Alkene Reaction Comparisons

Addition of Water

Reaction Name	Reagents	Markovnikov	Carbocation	Notes
Acid Catalyzed Hydration	H_2SO_4, H_2O	Yes	Yes	• Rearrangements possible • Adds an OH
Oxymercuration	1) $Hg(OAc)_2$, H_2O, THF 2) $NaBH_4$	Yes	No	• Racemic (enantiomers) • **No** possible rearrangements • Adds an OH
Hydroboration	1) BH_3, THF 2) NaOH, H_2O_2, H_2O	Anti	No	• **No** possible rearrangements • Adds an OH
Hydroxylation	1) OsO_4, pyr, 2) $NaHSO_3$, H_2O	--	No	• Syn • Adds 2 OHs • NMO (catalyst)

Halide (X) Additions

Reaction Name	Reagents	Markovnikov	Carbocation	Notes
H-X Additions	H-X	Yes	Yes	• Rearrangements possible
Halogenation	X_2, DCM	--	No	• Adds 2 X • Racemic, anti
Radical H-X Additions	H-X, ROOR	Anti	--	• Radical mechanism
Halohydrin	X_2, H_2O	X as the H, Yes	--	• Adds OH & X • Racemic, anti

Ring Formations

Reaction Name	Reagents	Adds	Notes
Cyclopropanation	CH_2I_2, Zn(Cu)	C ring	• Trans alkene -> anti • Cis alkene -> syn • New C-C bonds
Epoxidation	MCPBA, DCM	O ring	• Trans alkene -> anti • Cis alkene -> syn • Forms epoxide

Alkyne Reaction Comparisons

π Bond Reductions

Reaction Name	Reagents	Alkene to...	Notes
Complete Reductive Hydrogenation	H_2, Pd/C	Alkane	• Will remove present halides • Will keep reacting in excess
Incomplete Reductive Hydrogenation	H_2, Lindlar's Cat.	Cis Alkene	• Only makes cis alkene on internal alkynes
Dissolving Metal Reduction	2 Na, NH_3	Trans Alkene	• Uses radical like mechanism

Formation of Aldehydes/Ketones

Reaction Names	Reagents	Forms	Notes
Acid Catalyzed Hydration (Internal)	H_2SO_4, H_2O	Ketone	• Internal alkyne • Can form on either alkyne C (mixture)
Acid Catalyzed Hydration (Terminal)	$HgSO_4$, H_2SO_4, H_2O	Ketone	• Terminal alkyne • Forms on **more** substituted C
Hydroboration	a) $HB(Sia)_2$, THF b) NaOH, H_2O_2, H_2O	Aldehyde / Ketone	• Terminal alkyne (Ald) • Internal alkyne (Ket) • Forms on **less** substituted C for terminal alkyne • Can form on either alkyne C (mixture) for internal alkyne

Halide (X) Addition

Reaction Name	Reagents	Notes
H-X Addition (Terminal)	H-X	• If in excess, will react until it is an alkane • Can be stopped at alkene with 1 mol equivalent • Follows Markovnikov's
H-X Addition (Internal)	H-X	• If stopped at alkene with 1 mol equivalent, forms cis alkene • Follows Markovnikov's
Halogenation	X_2, DCM	• Halides are added to both ends, and can react in excess or 1 mol equivalent

Bond Cleavage

Reaction Name	Reagents	Notes
Ozonolysis	1) O_3, MeOH 2) DMS or Zn, AcOH	• Oxidizes alkene Cs to carbonyls • Cuts alkene • Forms aldehydes and/or ketones
Oxidative Cleavage of Syn-1,2-diol	HIO_4, H_2O	• Oxidizes OHs to carbonyls • Must be syn • Cuts alkane • Forms aldehydes

New C-C Bond Reaction Comparisons

Reaction Name	Reagents	Reactant	Notes
Acetylide Substitution Reaction	1) $NaNH_2$, NH_3 2) 1° alkyl halide	Terminal Alkyne	• SN2 Mechanism
Grignard Reagent (Alkyne)	1) CH_3MgBr, THF 2) 1° alkyl halide	Terminal Alkyne	• Must be done anhydrous • Acts as a strong base then nucleophile • Will attack carbonyls • SN2 Mechanism
Gilman Reagent	1) $(Alkyl)_2$-CuLi, THF	Haloalkene (Halogen directly on alkene)	• Cannot attack carbonyls
Organolithium	a) 2 Li, hexanes b) Substitution group	Alkyl Halide	• Acts as a strong base then nucleophile