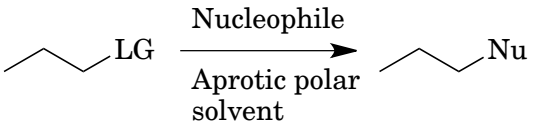
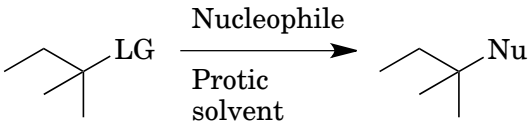
Reaction Summary

Nucleophilic substitution: alkyl-leaving group → alkyl-nucleophile

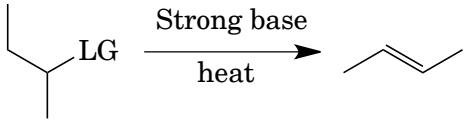


Concerted reaction (S_N2)

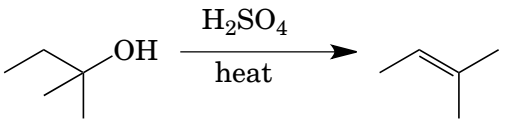


Via carbocation intermediate (S_N1)

Elimination: alkyl-leaving group → alkene

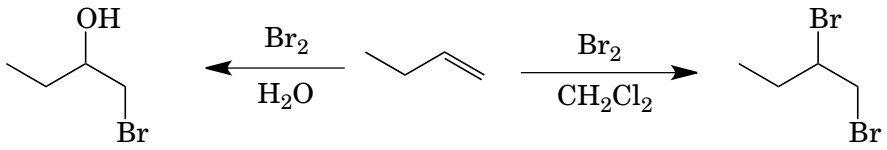


Concerted reaction (E2)



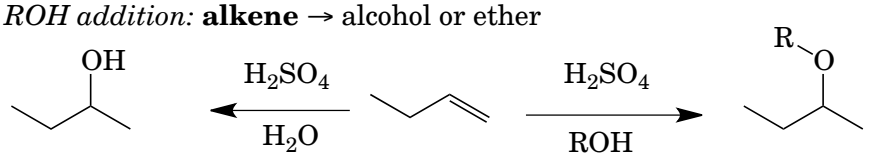
Via carbocation intermediate (E1)

Halogen addition: **alkene** → vicinal dihaloalkane or halohydrin



Anti addition (cyclic bromonium ion)

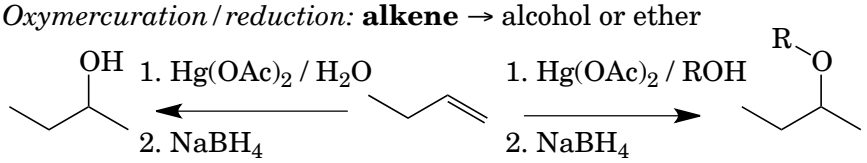
ROH addition: **alkene** → alcohol or ether



Via carbocation intermediate

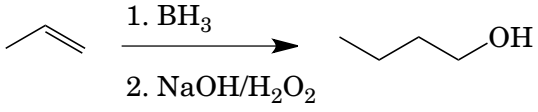
Markovnikov addition (no stereochem constraints)

Oxymercuration / reduction: **alkene** → alcohol or ether



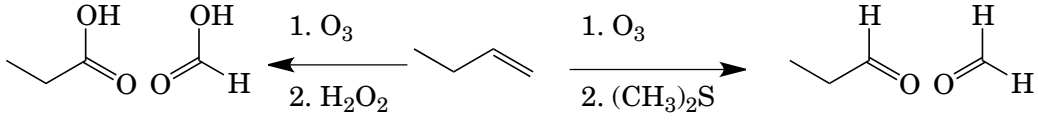
Markovnikov addition (*Anti* addition)

Hydroboration / oxidation: **alkene** → alcohol

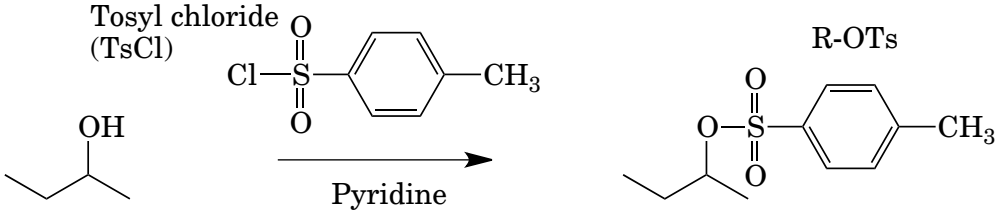


Anti-Markovnikov addition (*Syn* addition)

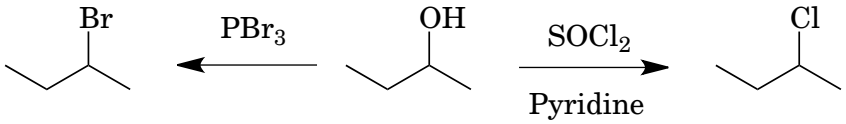
Ozonolysis: **alkene** → carboxylic acids or aldehydes



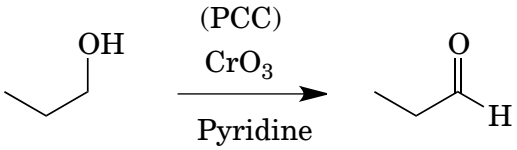
Tosylate synthesis: **alcohol** → tosylate



Alkyl halide synthesis: **alcohol** → alkyl halide

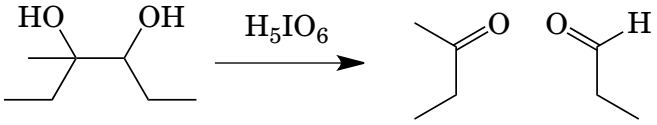


Alcohol oxidation: **alcohol** → aldehyde

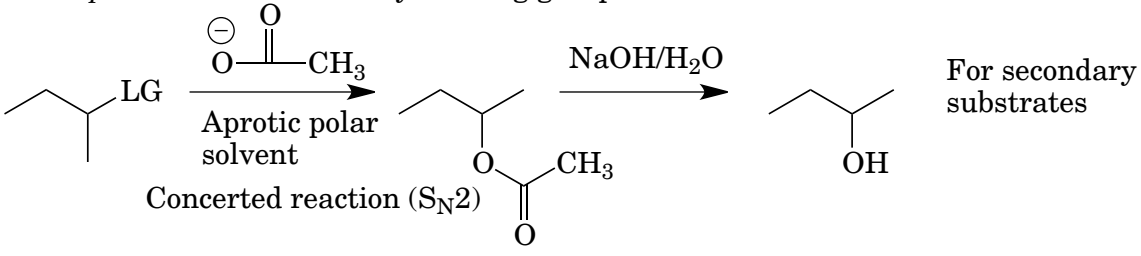


Alcohol oxidation: **alcohol** → carboxylic acid or ketone

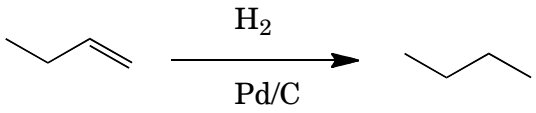
Glycol oxidation: glycol → aldehyde and/or ketone



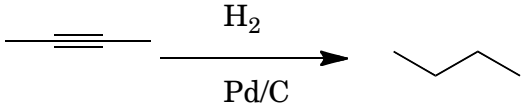
Nucleophilic substitution: alkyl-leaving group → alcohol



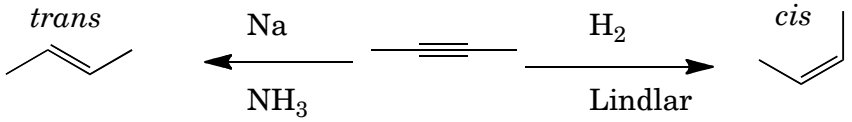
Hydrogenation: alkene → alkane



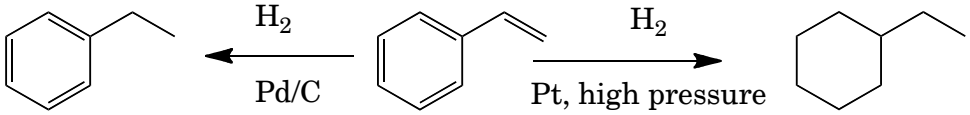
Hydrogenation: alkyne → alkane



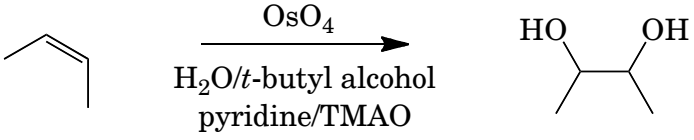
Hydrogenation: alkyne → alkene



Hydrogenation: aromatic → aromatic or to alkane

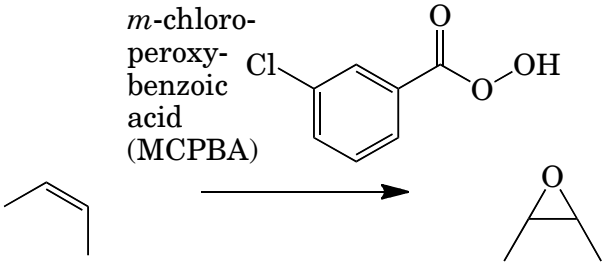


Glycol synthesis: alkene → glycol



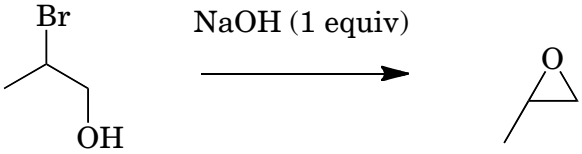
Syn addition

Epoxide synthesis: alkene → epoxide



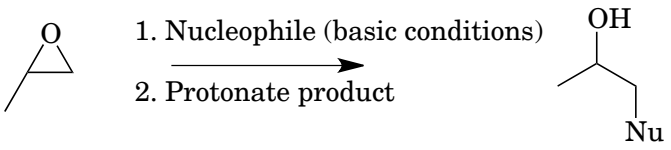
Syn addition

Epoxide synthesis: halohydrin → epoxide



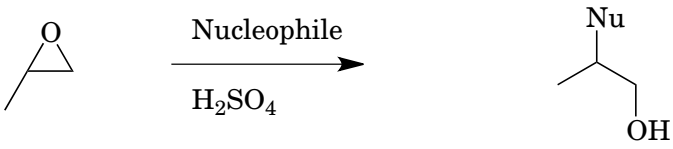
S_N2 attack by hydroxyl on carbon with Br

Epoxide ring-opening (basic): epoxide → alcohol and nucleophile



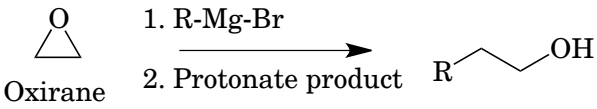
(**Example:** if the nucleophile is an alcoxide (RO^-), the result is an alcohol/ether; note that the nucleophile is on the less substituted carbon.)

Epoxide ring-opening (acidic): epoxide → alcohol and nucleophile



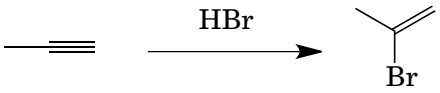
(**Example:** if the nucleophile is an alcohol, the result is an alcohol/ether); note that the nucleophile is on the more substituted carbon.)

Epoxide ring-opening (Grignard) epoxide → alcohol **two carbons longer**



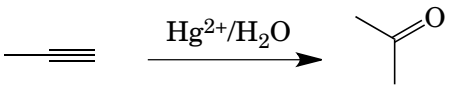
Note: this only yields predictable product when using oxirane)

HX addition: alkyne → vinyl halide



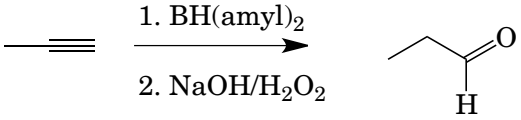
Note: excess HBr will result in *geminal* dibromide following second HBr addition

Hydration: alkyne → ketone



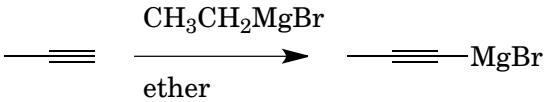
Markovnikov addition followed by enol/keto tautomerization

Hydroboration / oxidation: alkyne → aldehyde

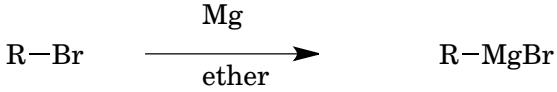


Anti-Markovnikov addition (*Syn* addition) followed by enol/keto tautomerization

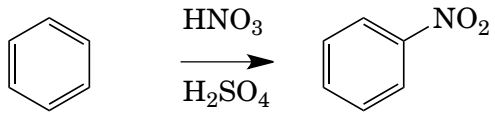
Grignard synthesis: alkyne → Grignard reagent



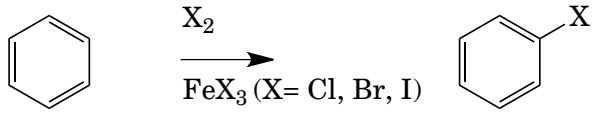
Grignard synthesis: haloalkane → Grignard reagent



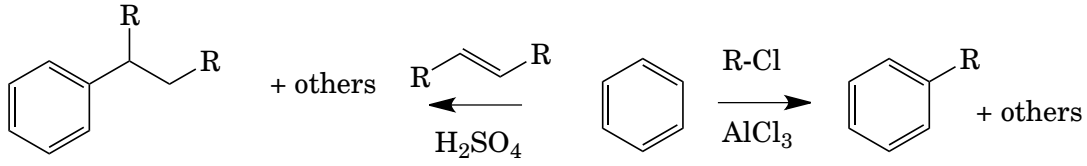
EAS Nitration: aromatic → nitro-aromatic



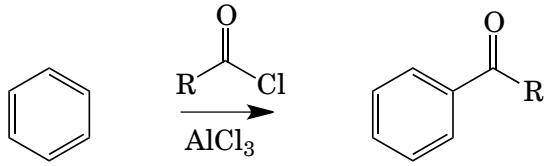
EAS Halogenation: aromatic → halo-aromatic



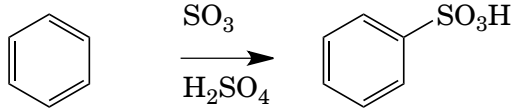
Friedel-Crafts Alkylation: aromatic → alkyl-aromatic



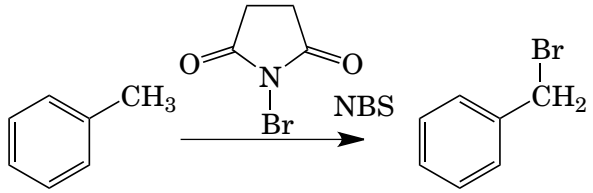
Friedel-Crafts Acylation: aromatic → acyl-aromatic



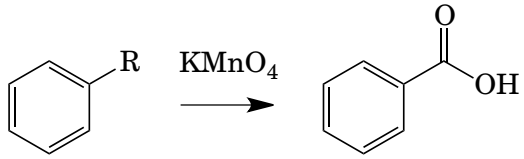
EAS Sulfonation: aromatic → aromatic sulfonic acid



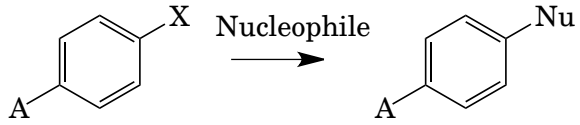
Benzylic / allylic bromination



Benzylic oxidation: alkyl-aromatic → aromatic carboxylic acid



Nucleophilic aromatic substitution: aryl halide → aryl-nucleophile



Note: at least one activating group in *ortho* or *para* position is necessry