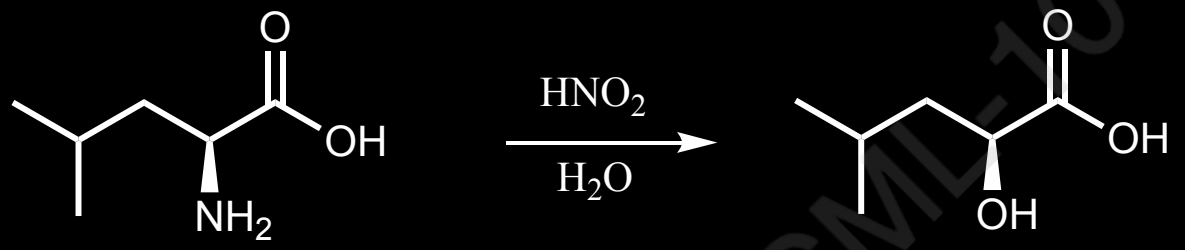
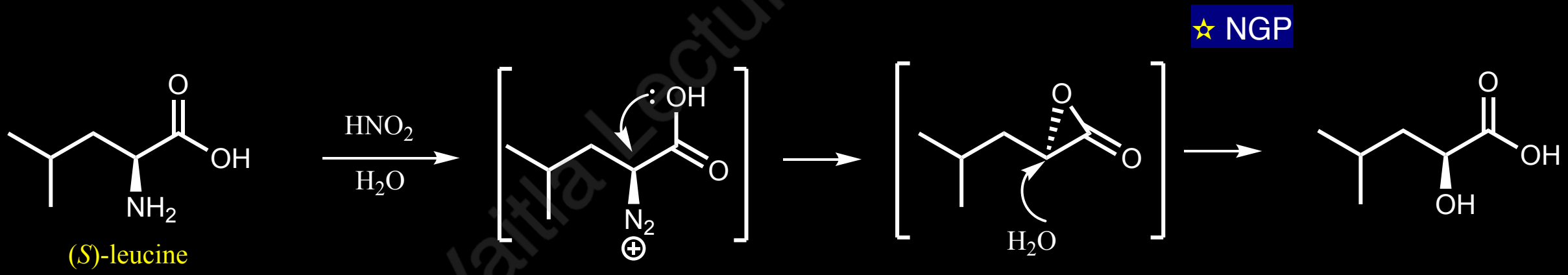
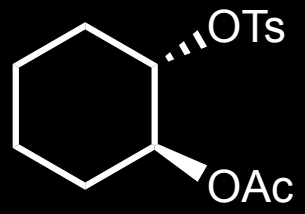
Neighboring Group Participation (Anchimeric assistance)



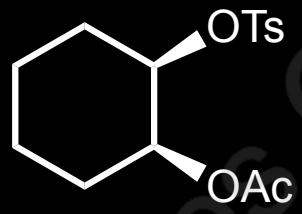


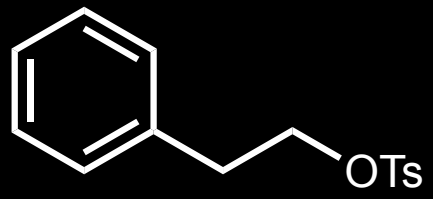
Neighboring Group Participation (Anchimeric assistance)

Reacts with water
600 times faster than

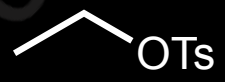


Reacts with CF_3CO_2H
3000 times faster than

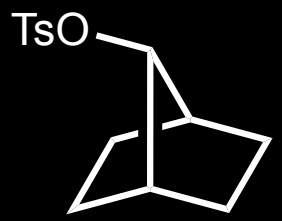




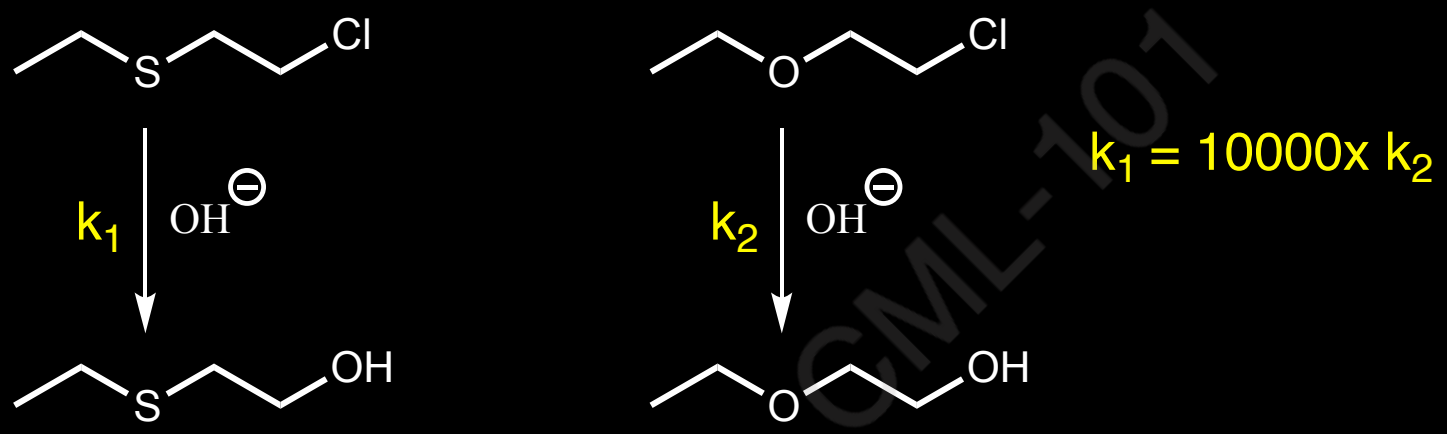
Reacts with CH_3CO_2H
670 times faster than



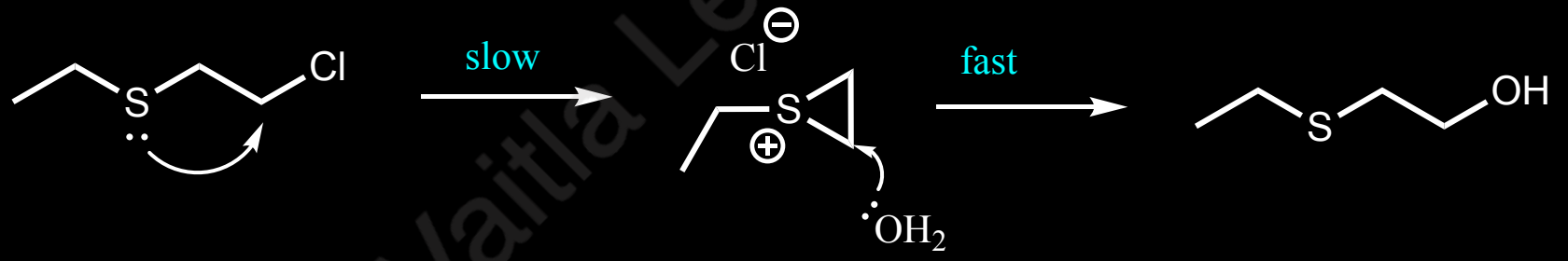
Reacts with CH_3CO_2H
10^6 times faster than



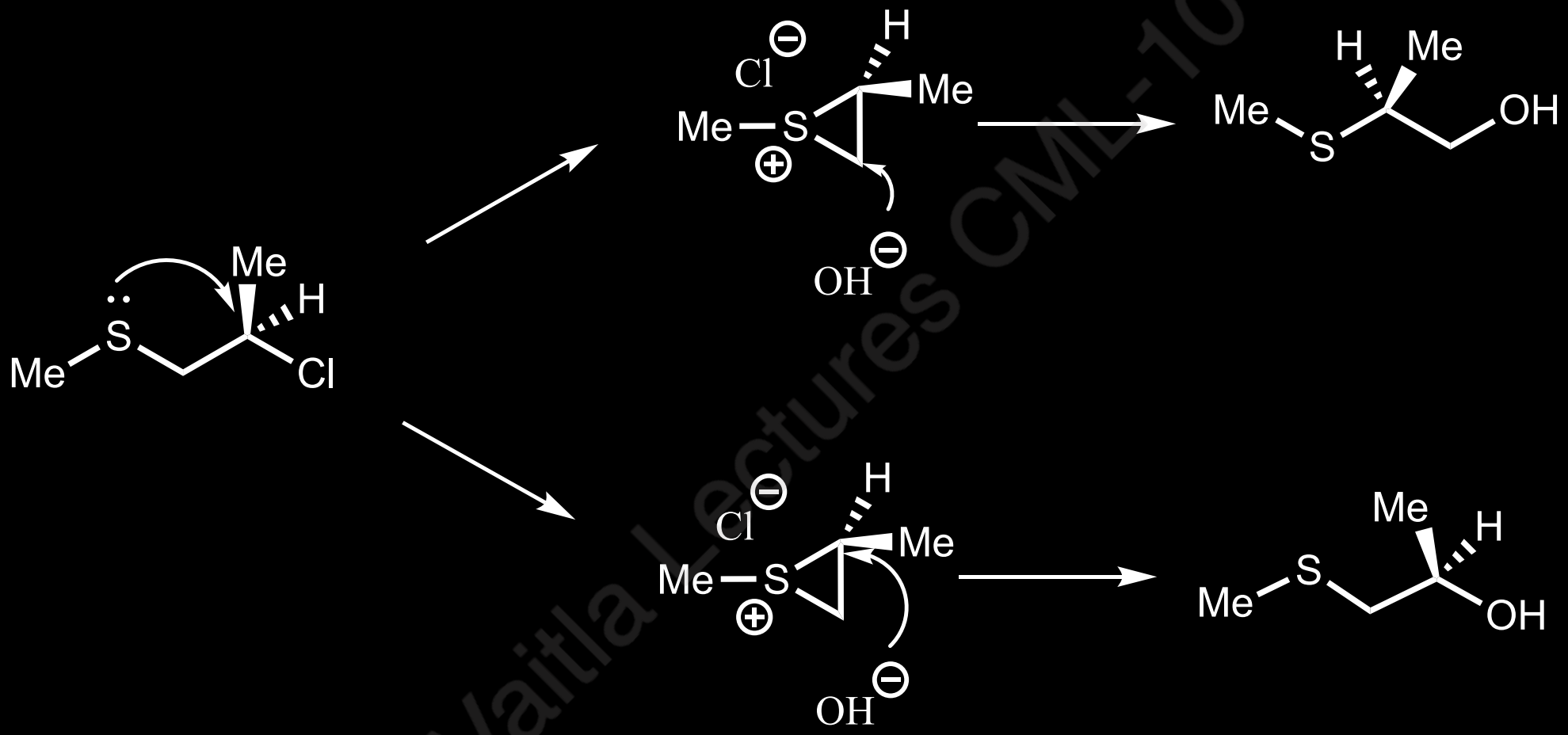
Neighboring Group Participation (Anchimeric assistance)



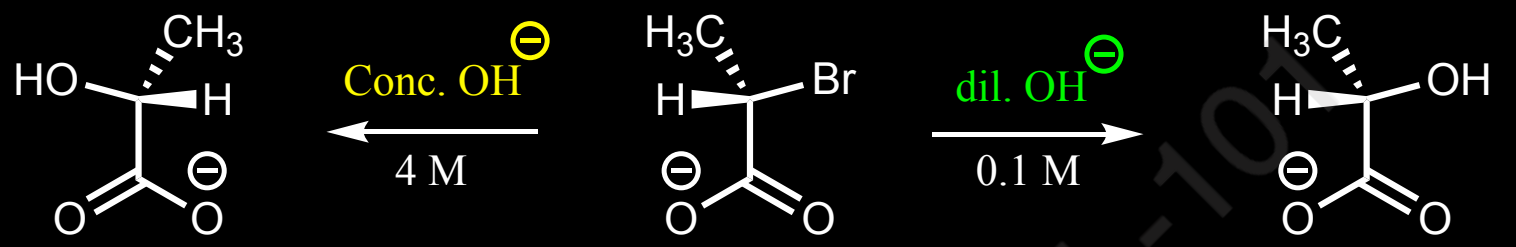
$k_1 = 10000x\ k_2$



Neighboring Group Participation (Anchimeric assistance)



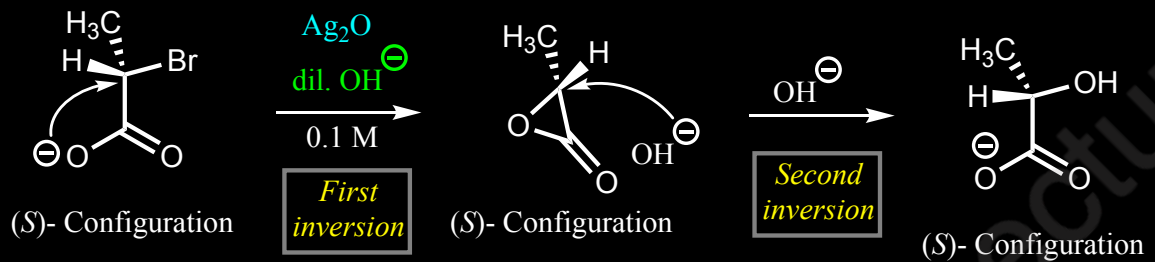
Neighboring Group Participation (Anchimeric assistance)



(*R*)- Configuration
(Inversion)

(*S*)- Configuration

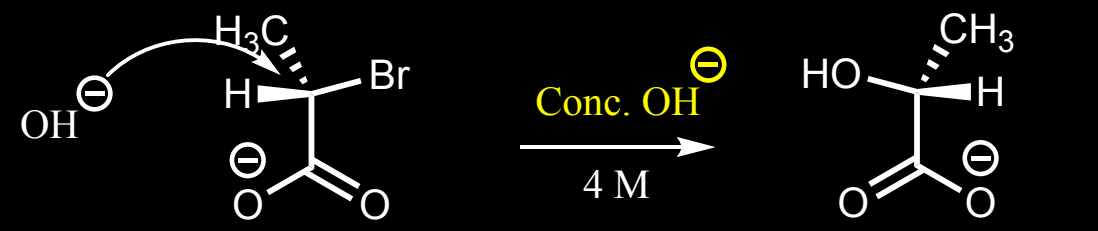
(*S*)- Configuration
(Retention)



(*S*)- Configuration

(*S*)- Configuration

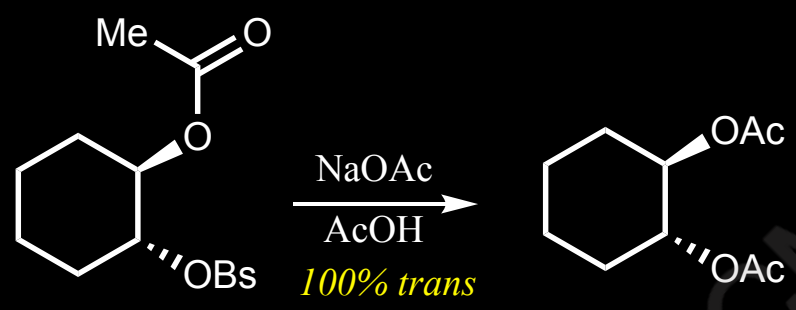
(*S*)- Configuration
(Retention)

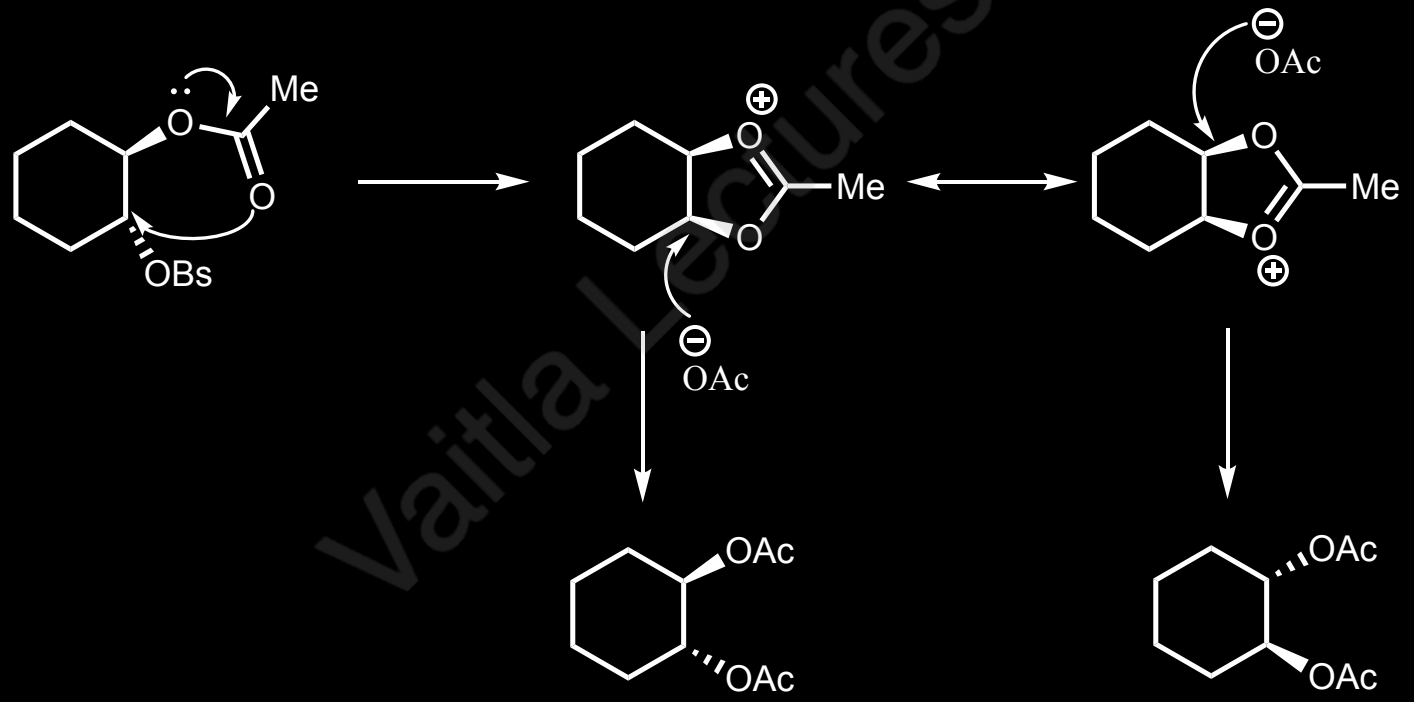


(*S*)- Configuration

(*R*)- Configuration
(Inversion)

Neighboring Group Participation (Anchimeric assistance)

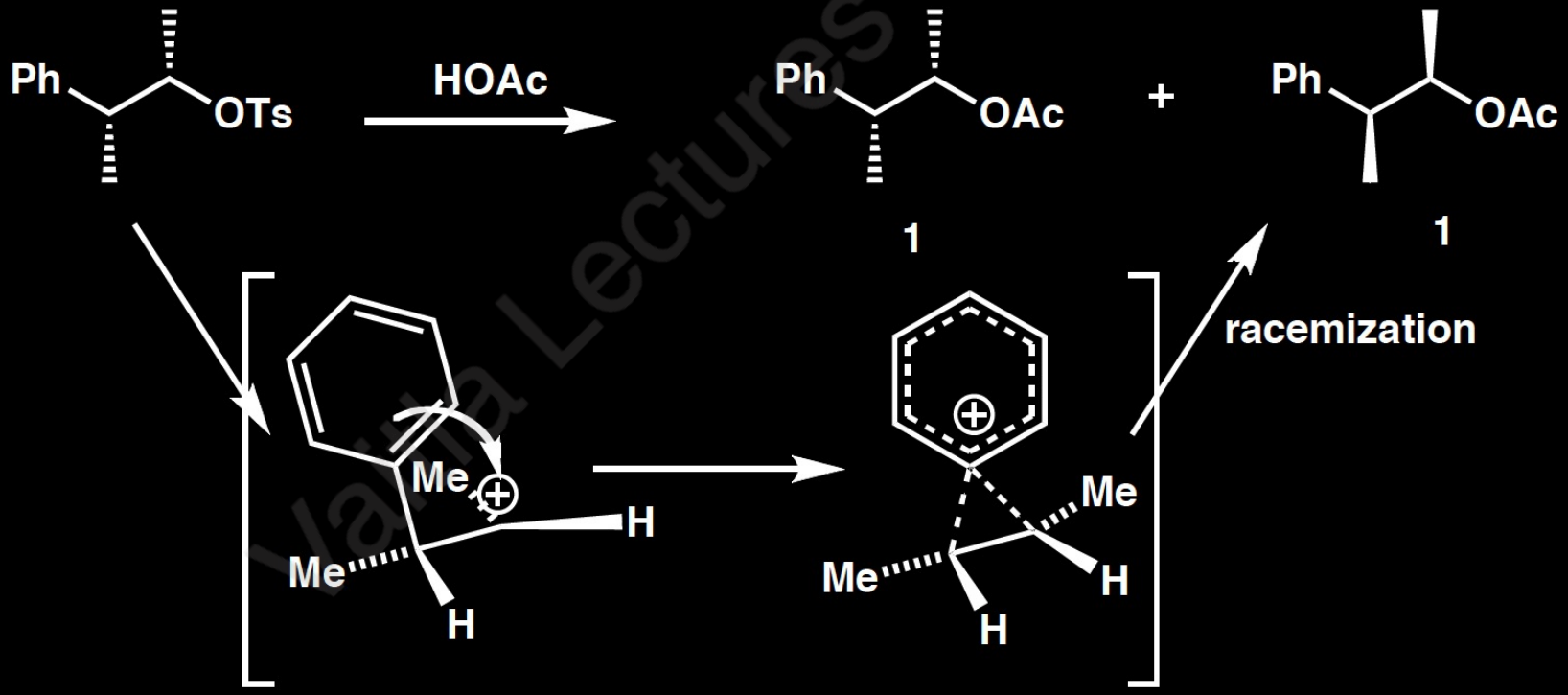




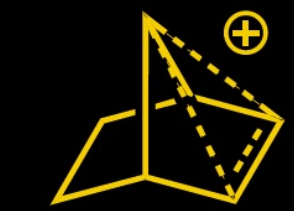
Neighboring Group Participation (Anchimeric assistance)

phenonium ion

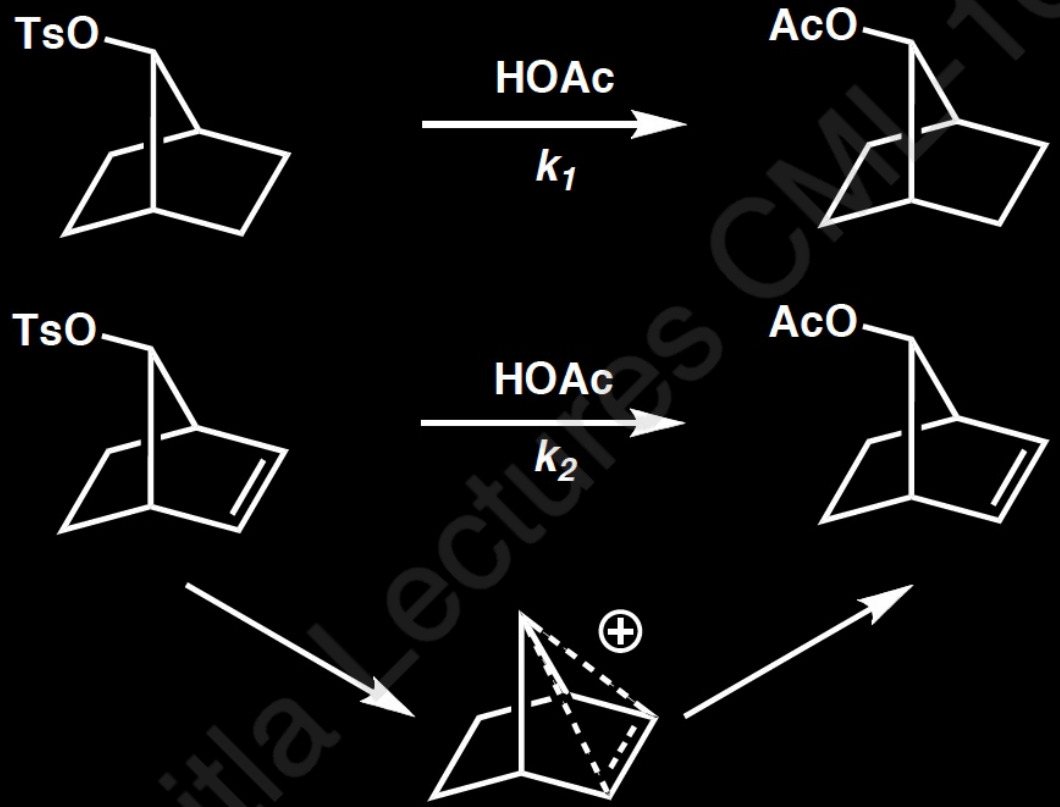
Aromatic group participation

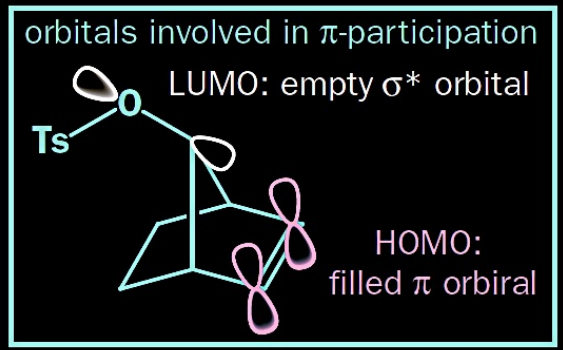


Neighboring Group Participation (Anchimeric assistance)



7-norbornenyl

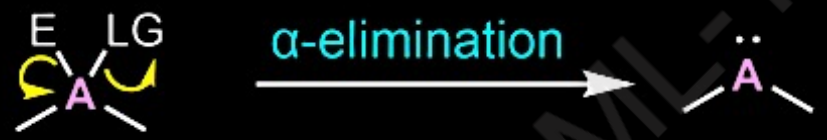




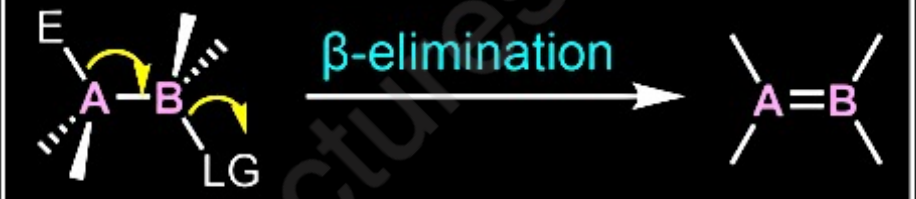
$k_2/k_1 = 10^{11}$

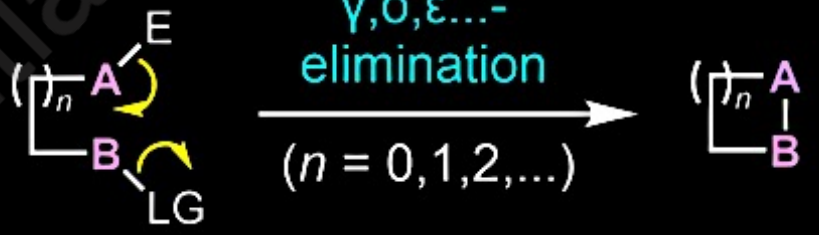
Norbornene Solvolysis occurs with complete retention of stereochemistry!

Elimination reactions



most common:

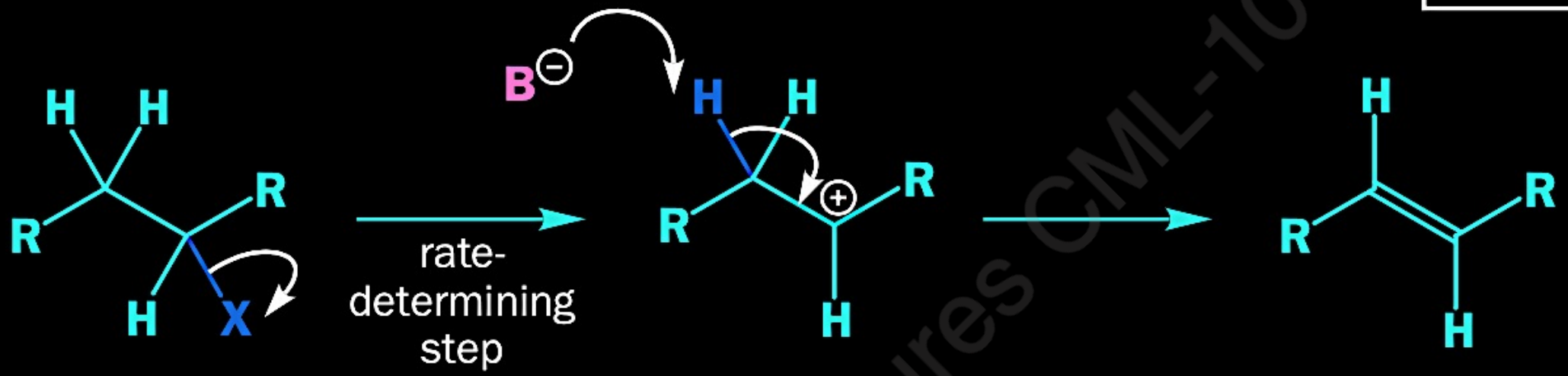




Elimination reactions

general mechanism for E1 elimination

rate = k[alkyl halide]

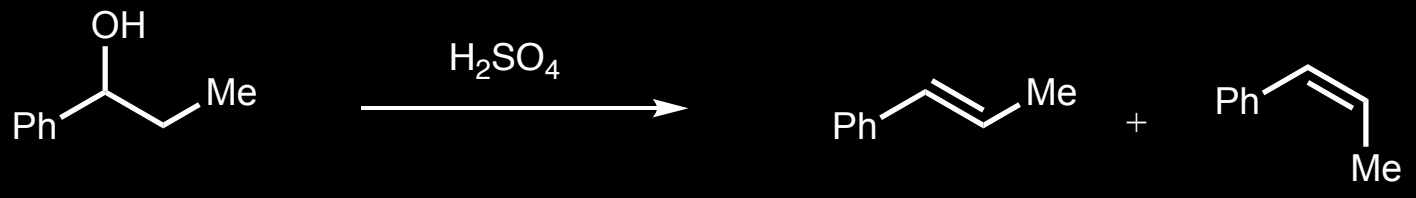


general mechanism for E2 elimination

rate = k[B^-][alkyl halide]

Elimination reactions

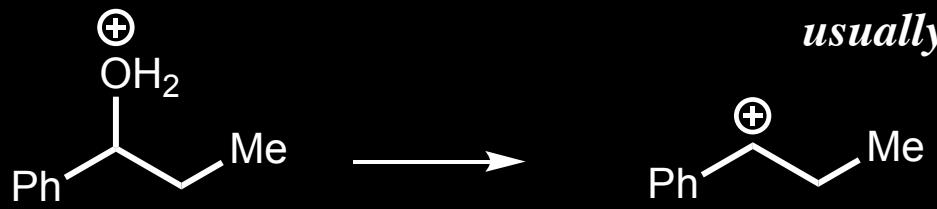
(Stereoselective reaction)

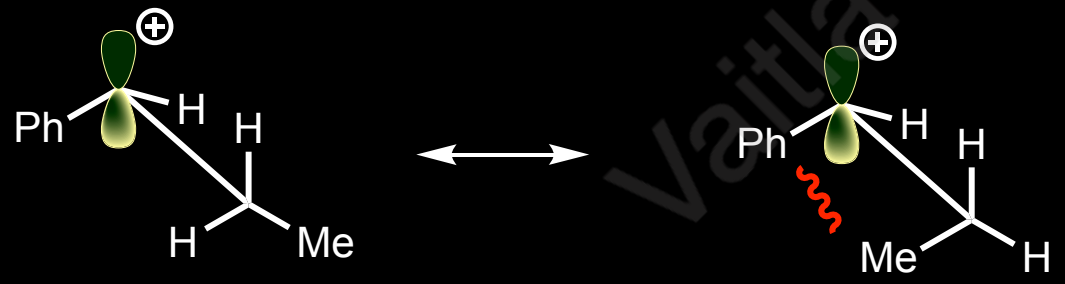


95% *E*-alkene

5% *Z*-alkene

(For steric reasons, E-alkenes are usually lower in energy than Z-alkenes)





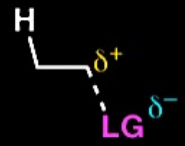
Higher energy intermediate

E1

Two steps

1) C–LG breaks

2) C–H breaks
C–C (pi) forms



Carbocation intermediate

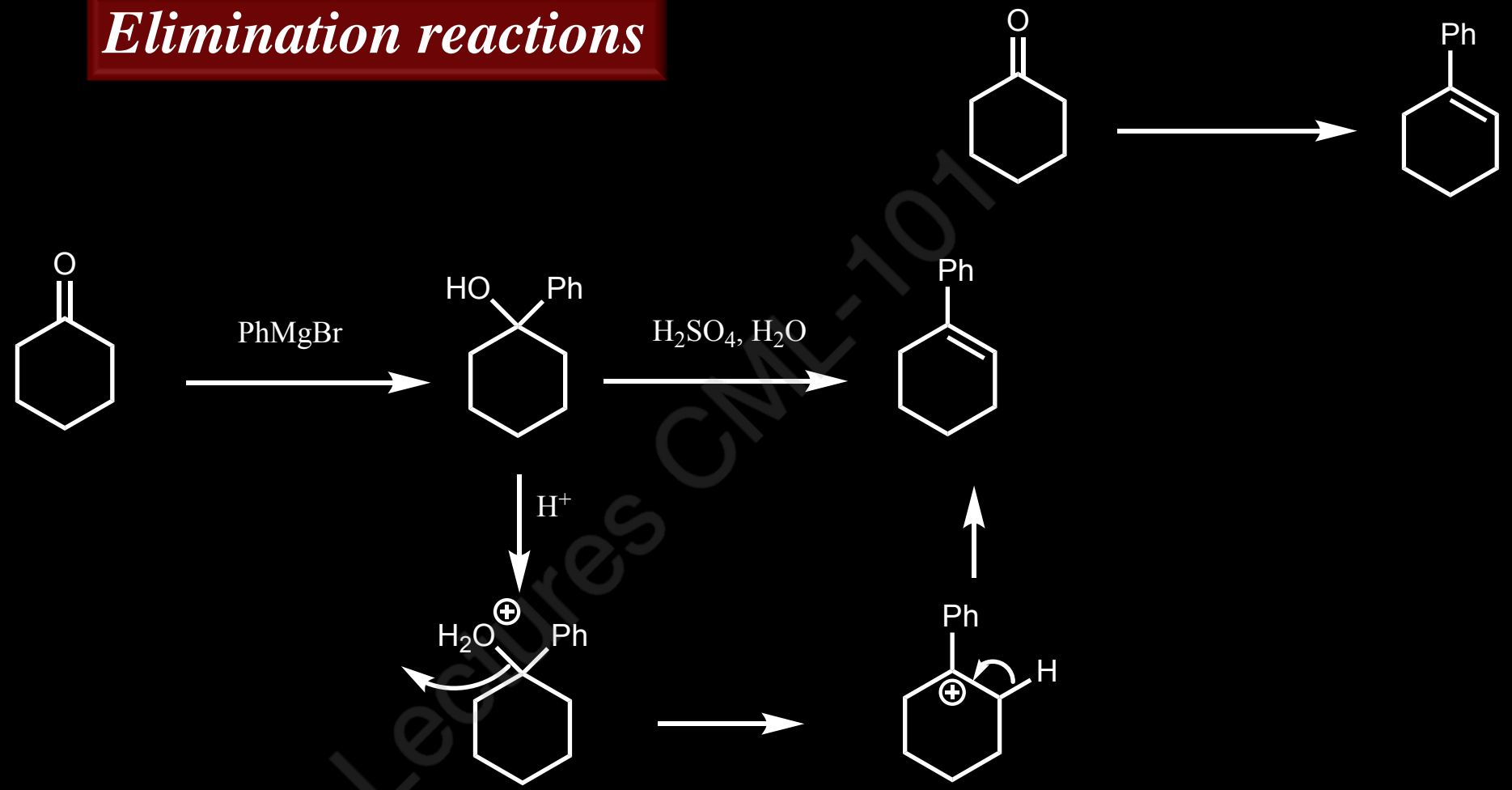
Carbocation stabilized by electron **donating** groups

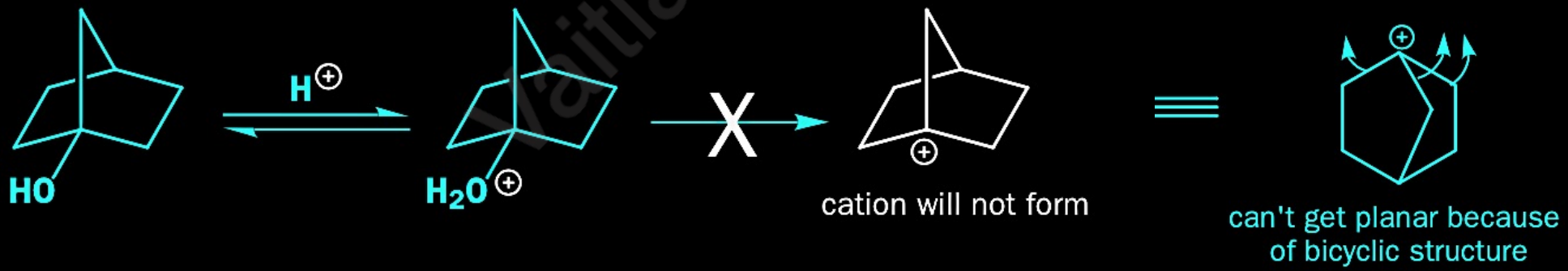
Assisted by **good** leaving groups

No strict requirement on stereochemistry of C–H and C–LG

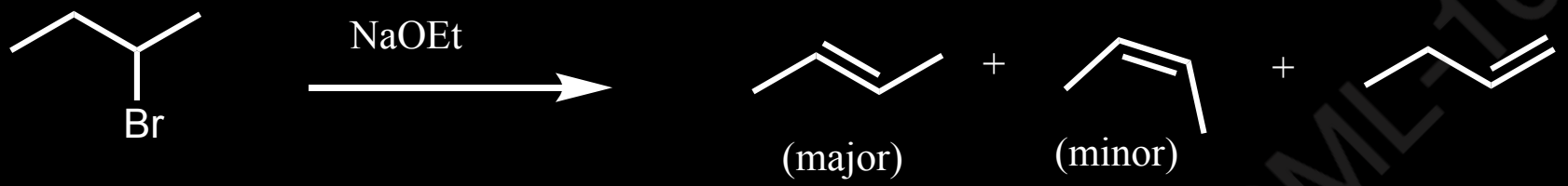
The new π–bond can only form if the vacant p-orbital of the Carbocation and breaking C-H bond are aligned parallel.

Elimination reactions





Elimination reactions



81%

19%

H and Br must be anti-periplanar for E2 elimination:
two possible conformations

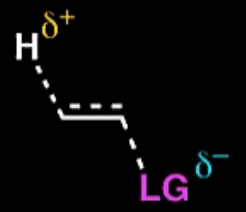
two methyl groups syn-coplanar (gauche) - more hindered

two methyl groups anti-periplanar – less hindered

E2

One step

C–H breaks, C–C (pi) forms
C–LG breaks, all at same time

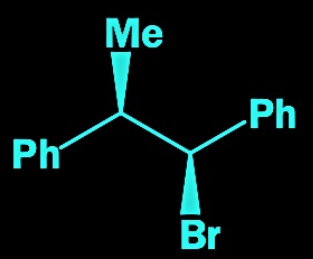


No intermediate (concerted)

C–H and C–LG are **anti**

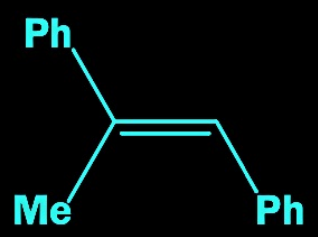
Elimination reactions

this diastereoisomer

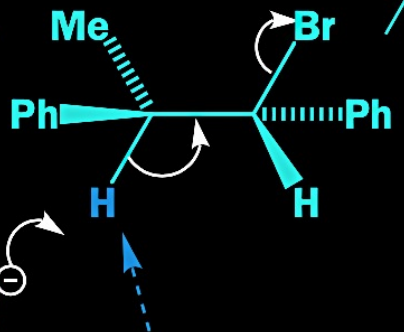


NaOH

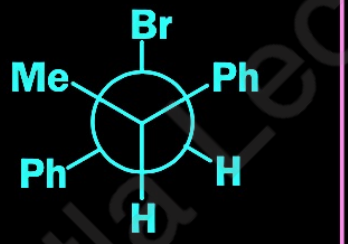
eliminates to give this alkene (*E*)



redraw

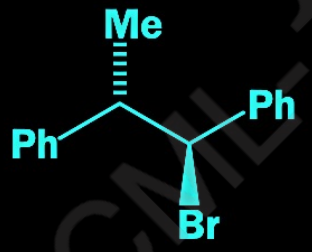


only this proton can be attacked by HO^-



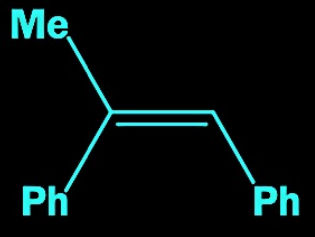
H and Br must be anti-periplanar

this diastereoisomer

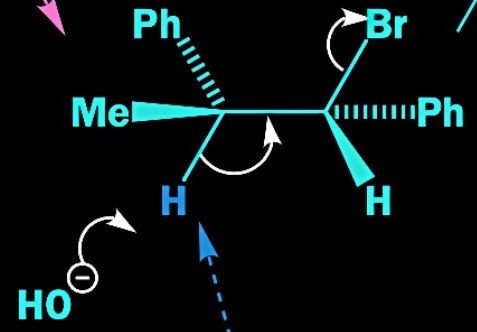


NaOH

eliminates to give this alkene (*Z*)

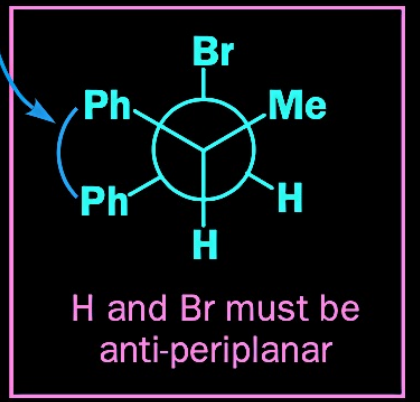


redraw



only this proton can be attacked by HO^-

slower reaction because of gauche interactions in reactive conformation



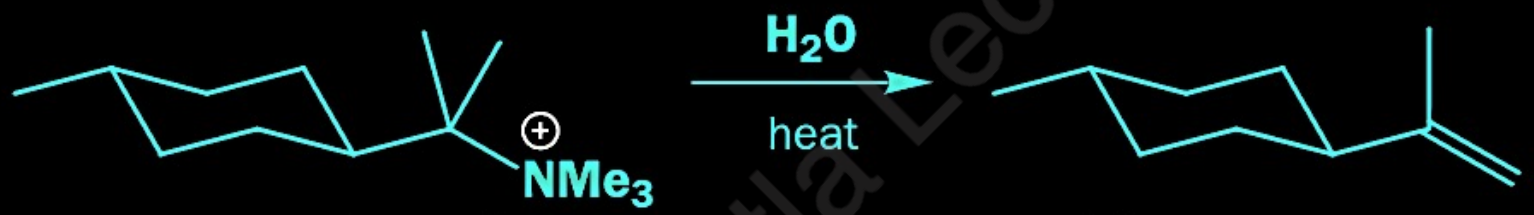
H and Br must be anti-periplanar

Elimination reactions

Eliminations of quaternary ammonium salts

ammonium salt

81% yield



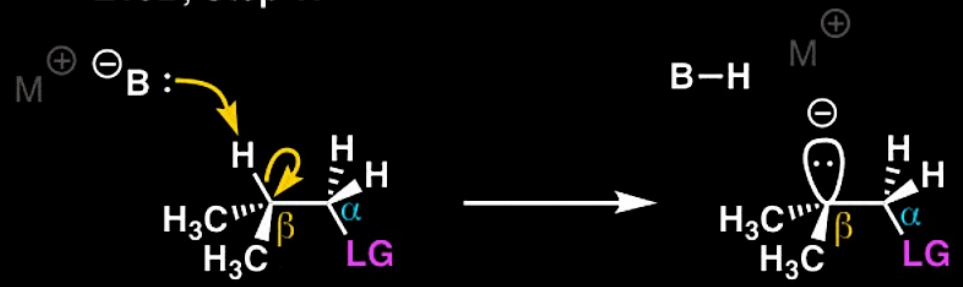
ammonium salt

98% yield

+ Me_3N

Elimination reactions

E1cB, Step 1:



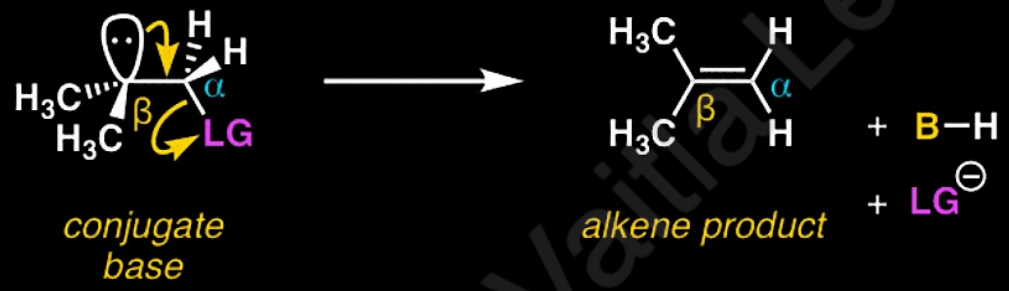
α = alpha carbon (attached to **LG**)

β = beta carbon (attached to H)

LG = leaving group (e.g. **Br**)

Bonds Formed	Bonds Broken
	C_β–H
B–H	

E1cB, Step 2:



α = alpha carbon (attached to **LG**)

β = beta carbon

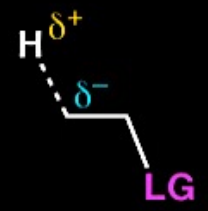
LG = leaving group (e.g. **Br**)

Bonds Formed	Bonds Broken
C_α–C_β (π)	
	C_α–LG

E1cB

Two steps

1) C–H breaks
2) C–LG breaks
   C–C (pi) forms



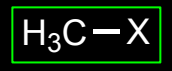
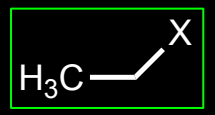
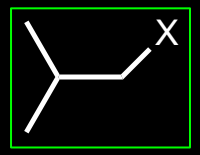
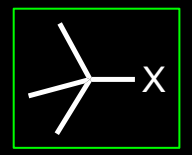
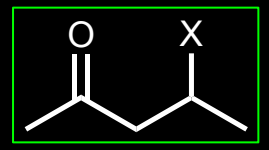
Carbanion intermediate

Carbanion stabilized by electron **withdrawing** groups

Assisted by **poor** leaving groups

No strict requirement on stereochemistry of C–H and C–LG

Summary of alkyl halide reactivity

	Poor nucleophile (e.g. H_2O, ROH)[a]	Weakly basic nucleophile (e.g. I^-, RS^-)	Strongly basic, unhindered nucleophile (e.g. RO^-)	Strongly basic, hindered nucleophile (e.g. DBU, DBN, *t*-BuO^-)
	no reaction	S_N2	S_N2	S_N2
	no reaction	S_N2	S_N2	E2
	no reaction	S_N2	E2	E2
	S_N1, E1 (slow)	S_N2	E2	E2
	E1 or S_N1	S_N1, E1	E2	E2
	E1cB	E1cB	E1cB	E1cB