Nucleophilic, bimolecular	Elimination, bimolecular
Reaction Mechanism	Occurs via carbocation intermediate. Shows 1 st order kinetics.	Occurs via carbocation intermediate. 1 st order kinetics Shows no deuterium isotope effect.	One step concerted rxn, no carbocation intermediate. 2 nd order kinetics.	One step rxn, no intermediates. Shows deuterium isotope effect. 2 nd order kinetics.
Reaction Conditions	Cooler temp favors substitution.	Heat favors elimination.	Cooler temp favors substitution.	Heat favors elimination.
Reagents	Substrate reactivity = 3° > 2° ~benzyl~allyl > 1° > methyl Best substrates are ones that yield the most stable carbocation.	Substrate reactivity = 3° > 2° > 1° Primary does not occur. No geometric requirement (because of 2 separate elimination steps)	Substrate reactivity = 1° > 2° > 3° Tertiary does not occur. With secondary halides, E2 and S _N 2 occur in competition. Disfavored by hindered substrates	Anti periplanar geometry required.
Attacking Nucleophile	Not important. Should be non-basic to prevent E2.	Favoured by weak nucleophiles (bases). If non-basic nucleophile (and protic solvent) used, competition with S _N 1 occurs.	Back side attack of nucleophile occurs. Must be good. RS ⁻ > H ⁻ > CN ⁻ > I ⁻ > CH ₃ O ⁻ > NH ₃ ⁻ > Br ⁻	Strong bases work best (e.g., RO ⁻ , OH ⁻ , H ₂ N ⁻) Also occurs if a big bulky base such as tert-butoxide is used.
Leaving Group	Requires good leaving group = form stable anions (conjugate bases of strong acids) = TosO ⁻ > I ⁻ > Br ⁻ > Cl ⁻ >>> F ⁻ > OH ⁻ > H ₂ N ⁻ > RO ⁻ Directly involved in rate limiting step. Neutral water also acts as leaving group.		Requires good leaving group = form stable anions = TosO ⁻ > I ⁻ > Br ⁻ > Cl ⁻ >>> F ⁻ > OH ⁻ > H ₂ N ⁻ > RO ⁻	
Solvent	Solvents have large effect but for different reasons as in S _N 2. Have to do with stabilization of the transition state, not the nucleophile as in S _N 2.	Favored by polar solvents. If protic solvents such as methanol, ethanol or acetic acid (and non-basic nucleophile) used, competition with S _N 1 occurs.	Polar aprotic solvents (CH ₃ CN, DMF, DMSO) best. They surround the accompanying cation but not the nucleophilic anion, thereby raising the energy of the nucleophile.	Polar protic solvent (e.g., ethanol) in combination with a strong base works best.
	Take place much more rapidly in polar protic solvents, such as water.		Protic solvents (which contain -OH or -NH) are the worst. They can H-bond to the nucleophile, thereby lowering its energy	
Product	Racemic mixtures result from optically active substrates.	Base induced eliminations give more highly substituted alkene (Zaitsev's rule). Rearrangements possible and mixtures of products may form.	'Walden' Inversion of stereochemistry occurs at the chiral carbon.	Most highly substituted alkene formed (Zaitsev's rule). Rearrangements possible and mixtures of products may form.

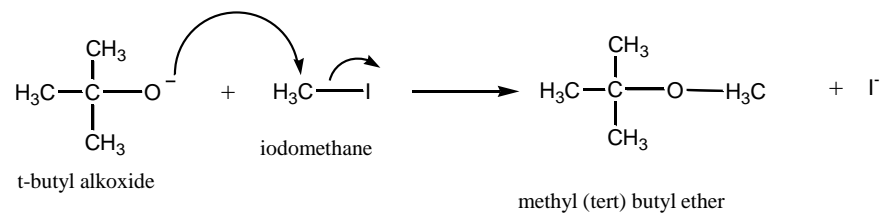
S_N1 Example



E1 Example



S_N2 Example



E2 Example

