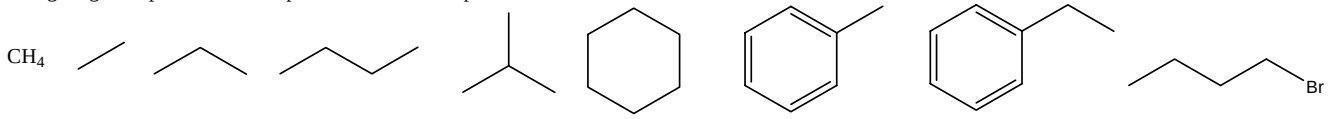
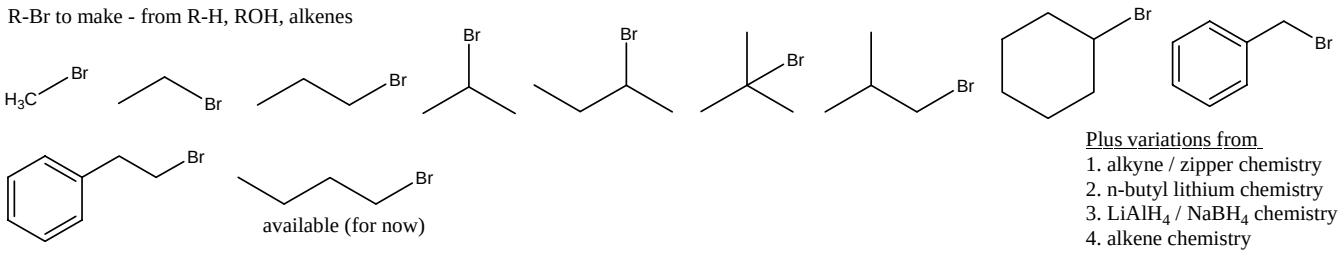
Starting "organic" points: alkanes, plus a few other compounds.



You are also allowed to use any of the reagents covered in our course.

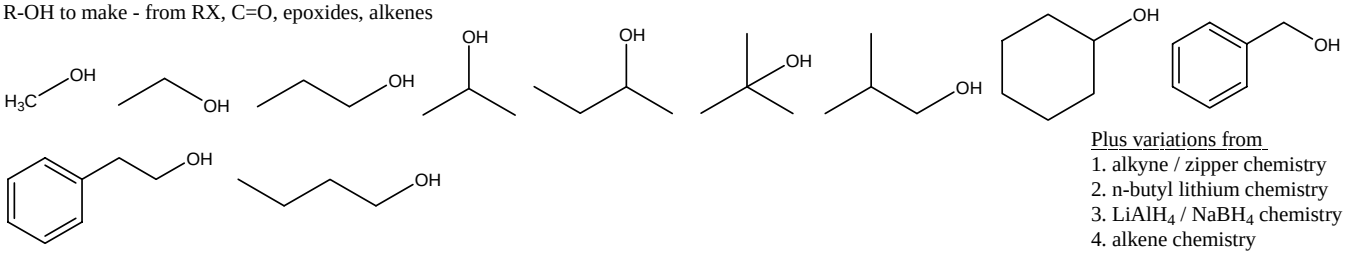
R-Br to make - from R-H, ROH, alkenes



available (for now)

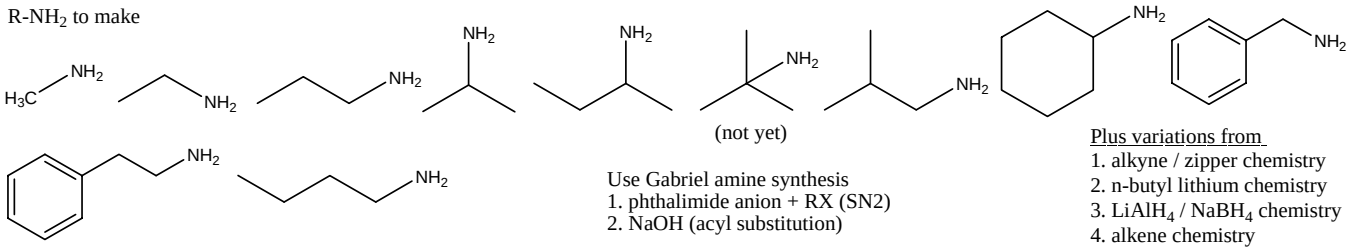
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

R-OH to make - from RX, C=O, epoxides, alkenes



Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

R-NH_2 to make

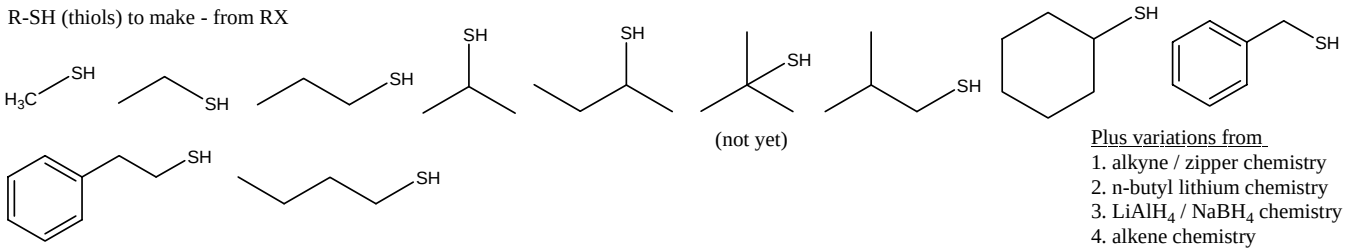


(not yet)

Use Gabriel amine synthesis
1. phthalimide anion + RX (SN2)
2. NaOH (acyl substitution)

Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

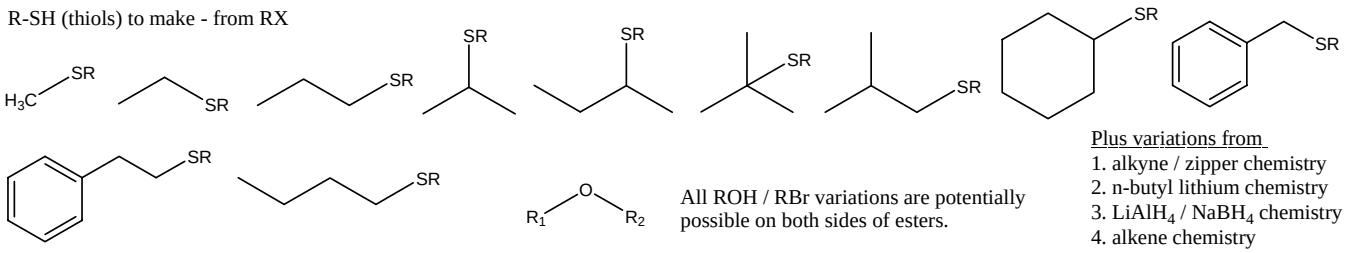
R-SH (thiols) to make - from RX



(not yet)

Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

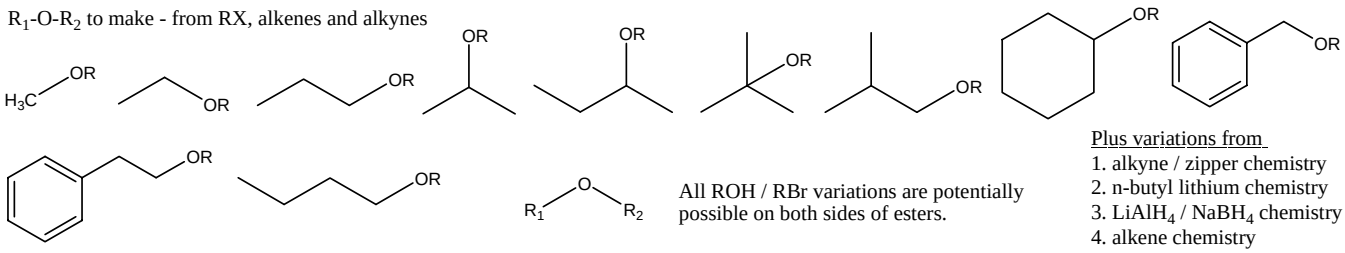
R-SH (thiols) to make - from RX



All ROH / RBr variations are potentially possible on both sides of esters.

Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

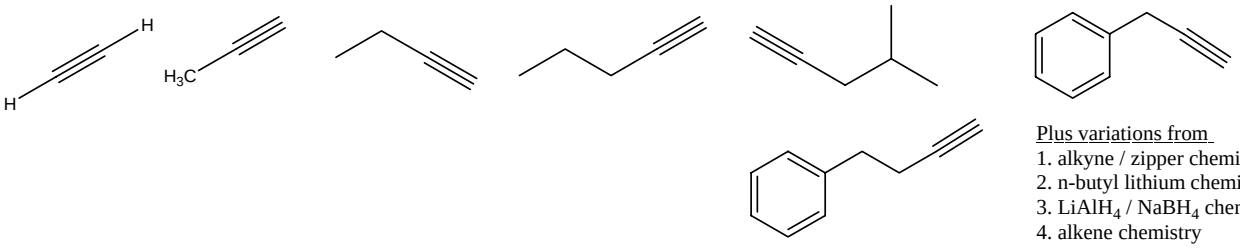
R_1-O-R_2 to make - from RX, alkenes and alkynes



All ROH / RBr variations are potentially possible on both sides of esters.

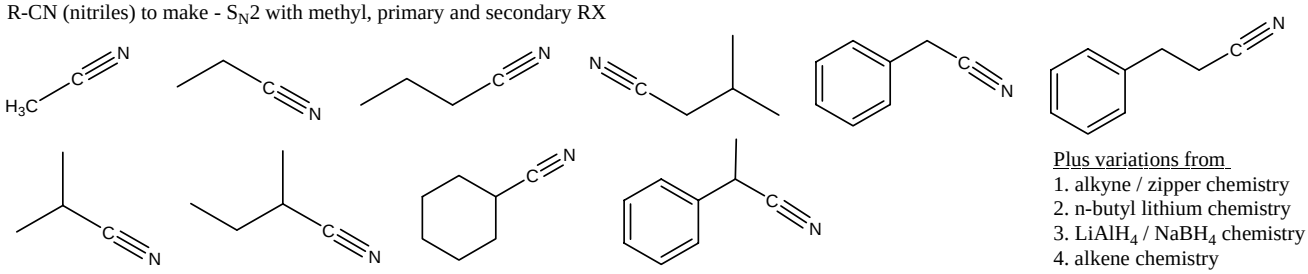
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

R-CC-R (alkynes) to make - S_N2 with methyl and primary RX and double elimination reactions



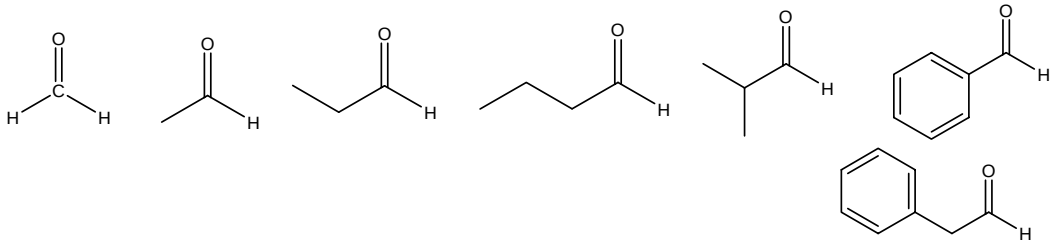
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

R-CN (nitriles) to make - S_N2 with methyl, primary and secondary RX



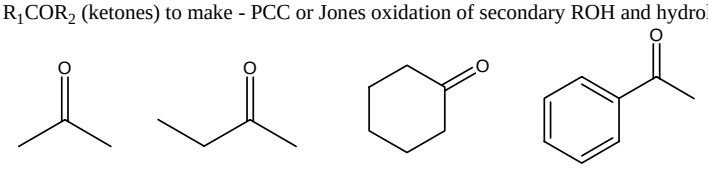
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

RCHO (aldehydes) to make - PCC oxidation of methanol and primary ROH and 1. dialkylborane 2. oxidation chemistry with alkynes.



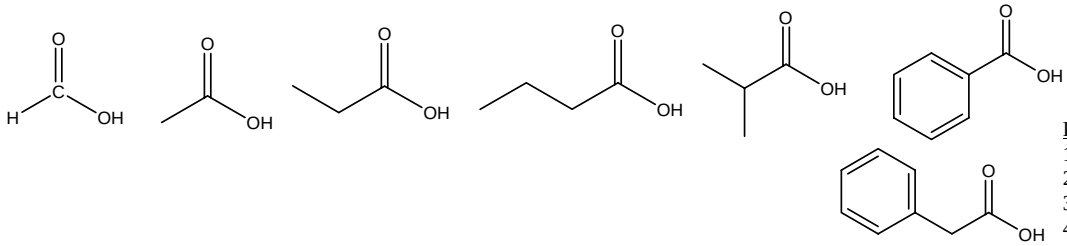
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

R_1COR_2 (ketones) to make - PCC or Jones oxidation of secondary ROH and hydrolysis of alkynes



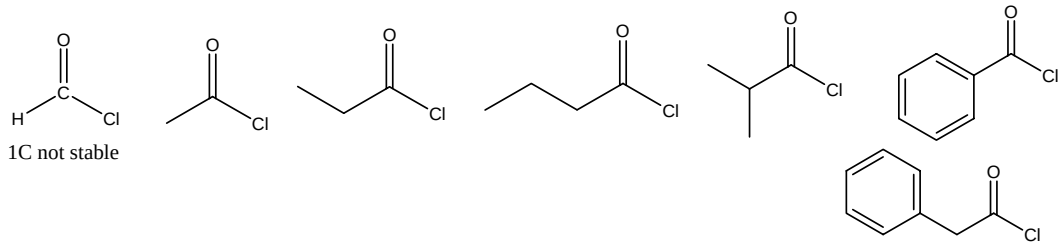
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

RCO_2H (carboxylic acids) to make - Jones oxidation of aldehydes, methanol and primary ROH, and acid or base hydrolysis of nitriles



Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

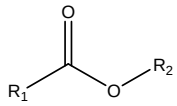
RCOCl (acid chlorides) to make - carboxylic acids + thionyl chloride ($SOCl_2$)



1C not stable

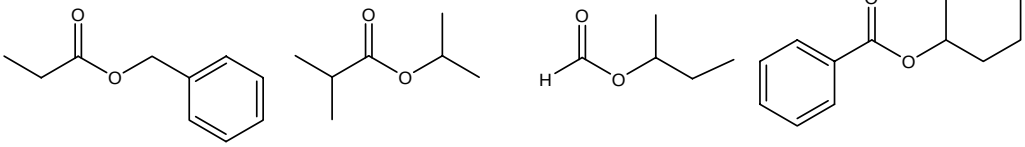
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

RCO_2R (esters) to make - S_N2 carboxyloates with methyl, primary and secondary RX and acid chlorides with ROH



All RCO_2H / RBr or RCOCl / ROH variations are potentially possible on both sides of esters.

Limited examples



Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

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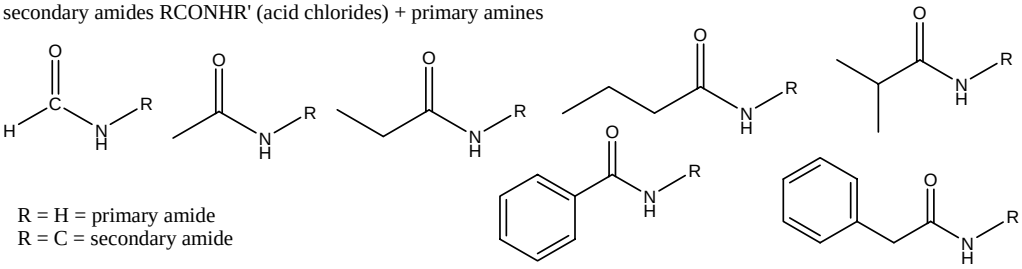
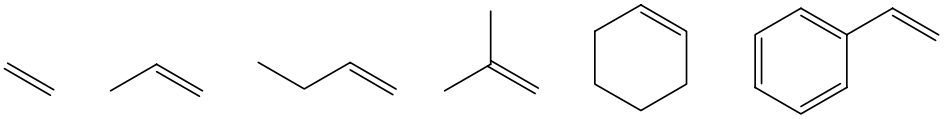
primary amides $RCONH_2$ from acid or base hydrolysis of nitriles and
secondary amides RCONHR' (acid chlorides) + primary amines



R = H = primary amide
R = C = secondary amide

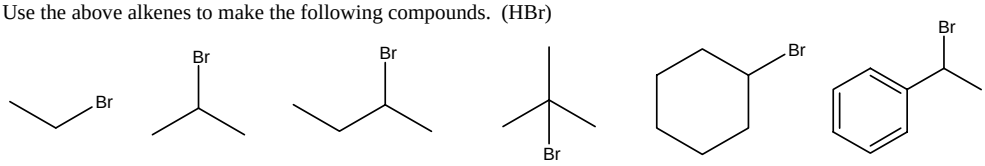
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Alkenes to make - from E2 chemistry with RX, from E1 chemistry with $ROH/H_2SO_4/\Delta$ (for now, soon E or Z from alkynes)



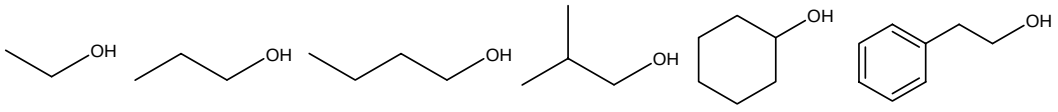
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (HBr)



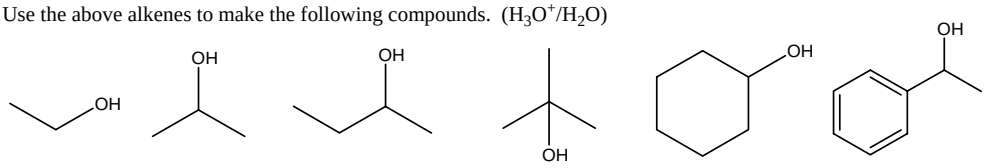
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (1. BH_3 2. H_2O_2 / $HO^{\ominus}$)



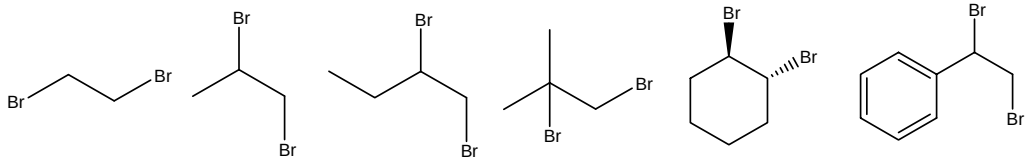
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (H_3O^+/H_2O)



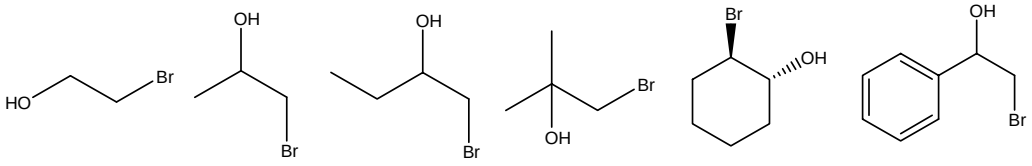
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (Br_2)



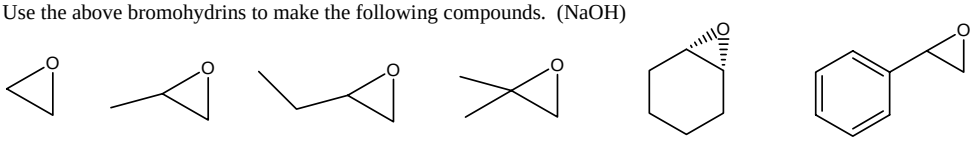
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (Br_2 / H_2O)



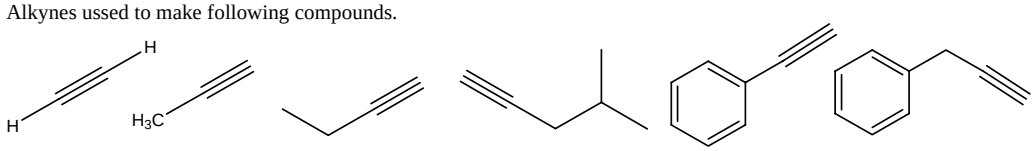
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above bromohydrins to make the following compounds. (NaOH)



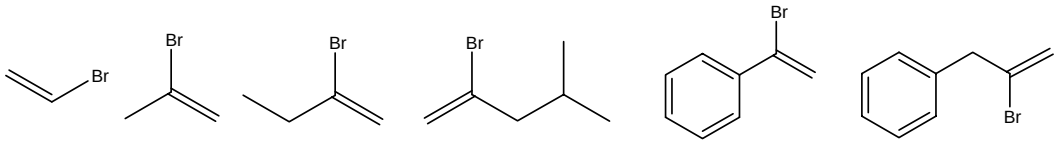
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Alkynes ussed to make following compounds.



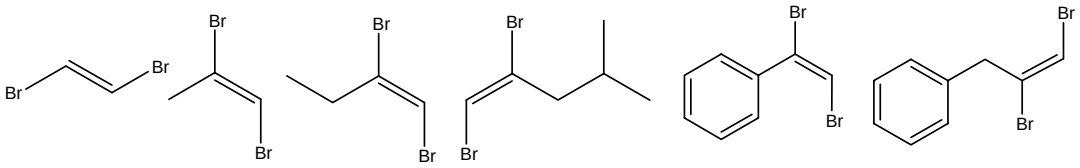
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkynes to make the following compounds. (HBr)



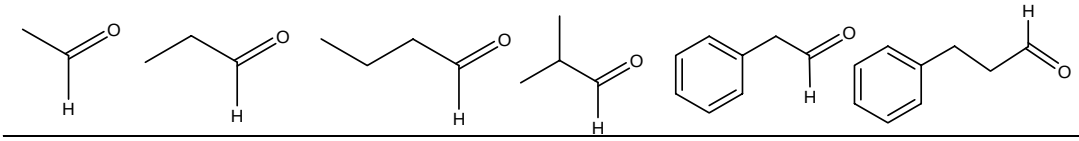
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (Br_2)



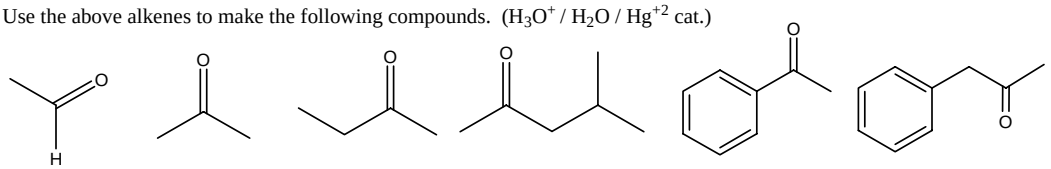
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

Use the above alkenes to make the following compounds. (1. R_2BH 2. H_2O_2 / $HO^{\ominus}$)



Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

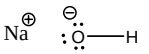
Use the above alkenes to make the following compounds. (H_3O^+ / H_2O / Hg^{+2} cat.)

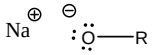


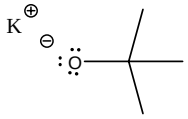
Plus variations from
1. alkyne / zipper chemistry
2. n-butyl lithium chemistry
3. $LiAlH_4$ / $NaBH_4$ chemistry
4. alkene chemistry

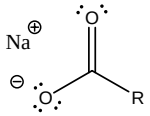
Nucleophiles/Bases
(sometimes nucleophiles, and sometimes bases)

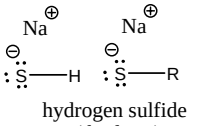
Strong

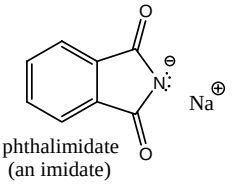

hydroxide

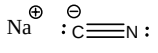

alkoxides

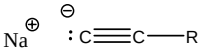

potassium t-butoxide

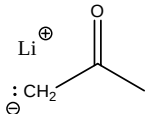

carboxylates

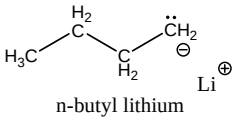

hydrogen sulfide (thiolates)

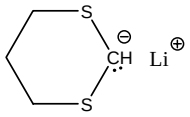

phthalimidate (an imidate)


cyanide

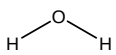

acetylides

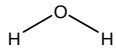

ketone enolates

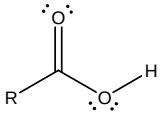

n-butyl lithium


dithiane carbanion

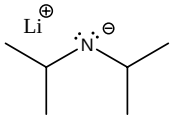
Weak

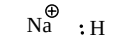

water

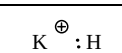

alcohols

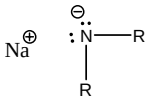

carboxylic acids

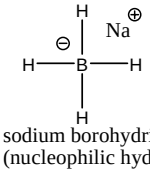
Always react as bases

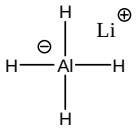

lithium diisopropylamide (LDA)


sodium hydride


potassium hydride

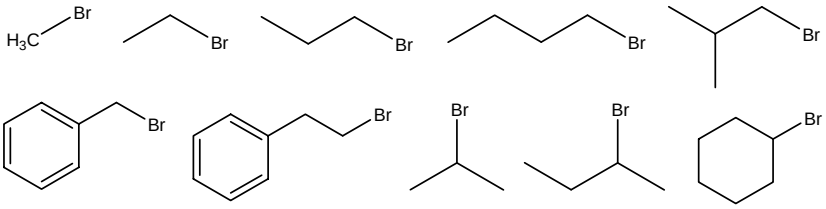

sodium amide


sodium borohydride (nucleophilic hydride)


lithium aluminium hydride (LAH) (nucleophilic hydride)

Electrophiles / Acids
(from our course)

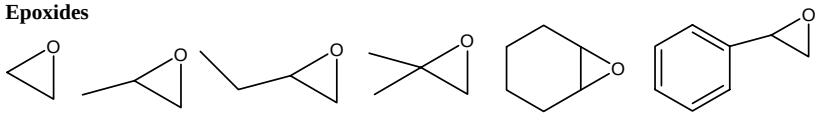
RX Compounds



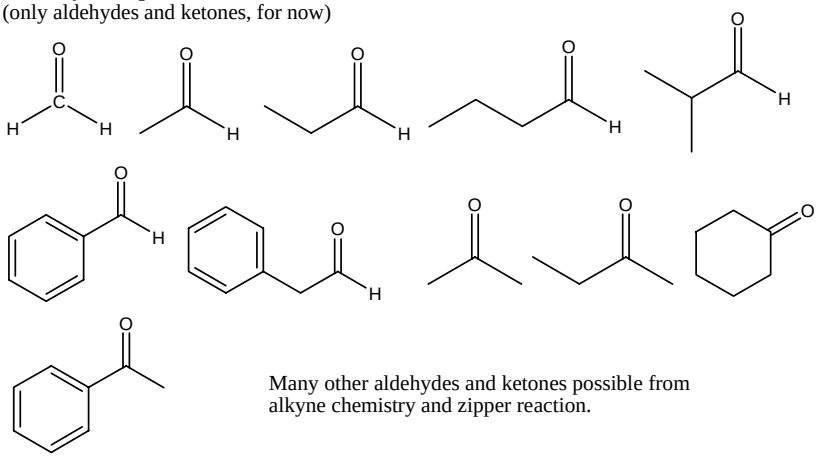
RX compounds (Cl, Br, I, OTs)

methyl RX
primary RX
secondary RX
tertiary RX
allylic RX
benzylic RX

Epoxides



Carbonyl Compounds
(only aldehydes and ketones, for now)



Many other aldehydes and ketones possible from alkyne chemistry and zipper reaction.

Other reagents discussed (so far) - don't know if I got all of them (let me know)

HCl, HBr, HI

Cl_2, Br_2

Br_2 / H_2O

Cl_2, Br_2
hν

1. BH_3
2. H_2O_2 / HO^-
(with alkenes)

1. R_2BH
2. H_2O_2 / HO^-
(with alkynes)

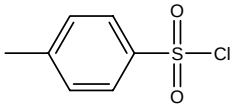
H_2SO_4

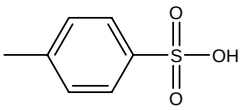
$SOCl_2$

PBr_3

CrO_3 / H_2O / H_3O^+
Jones

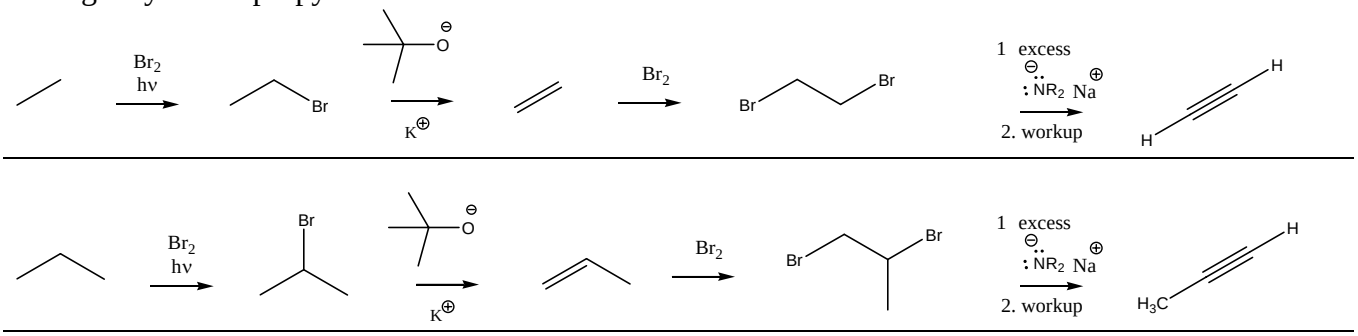
CrO_3 / pyridine
PCC


toluene sulfonyl chloride
tosyl chloride = Ts-Cl


toluene sulfonic acid
Ts-OH

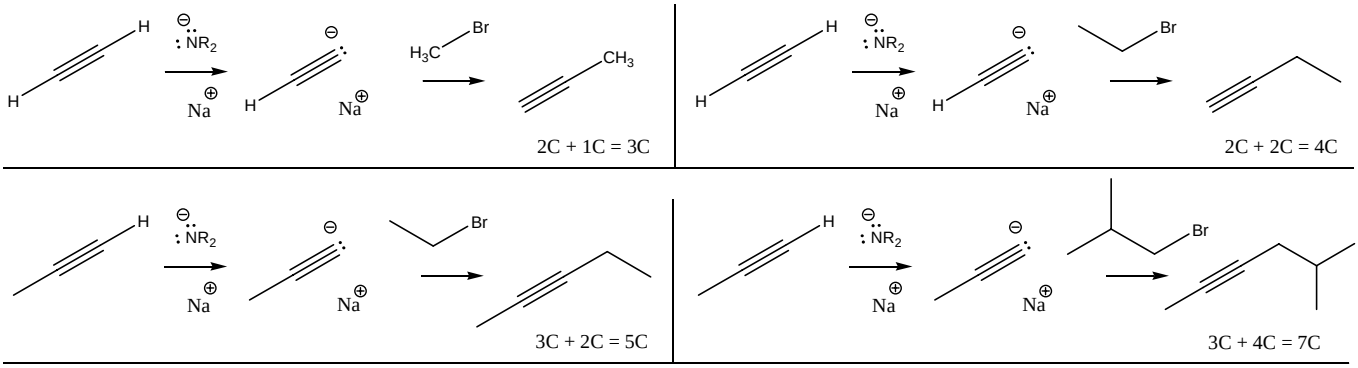
Alkyne reactions and Zipper chemistry

Making ethyne and propyne

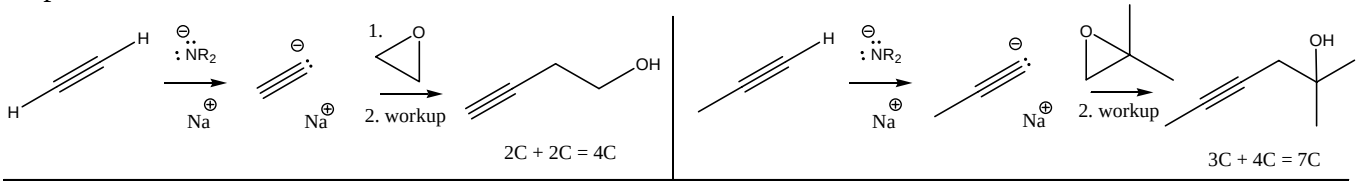


Extending ethyne and propyne with our 3 classes of electrophiles

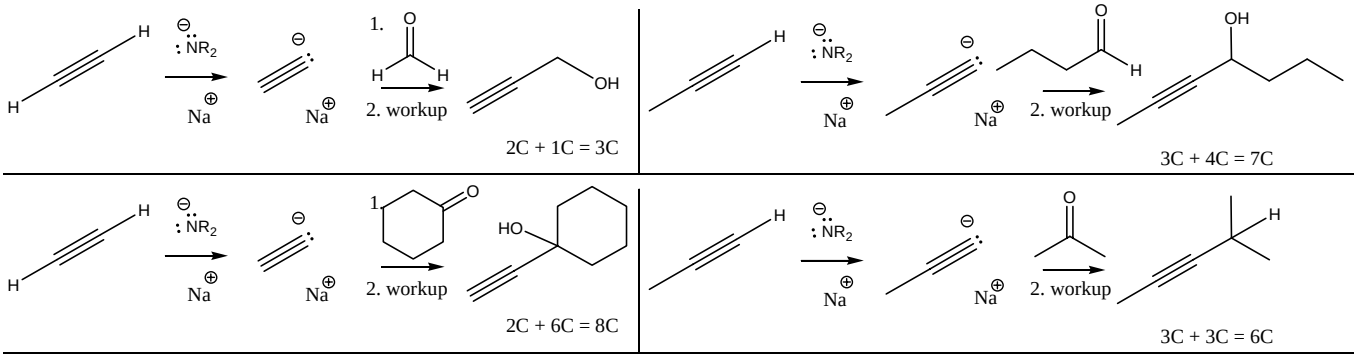
a. RX electrophiles (methyl and primary)



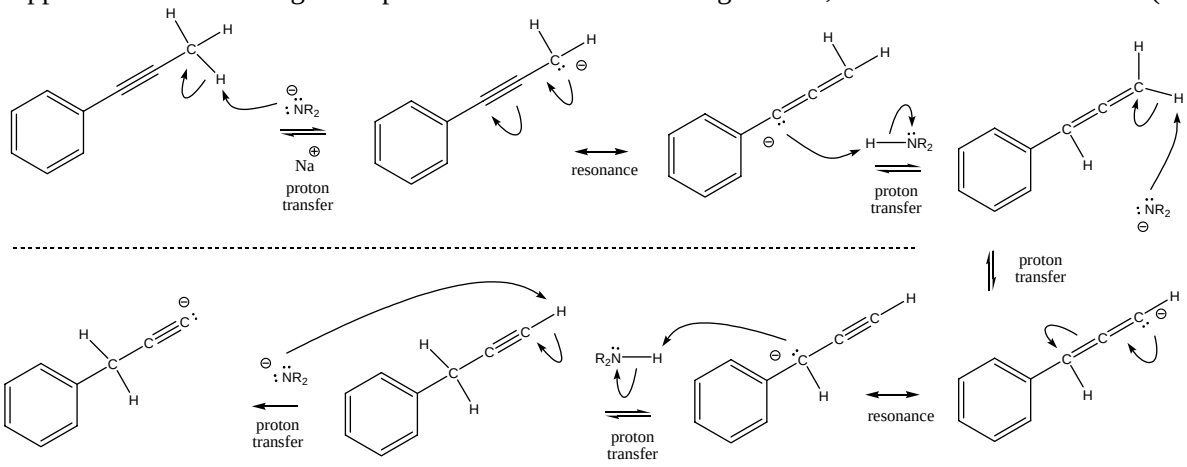
b. epoxides



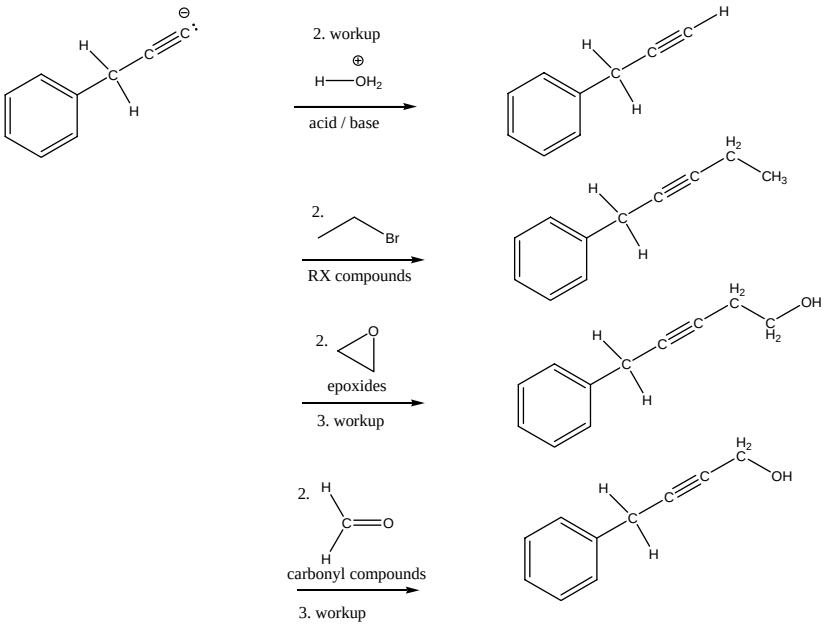
c. carbonyls (aldehydes and ketones)



Zipper Reaction - moving the triple bond to the end of a straight chain, similar to tautomerization (in base)



Most stable anion pushes equilibrium to this point.



Examples of some possible patterns.