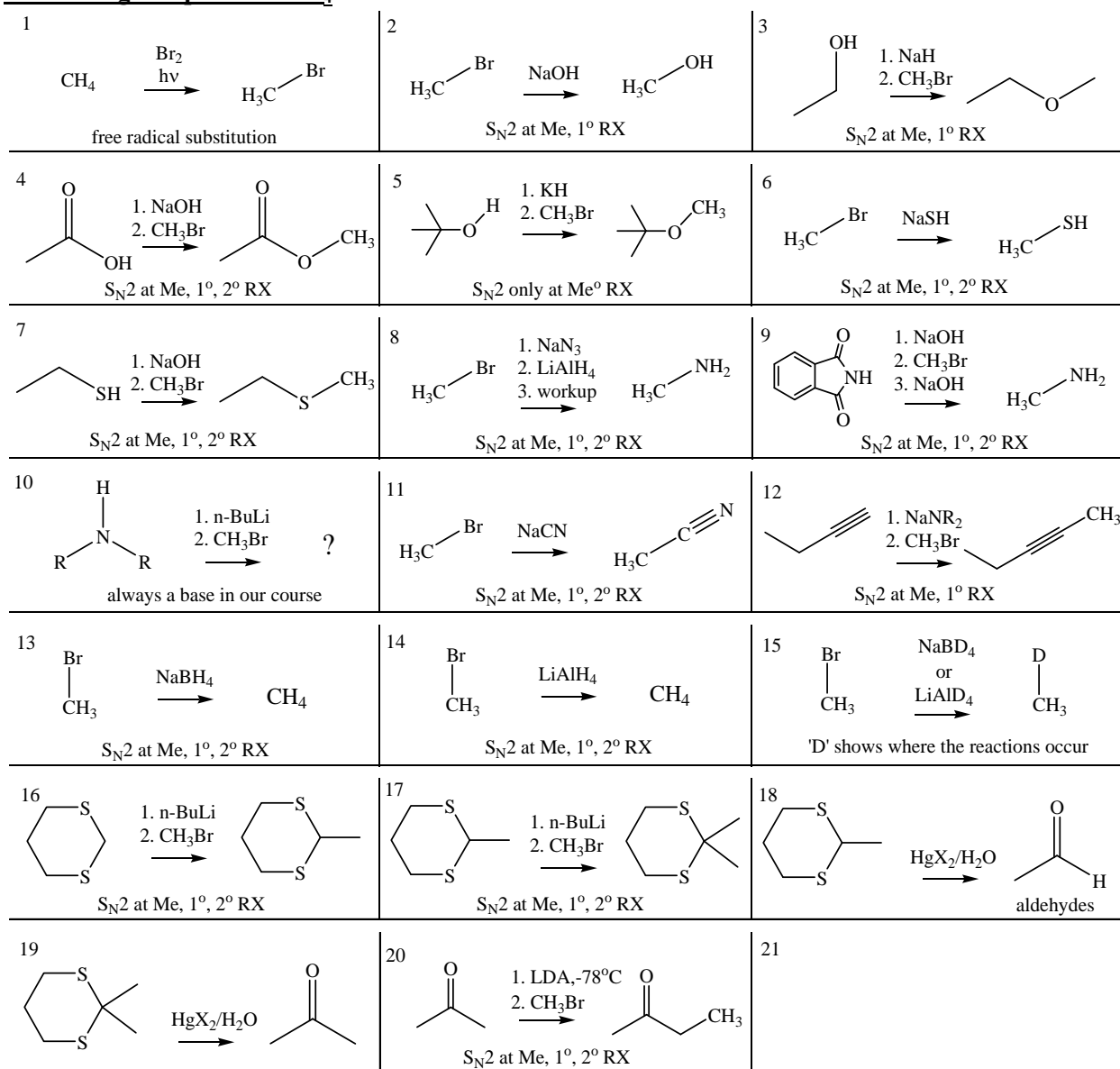
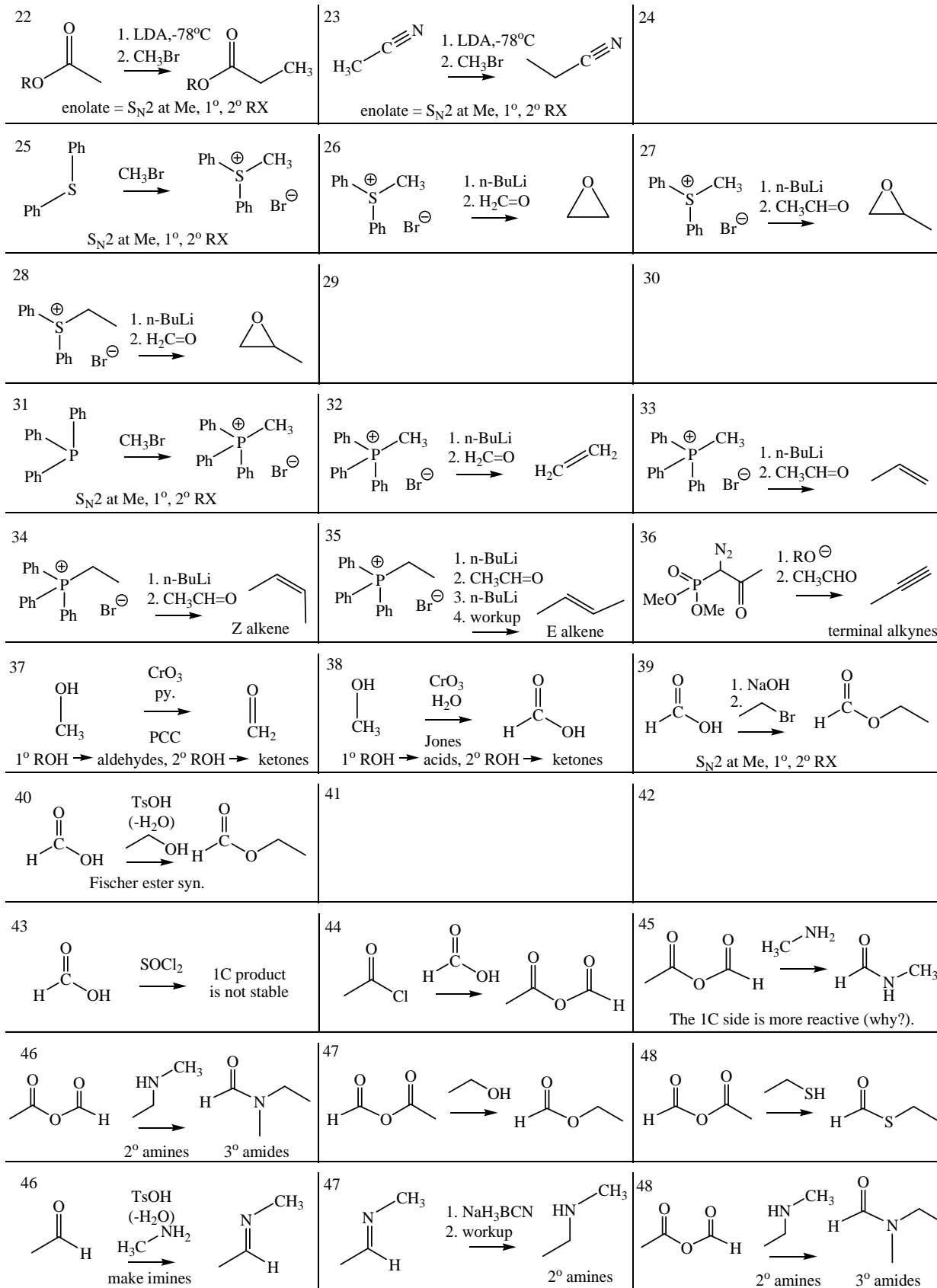
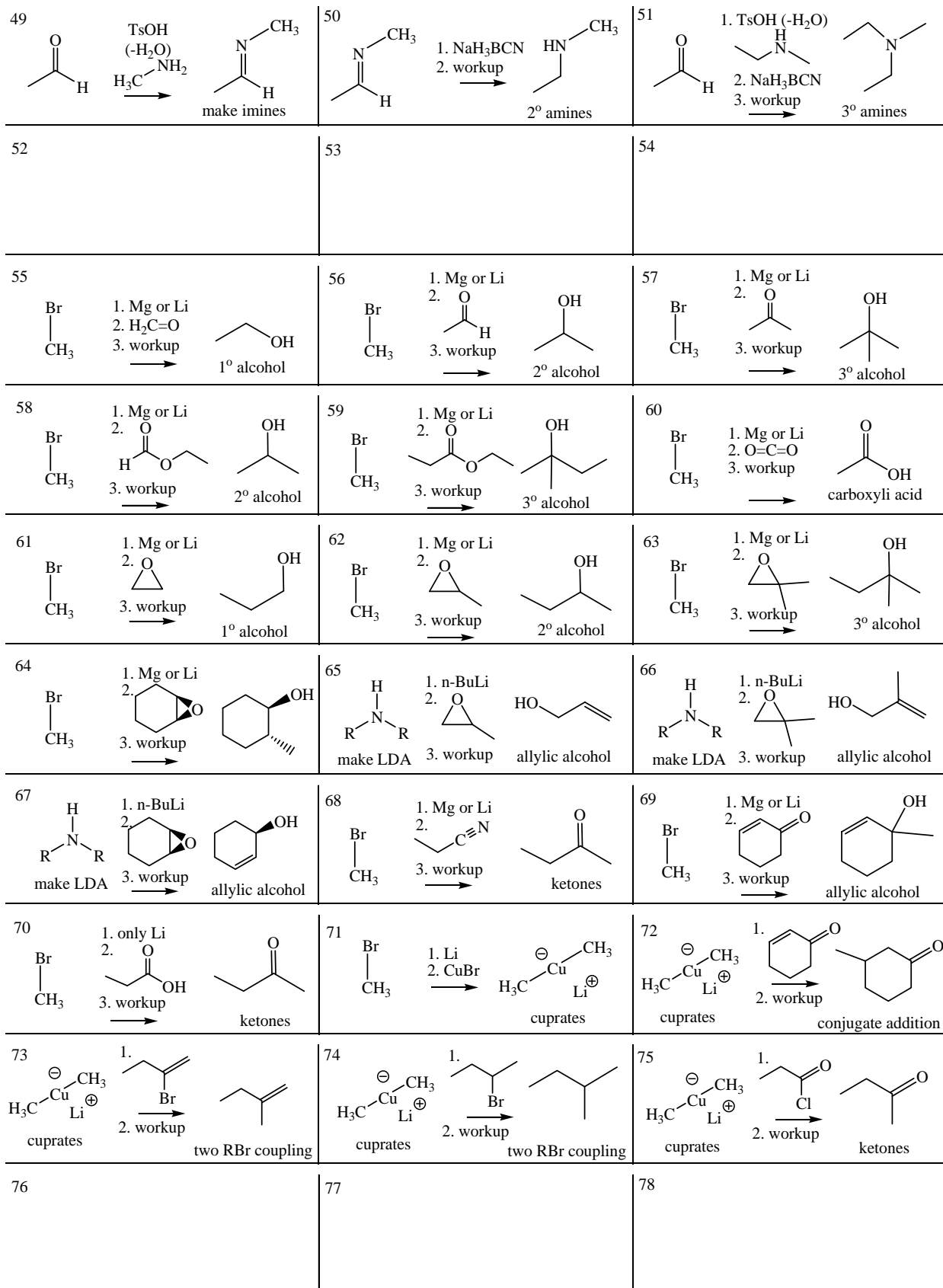


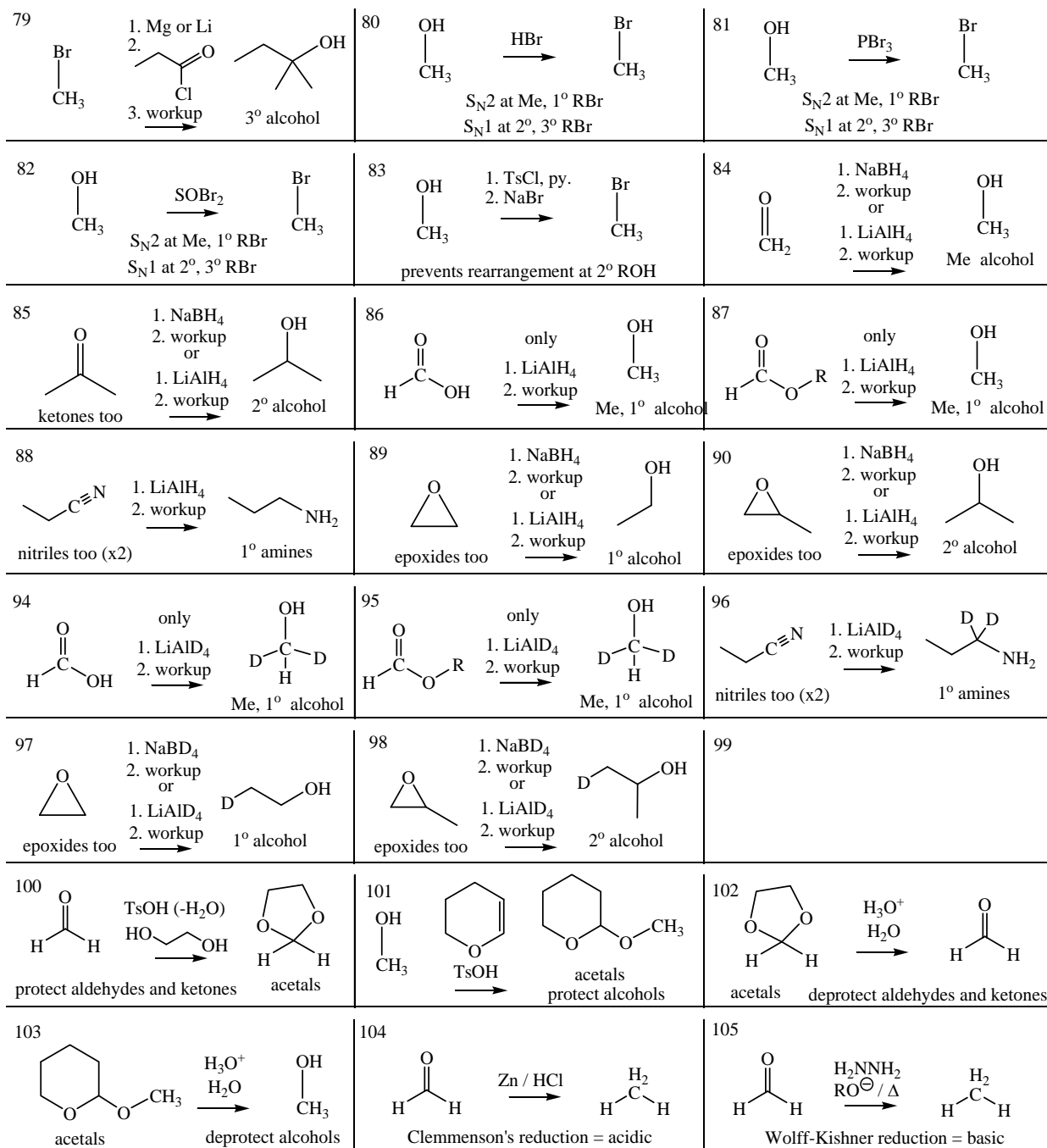
Only typical first year organic reactions are listed below, following simplistic rules (used in my course). Workup means neutralize acid or base conditions to get a neutral product (could be acid or base). Real organic reactions can often be ambiguous when all of the details are included (solvent, temperature, concentration, counter ions, catalysts, etc.). Organic chemistry's middle name is 'ambiguous' (Organic Ambiguous Chemistry). For your first time through organic, I simplify some of that ambiguity by making reaction choices more clear cut than they might be if all factors are considered. If you are learning from another instructor, who disagrees with my rules, or if you find the inevitable errors, just change a reaction to suit your needs. These reactions are your working tools to synthesize more complicated molecules. I have tried to include reagents for most of the 1C, 2C and 3C examples that we study. These are your building blocks to 4C, 5C, 6C and larger organic molecules, many of which are listed after the 1C, 2C and 3C examples. You should also be able to sketch out a plausible mechanism for each reaction. I left a few blank spaces in case you or I need to add in any additional reactions. Unlike biochemistry, organic mostly uses simple monofunctional molecules, so you don't often have to worry about competing functional groups (called chemoselectivity). Your choices are limited to the few reactions that are in our tool box. Try to have some fun as you make your own creations. Please let me know when you find the errors. You will find alkene and alkyne reactions at the very end.

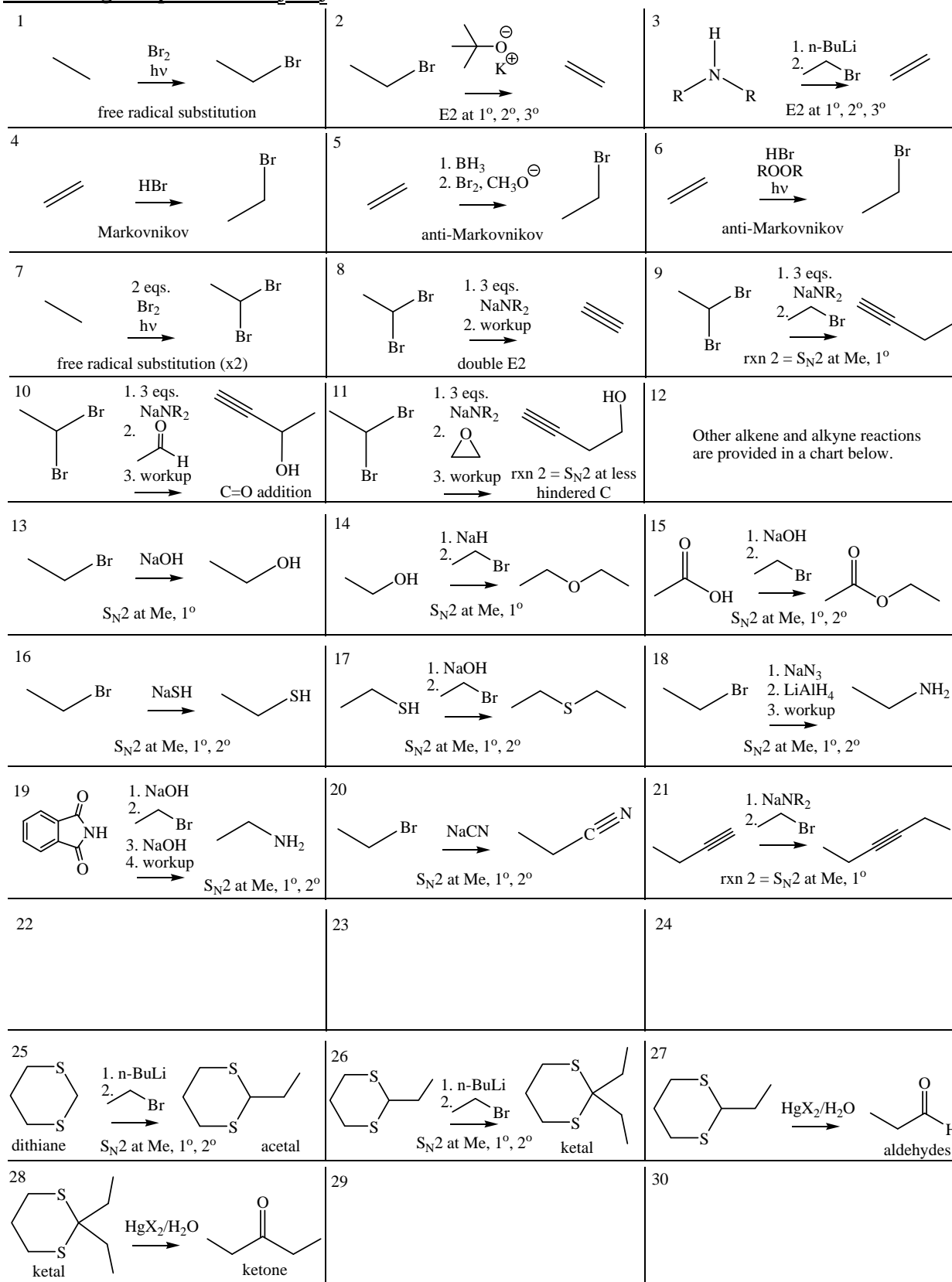
1C starting compound = CH₄

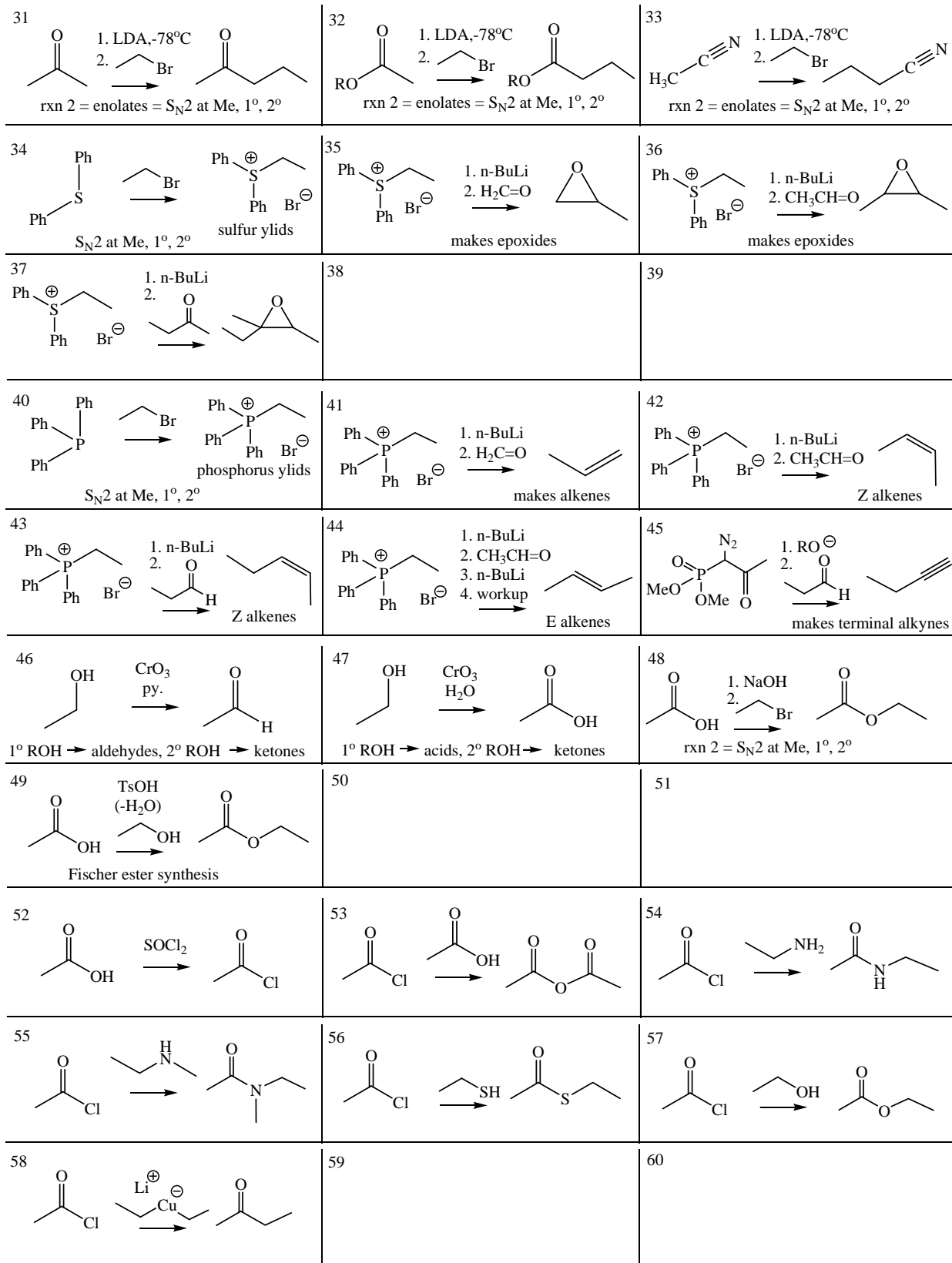


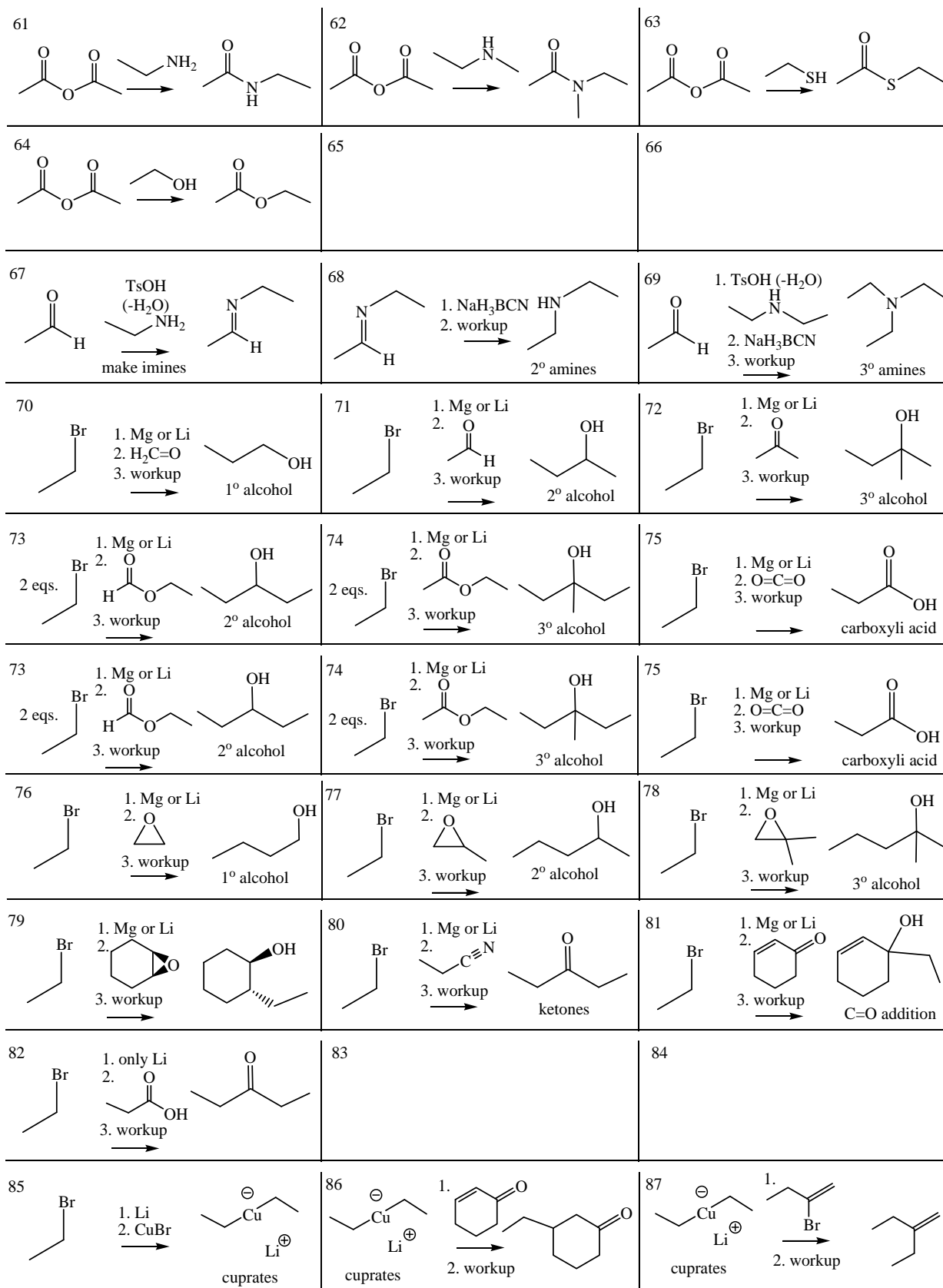


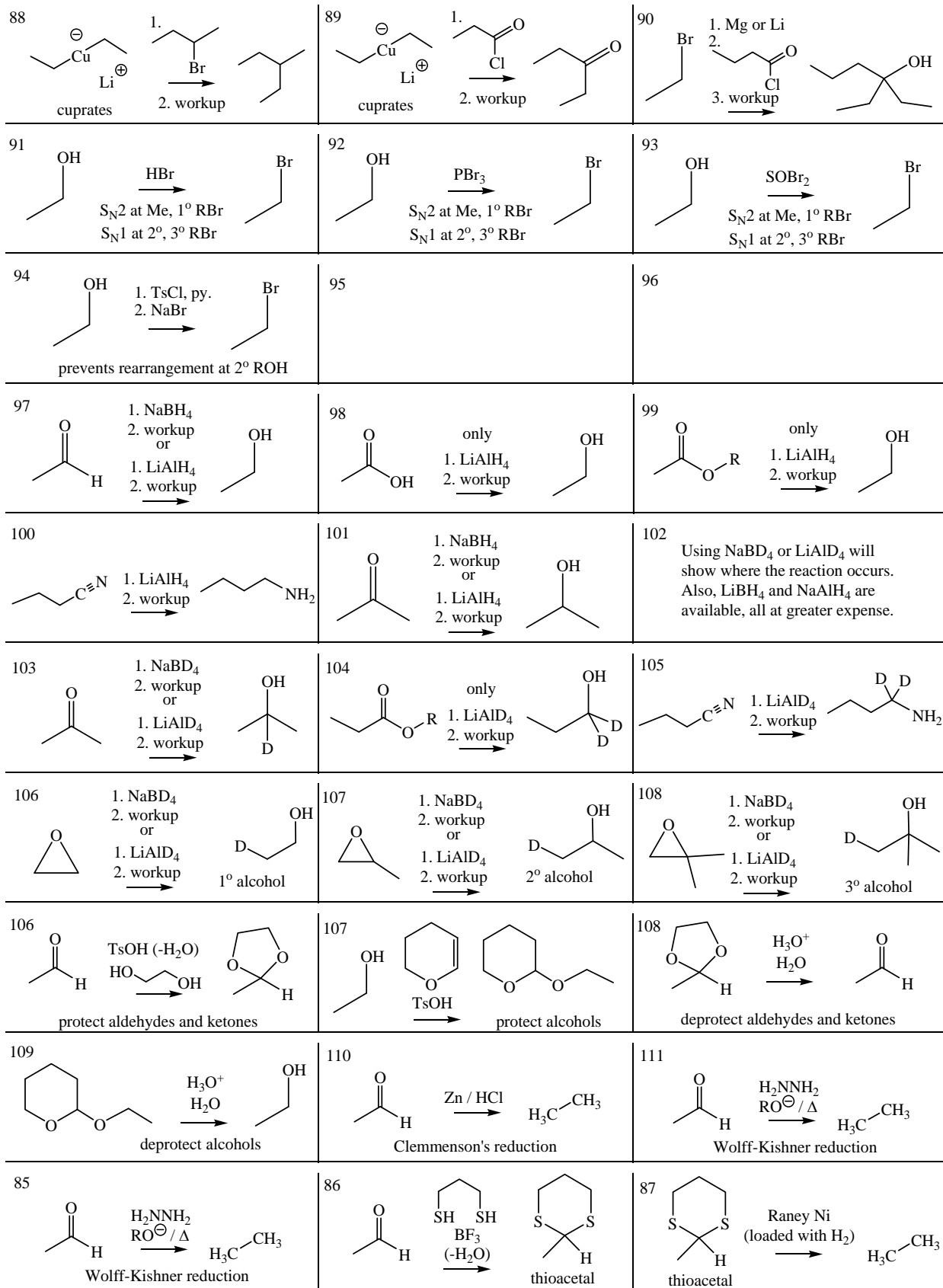


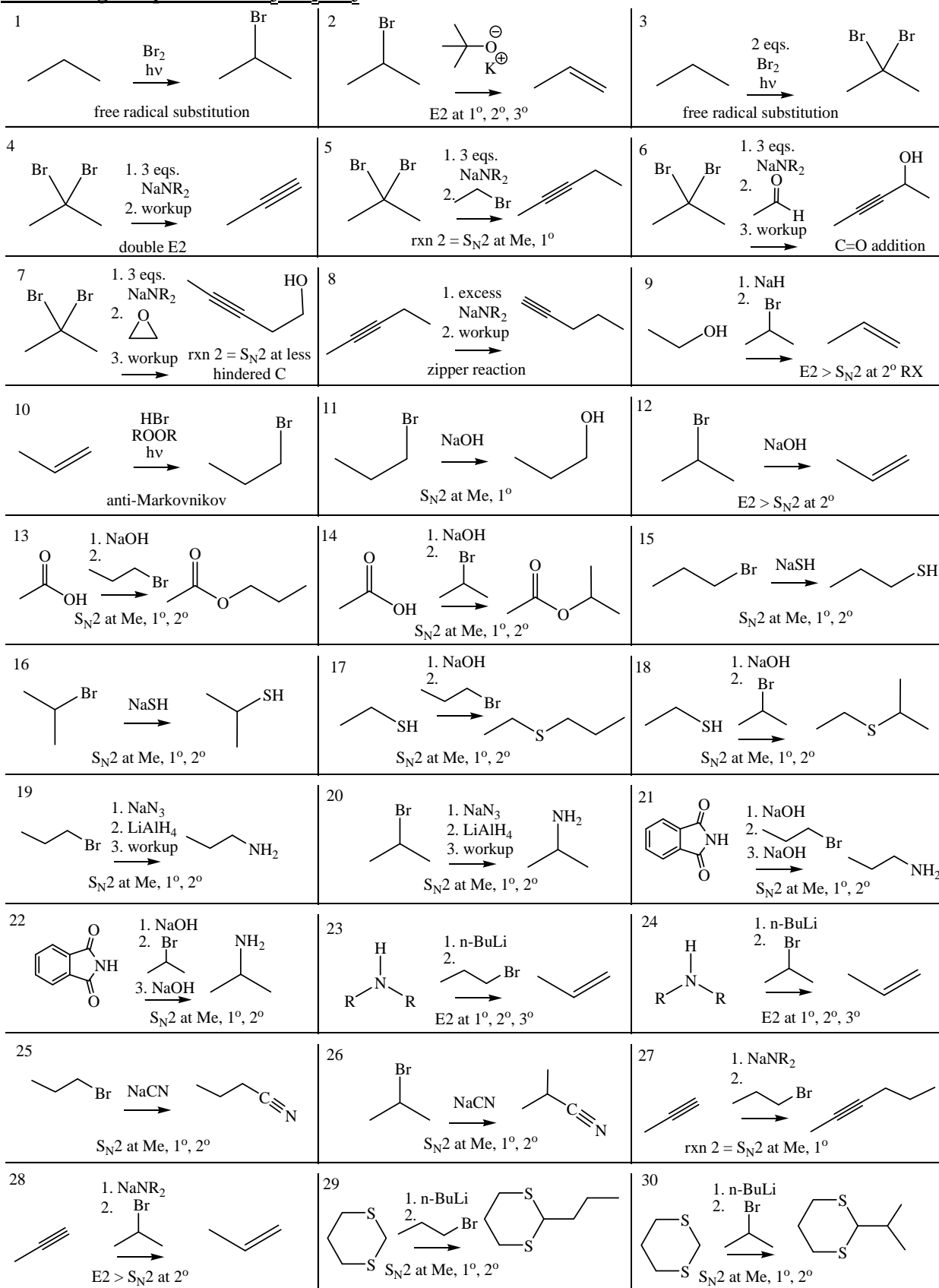


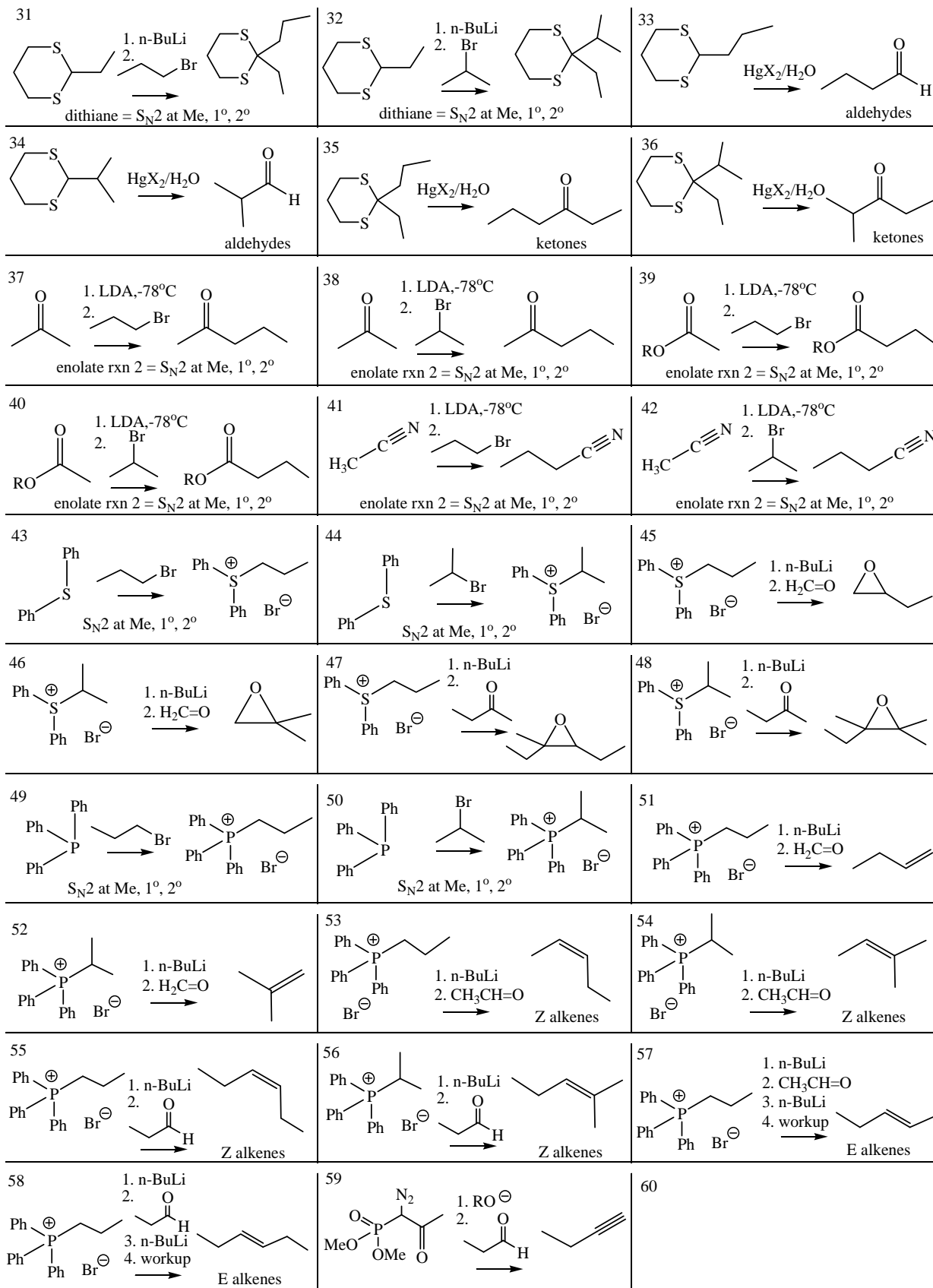
2C starting compound = CH₃CH₃


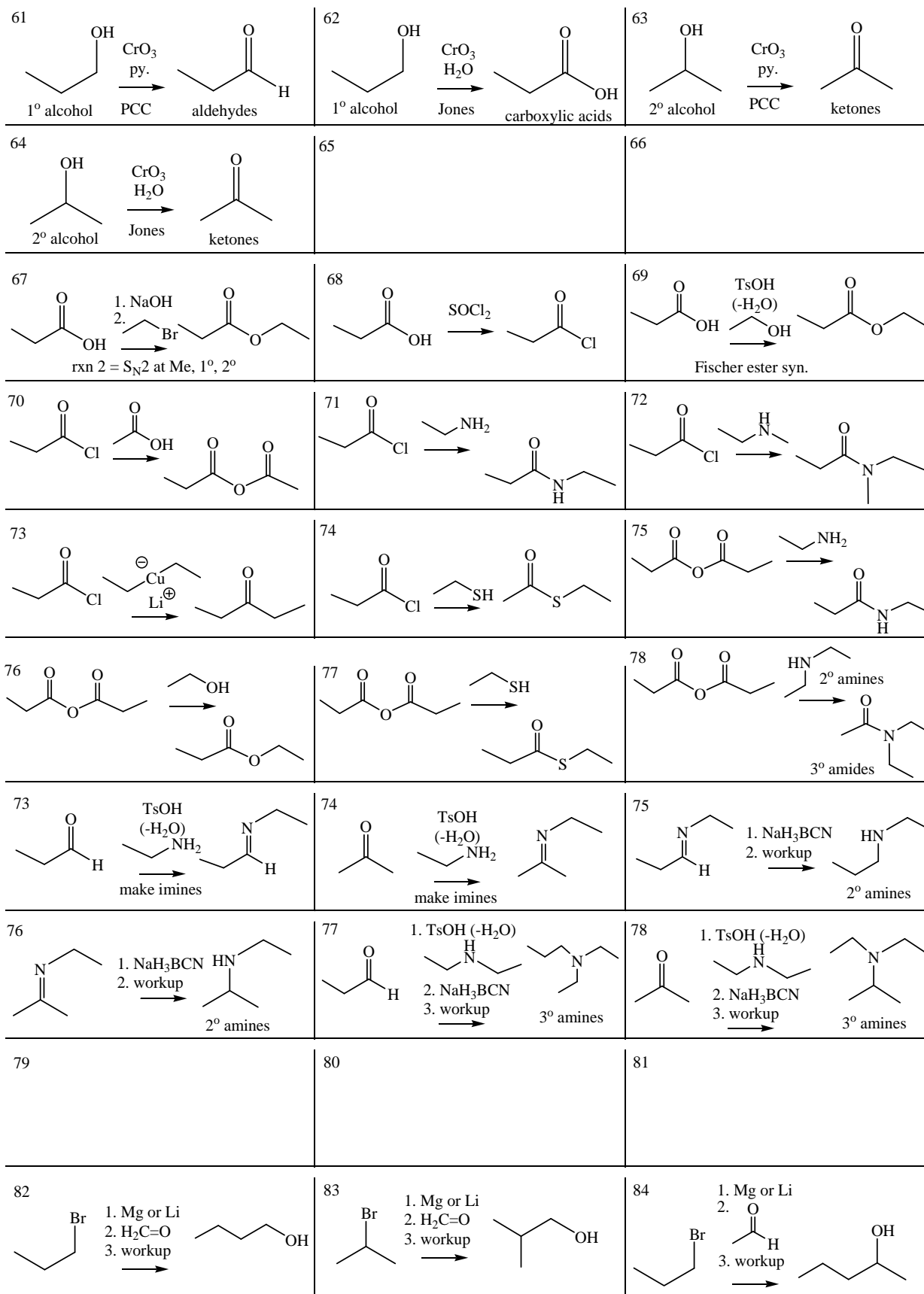


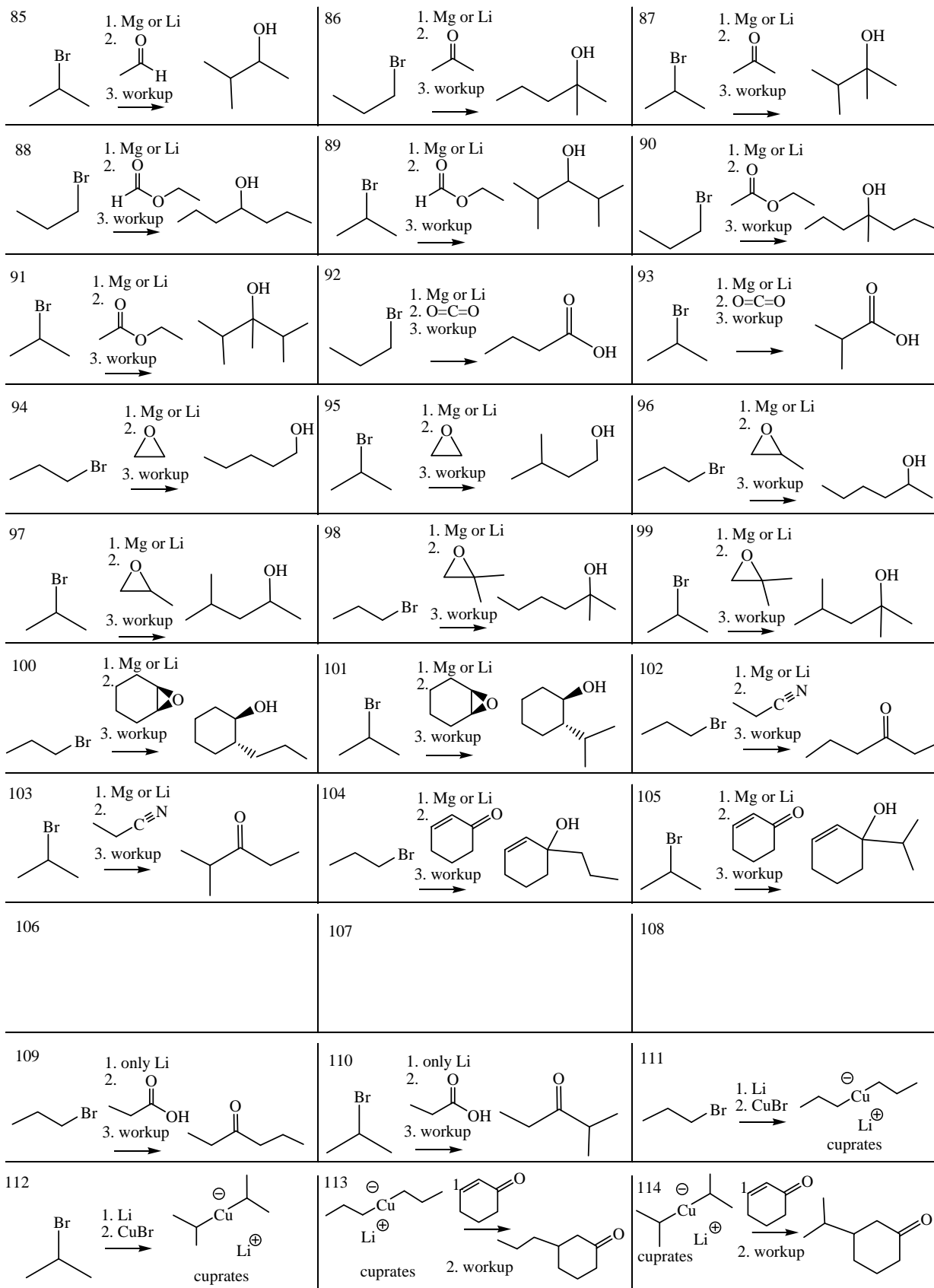


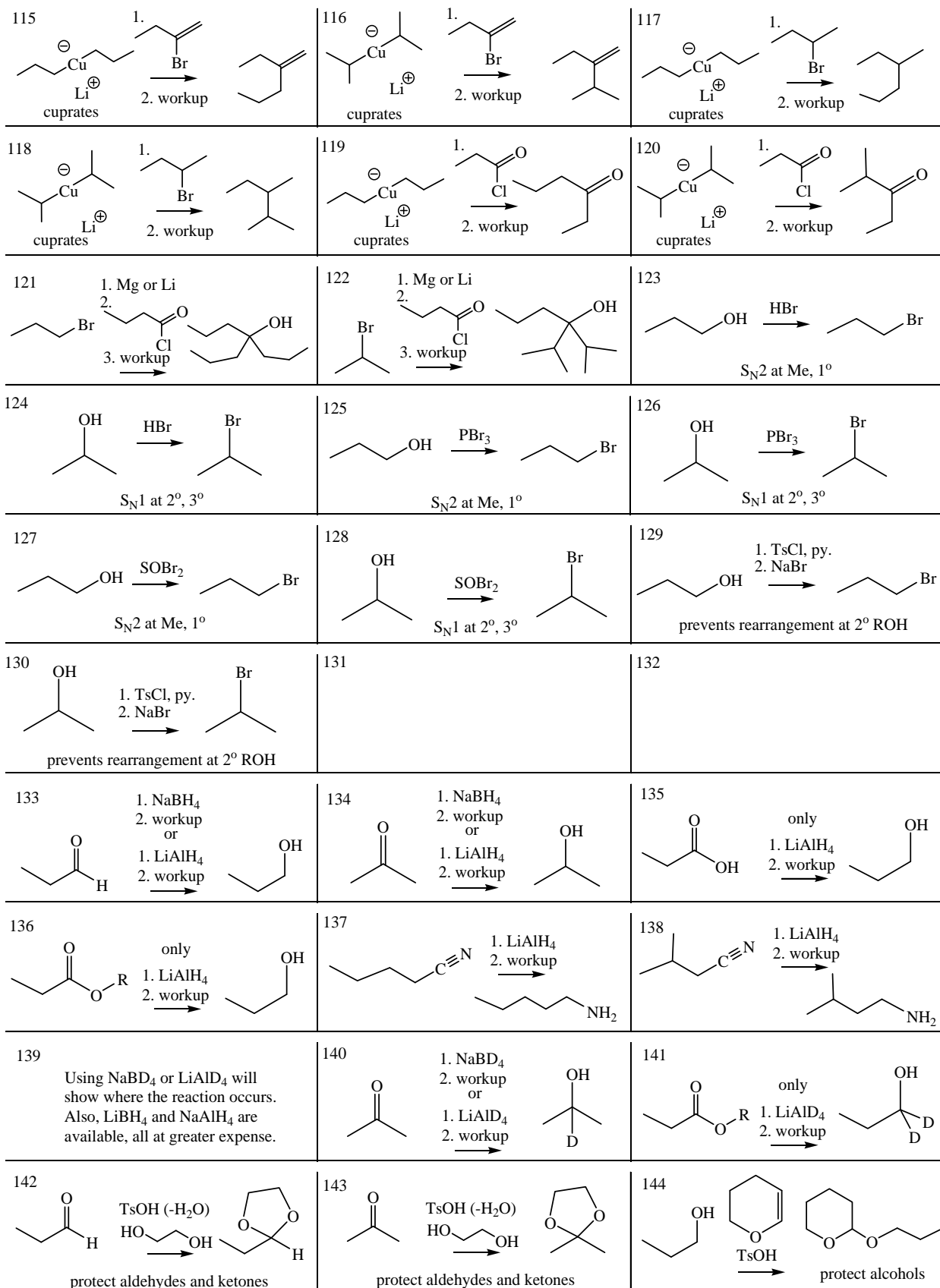


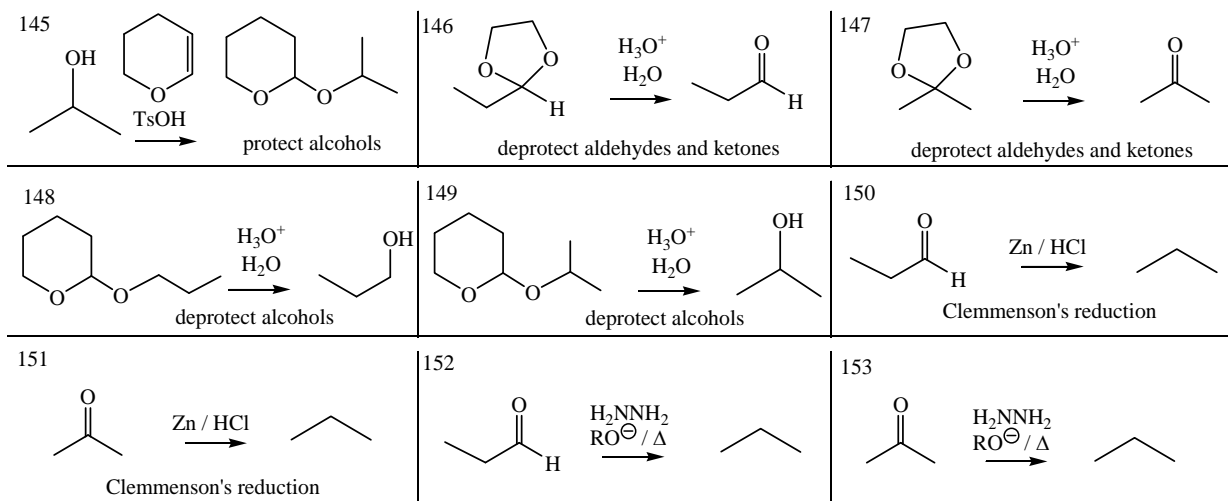
3C starting compound = CH₃CH₂CH₃




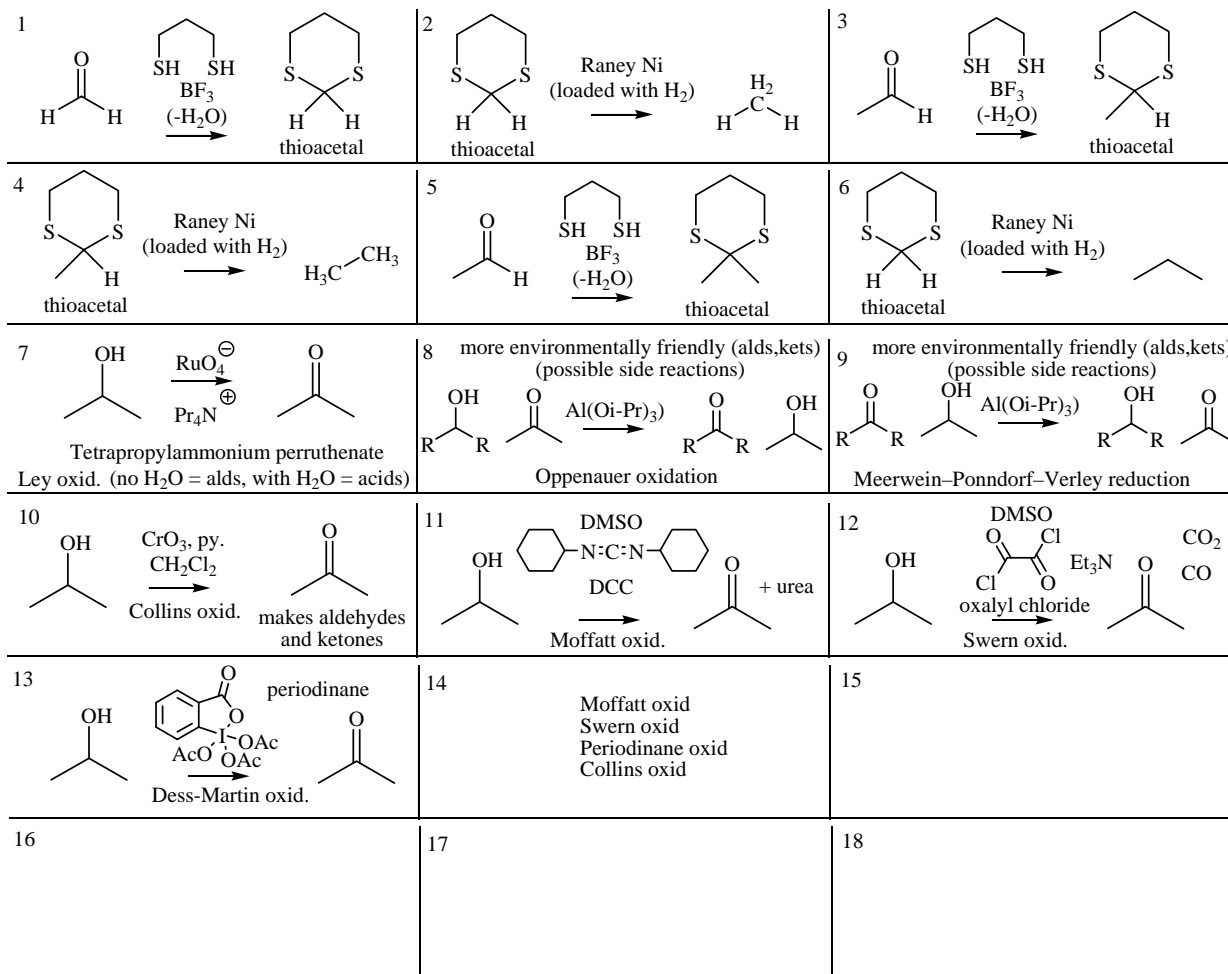








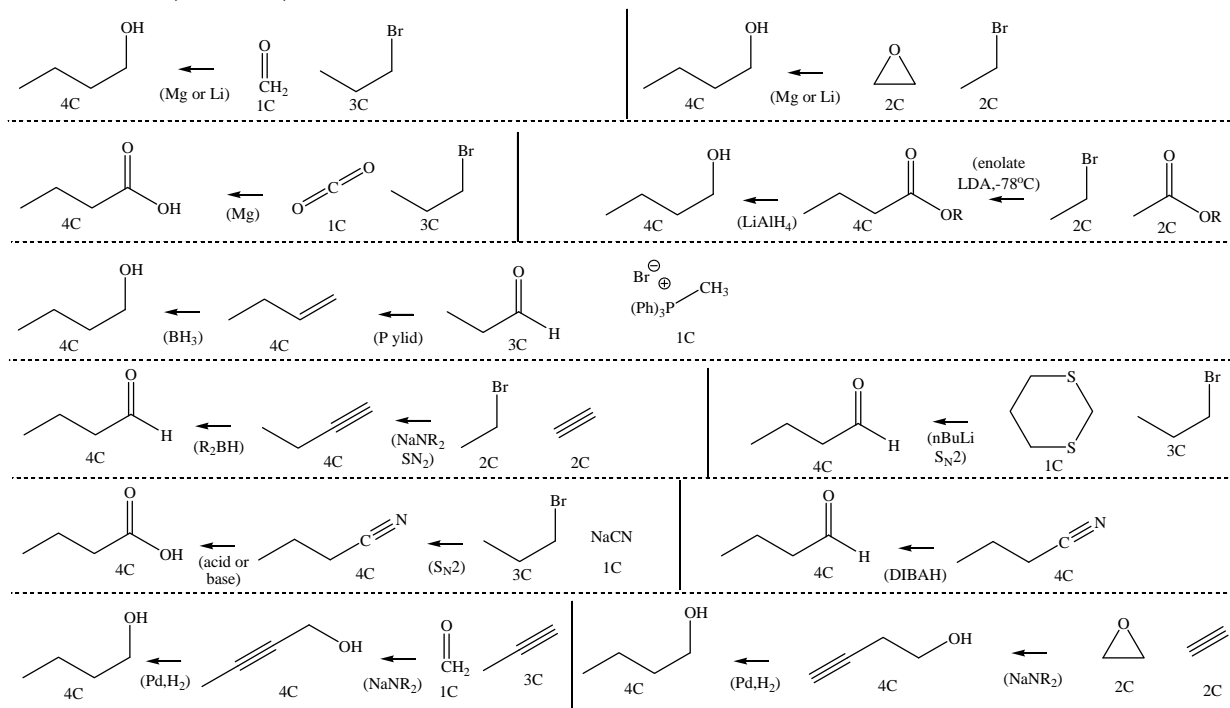
Miscellaneous other reactions not required for our course. You can add others, if needed.



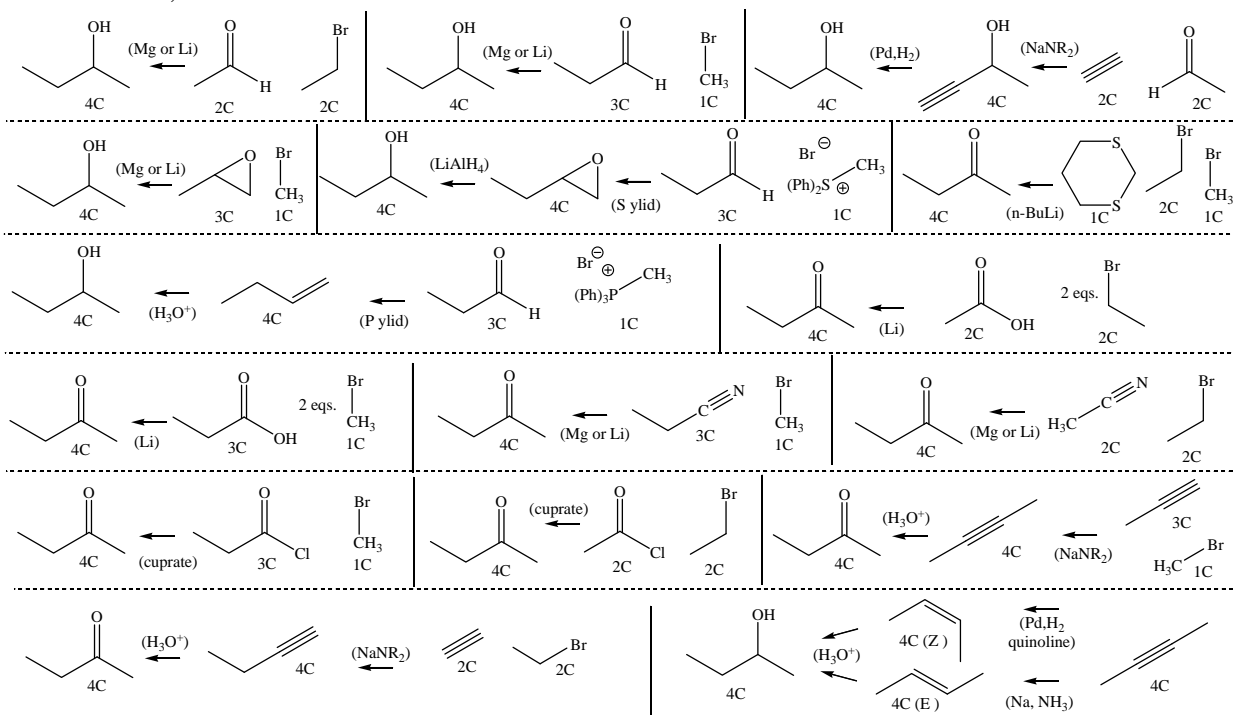
Each of the following proposed synthetic approaches is built on the earlier preparations. Specific reactions are given for the 1C, 2C and 3C compounds. Those are used to make 4C compounds, which are then used to make 5C compounds, which are then used to make 6C compounds. Many example sequences are not efficient or practical, but given to show how reactions can be used. All of the C-C bond forming reactions involve nucleophile/electrophile strategies. Reagents are only shown for the C1, C2 and C3 compounds. It is assumed that you can supply the necessary reagents for C4 and higher compounds (they are repeats of the 1C, 2C and 3C examples), though brief hints may be given under the reaction arrows. The target molecules are mainly alcohols aldehydes, ketones or acids.

4C targets (alcohols, aldehydes, ketones and carboxylic acids)

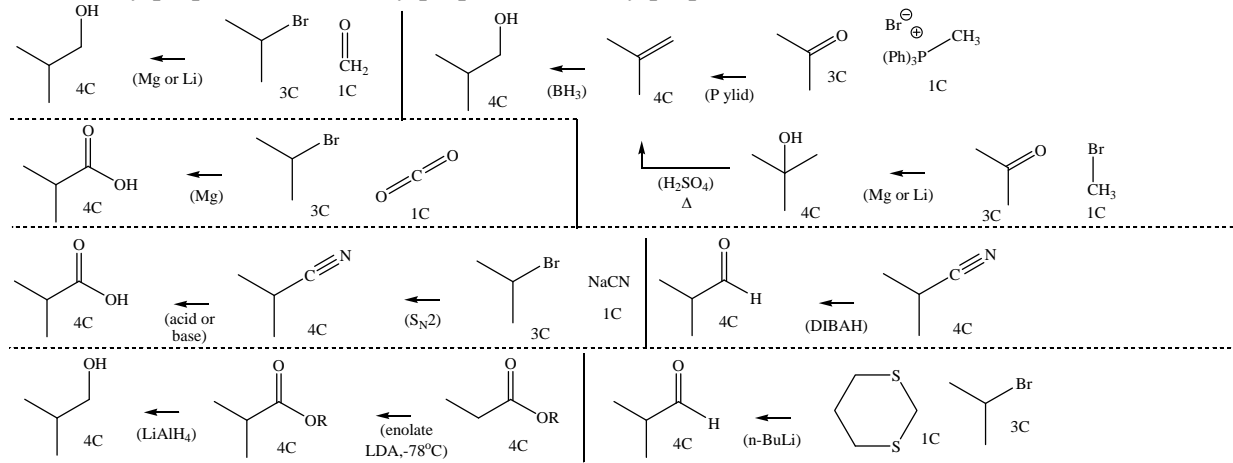
1. butan-1-ol, butanal, butanoic acid



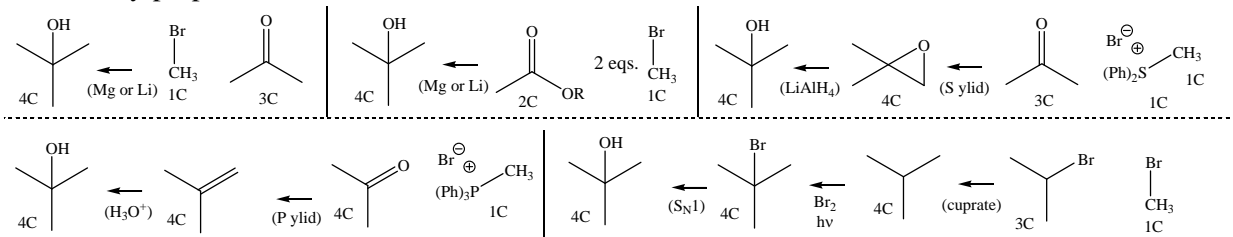
2. butan-2-ol, butan-2-one



3. 2-methylpropan-1-ol, 2-methylpropanal, 2-methylpropanoic acid

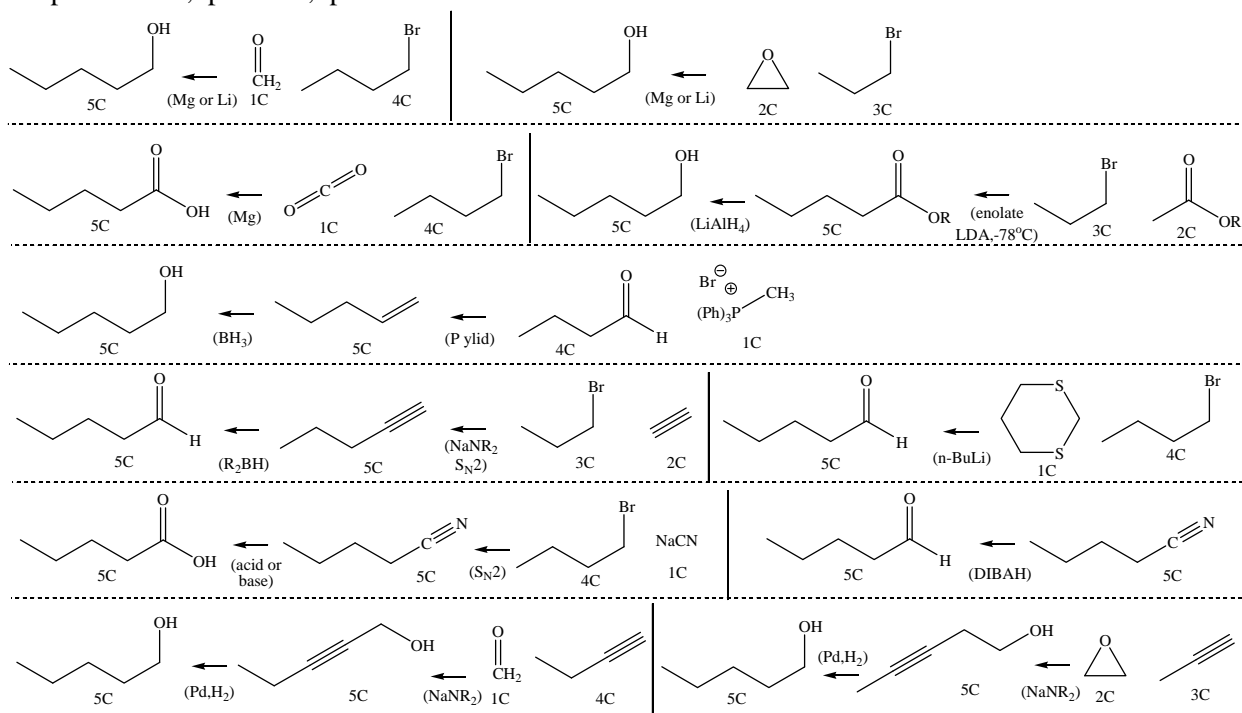


4. 2-methylpropan-2-ol

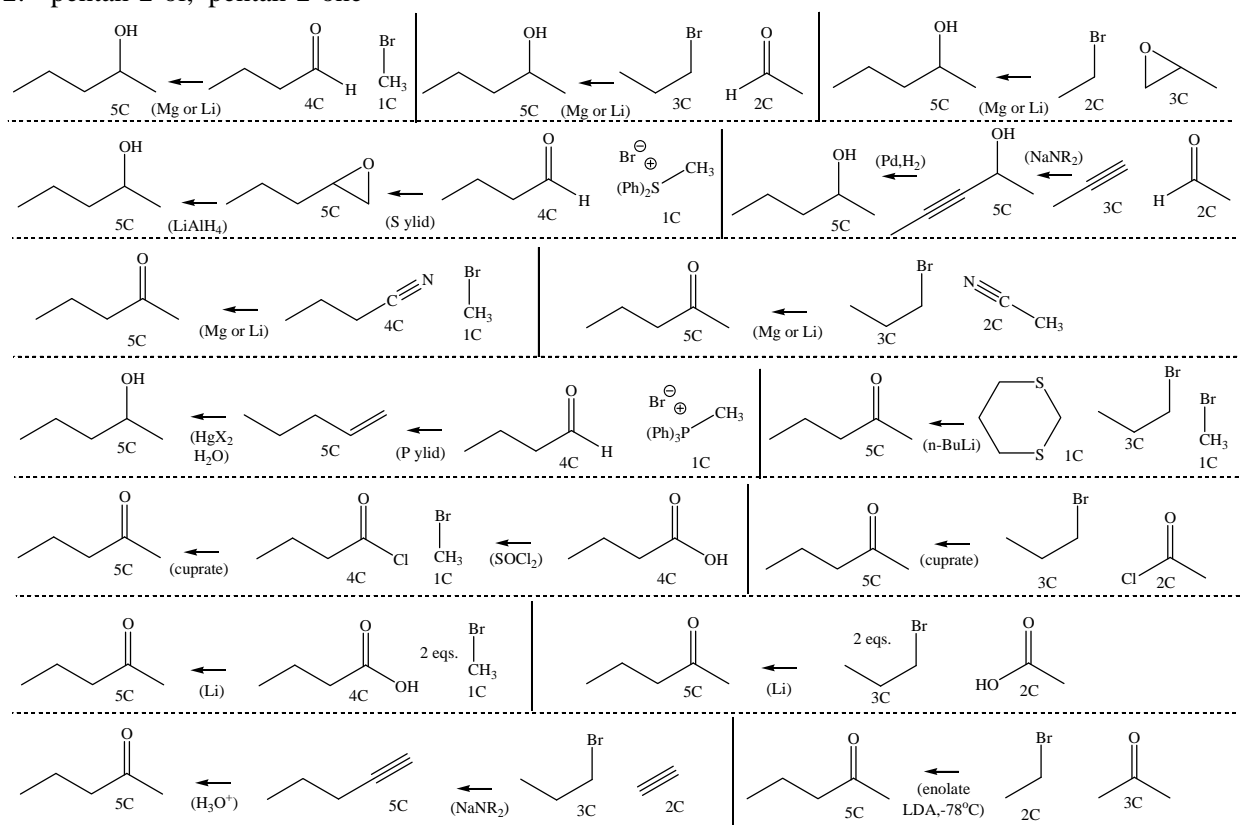


5C targets (alcohols, aldehydes and carboxylic acids)

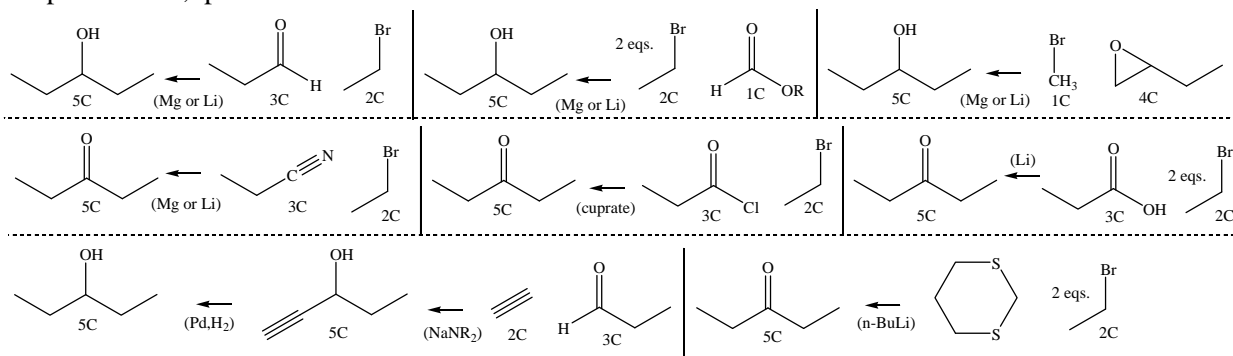
1. pentan-1-ol, pentanal, pentanoic acid



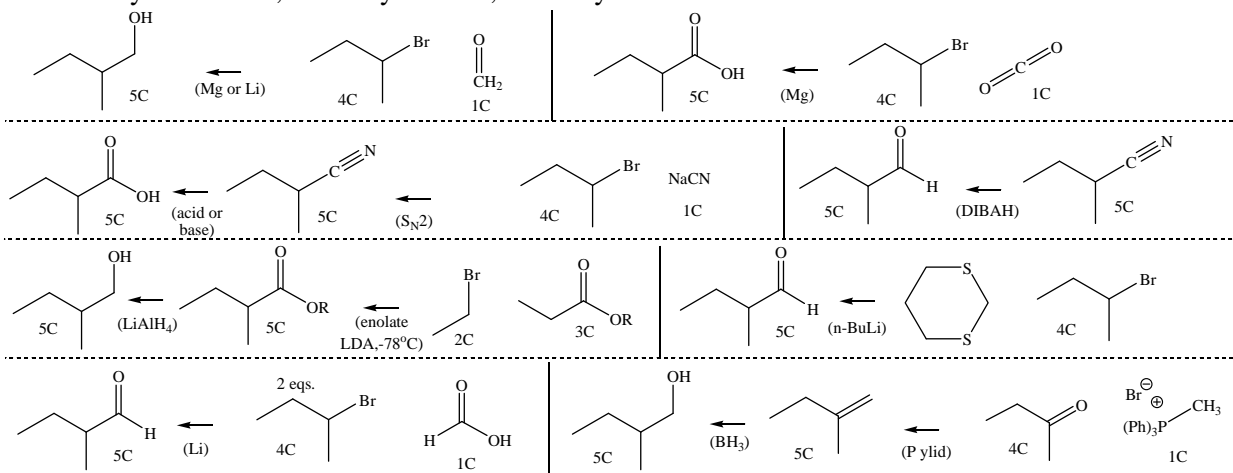
2. pentan-2-ol, pentan-2-one



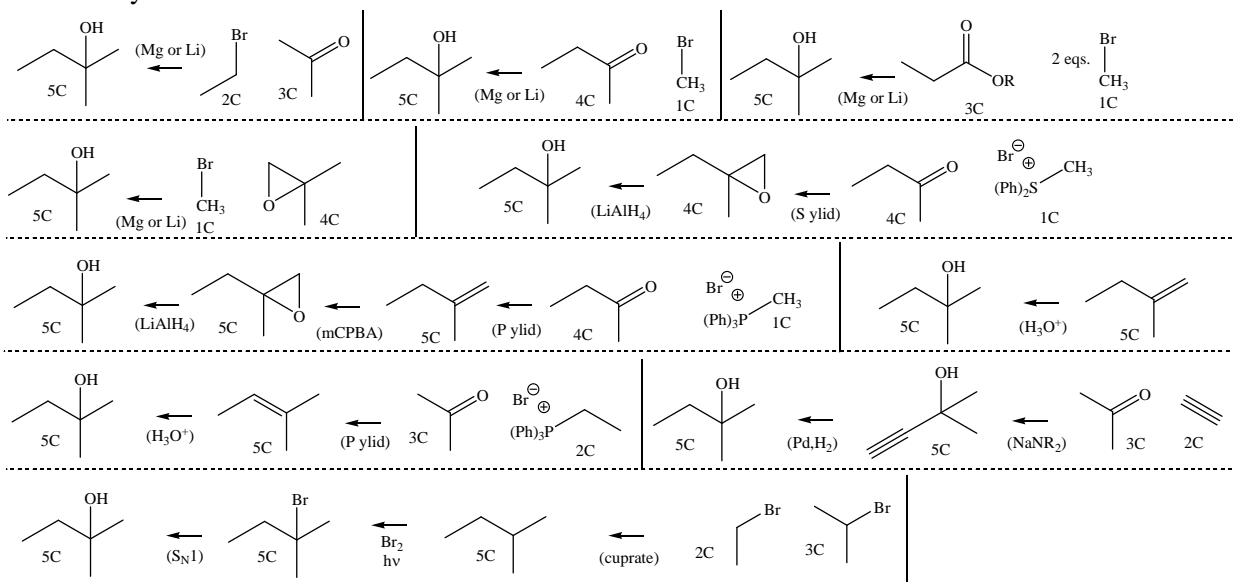
3. pentan-3-ol, pentan-3-one



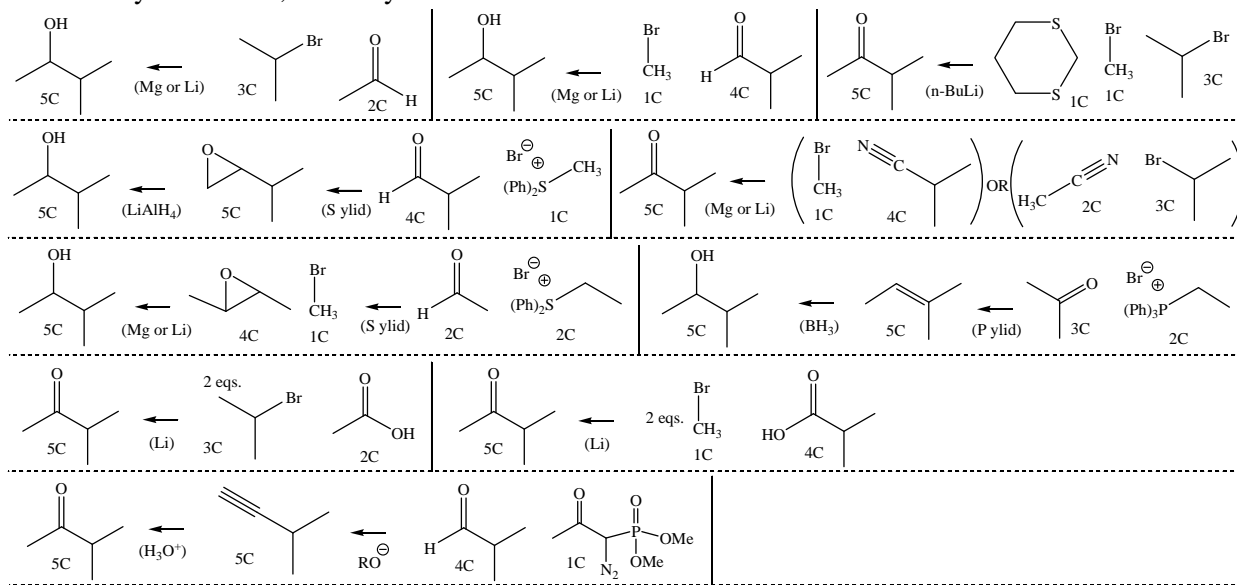
4. 2-methylbutan-1-ol, 2-methylbutanal, 2-methylbutanoic acid



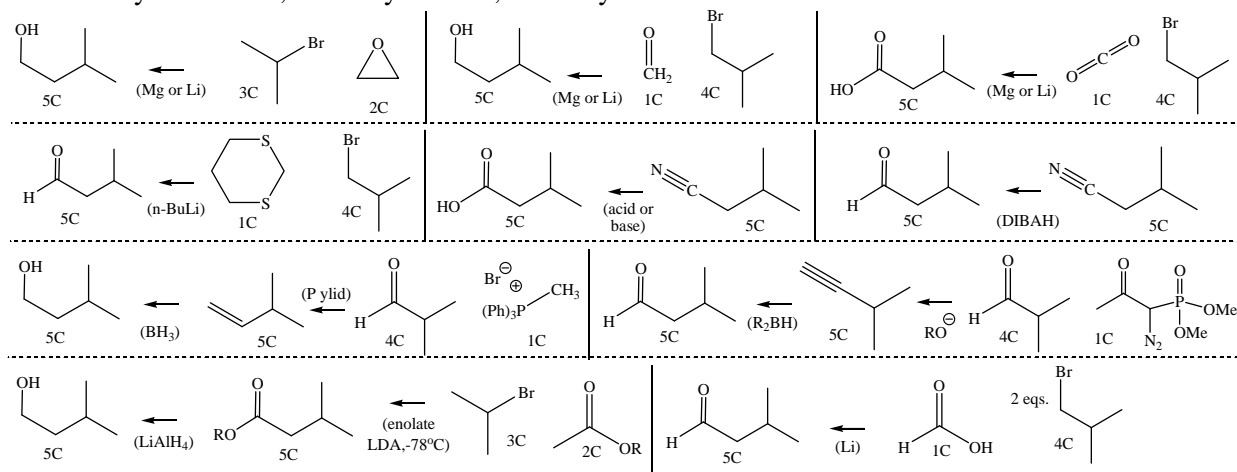
5. 2-methylbutan-2-ol



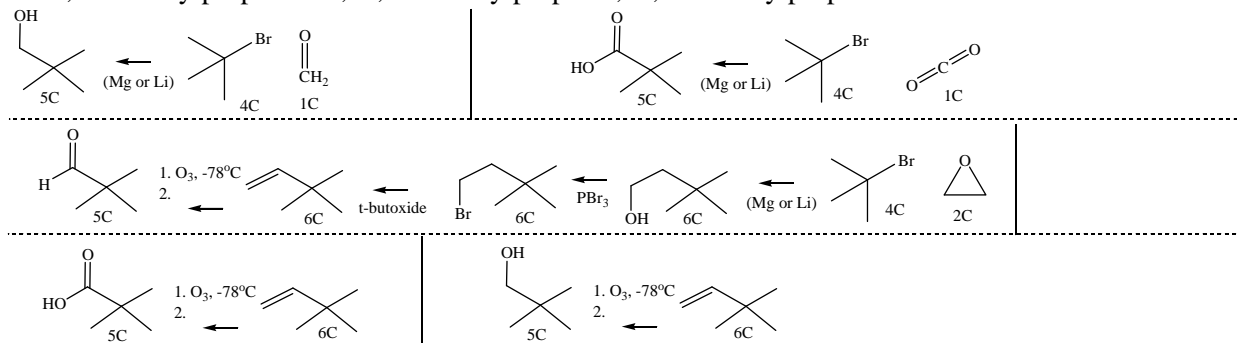
6. 2-methylbutan-3-ol, 2-methylbutan-3-one



7. 3-methylbutan-1-ol, 3-methylbutanal, 3-methylbutanoic acid

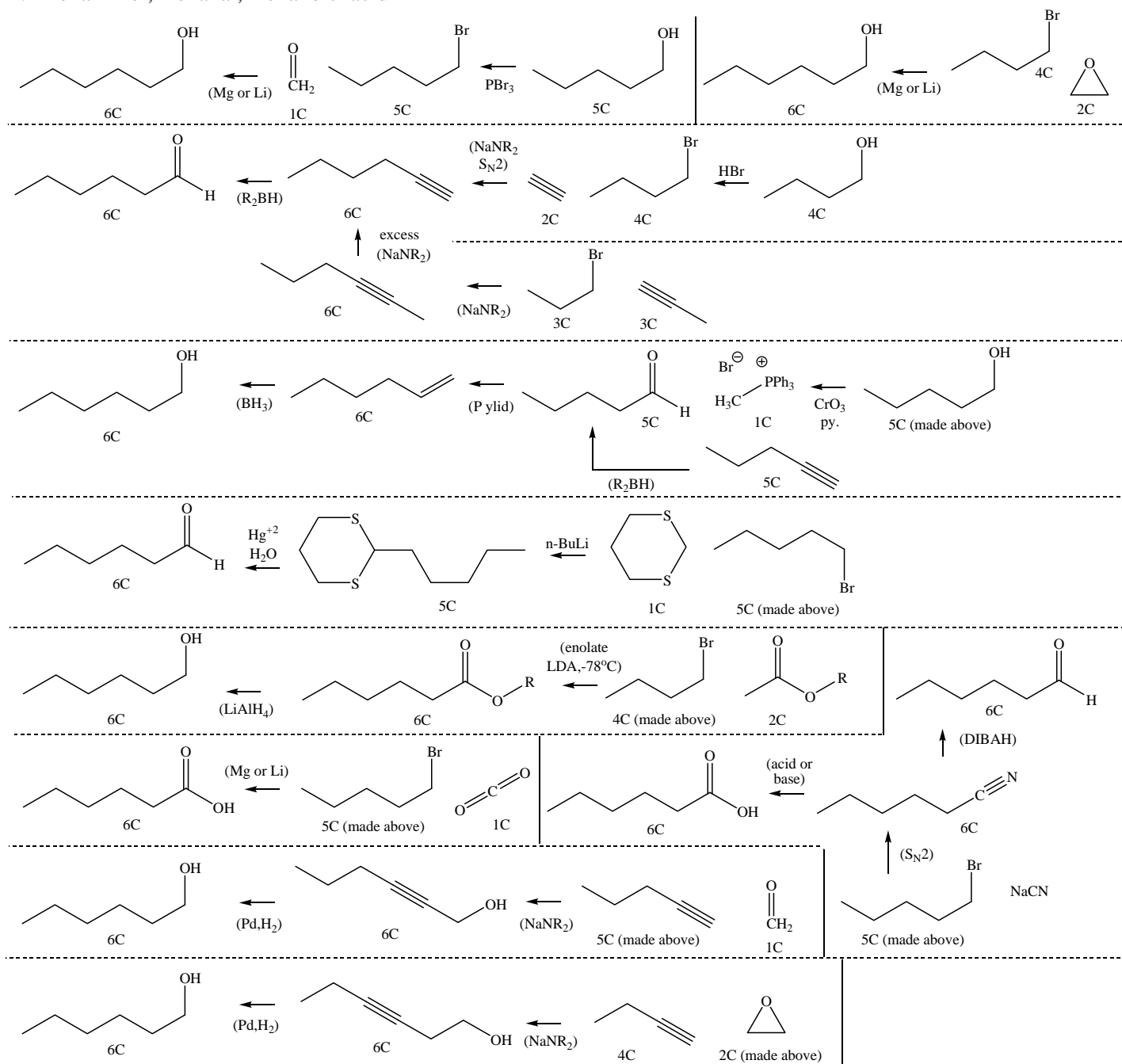


8. 2,2-dimethylpropan-1-ol, 2,2-dimethylpropanal, 2,2-dimethylpropanoic acid

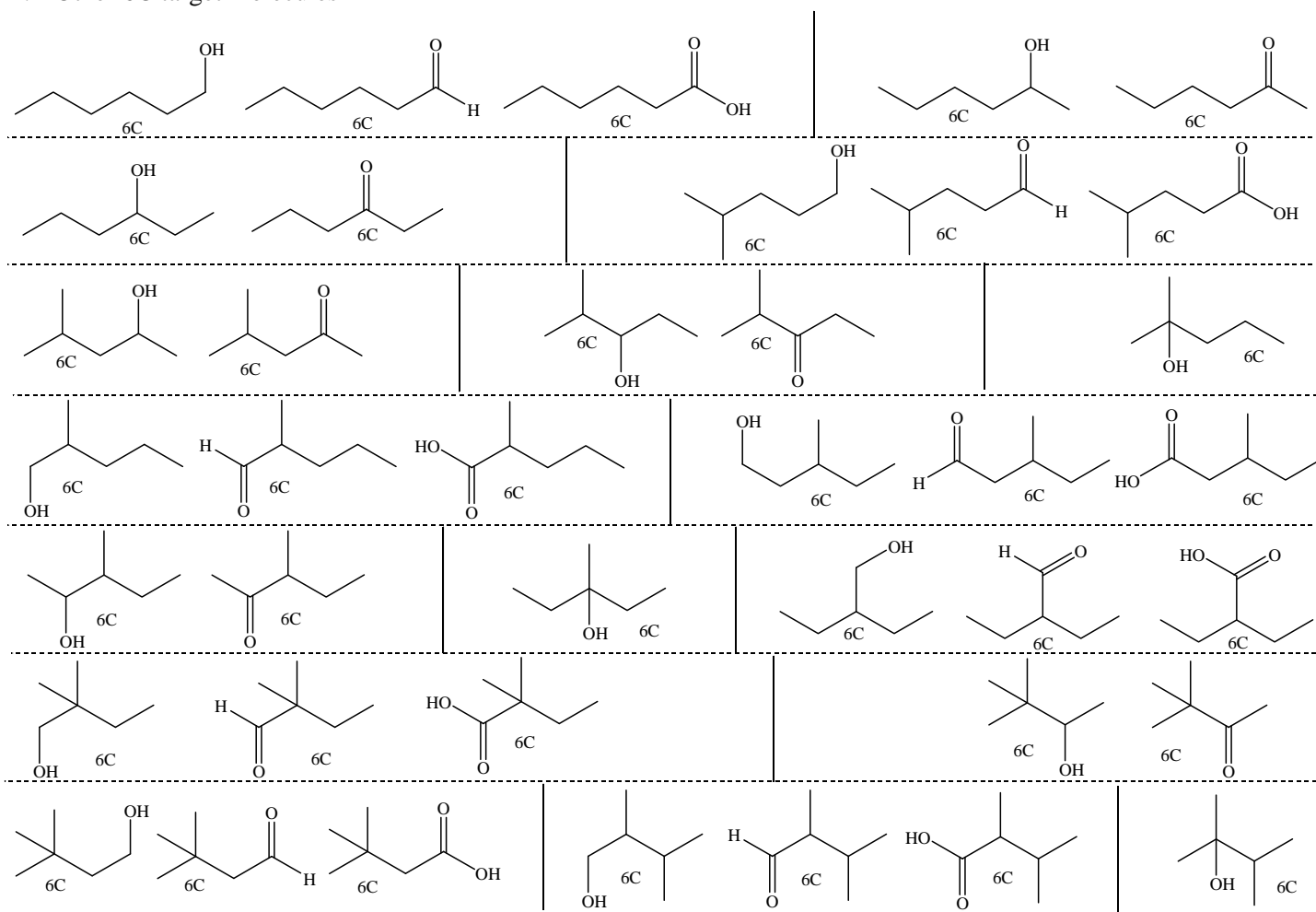


6C targets (alcohols, aldehydes, ketones and carboxylic acids)

1. hexan-1-ol, hexanal, hexanoic acid



2. Other 6C target molecules



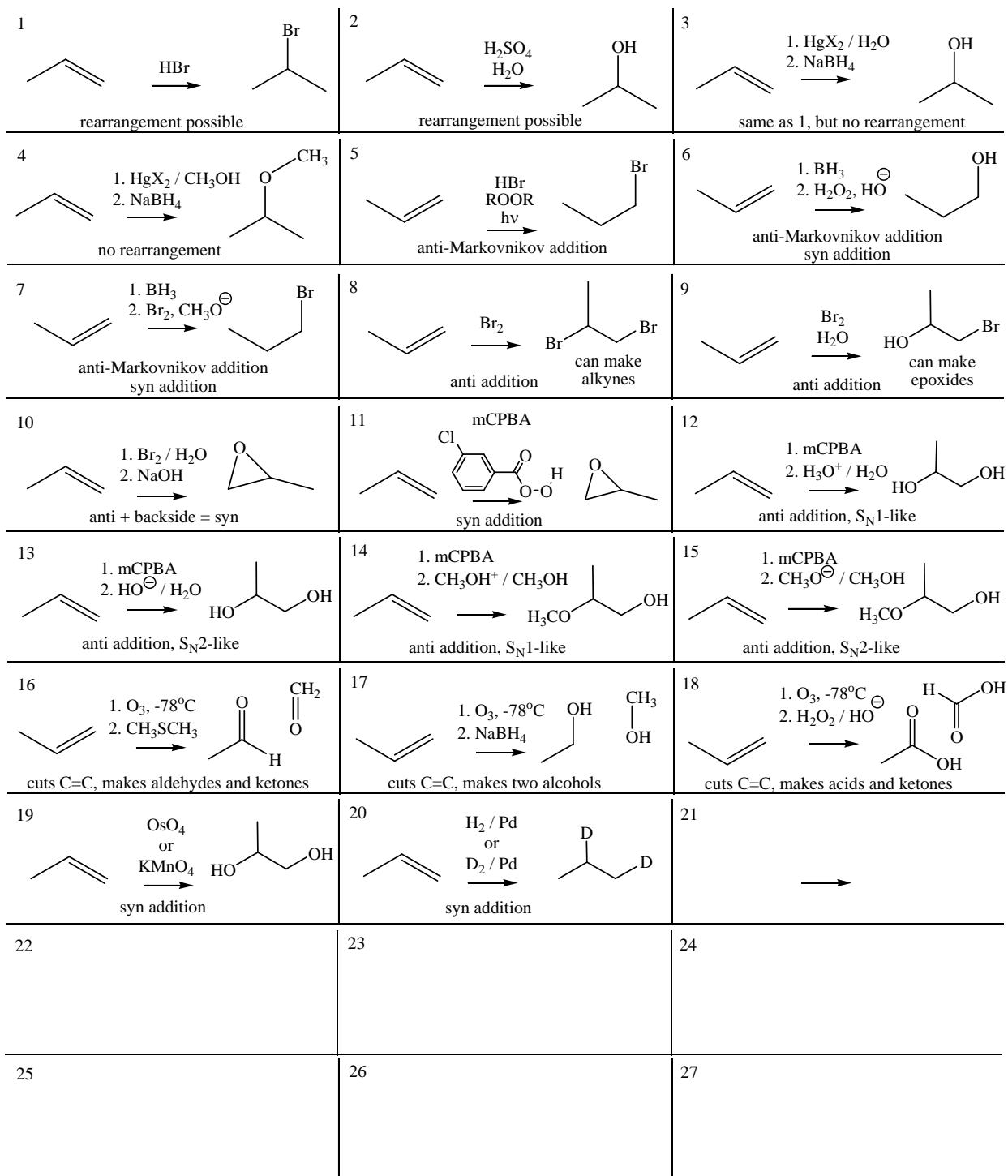
Alkene reactions

Ethene –does not show regioselectivity or stereoselectivity

1 rearrangement possible	2 rearrangement possible	3 same as 1, but no rearrangement
4 no rearrangement	5 anti-Markovnikov addition	6 anti-Markovnikov addition syn addition
7 anti-Markovnikov addition syn addition	8 anti addition can make alkynes	9 anti addition can make epoxides
10 anti + backside = syn	11 syn addition	12 anti addition, SN1-like
13 anti addition, SN2-like	14 anti addition, SN1-like	15 anti addition, SN2-like
16 cuts C=C, makes aldehydes and ketones	17 cuts C=C, makes two alcohols	18 cuts C=C, makes acids and ketones
19 syn addition	20 syn addition	21
22	23	24
25	26	27

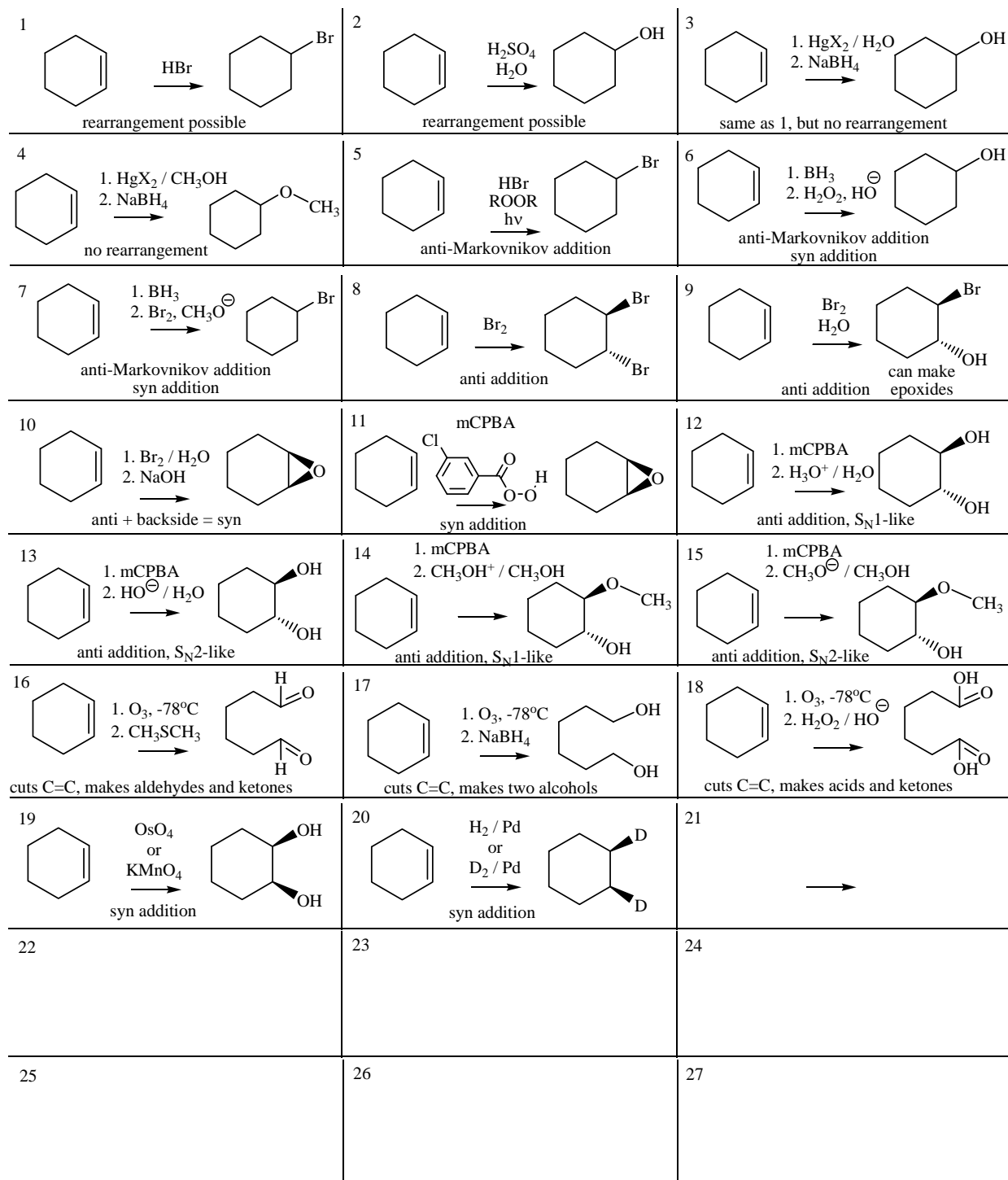
Alkene reactions

Propene –shows regioselectivity but not stereoselectivity



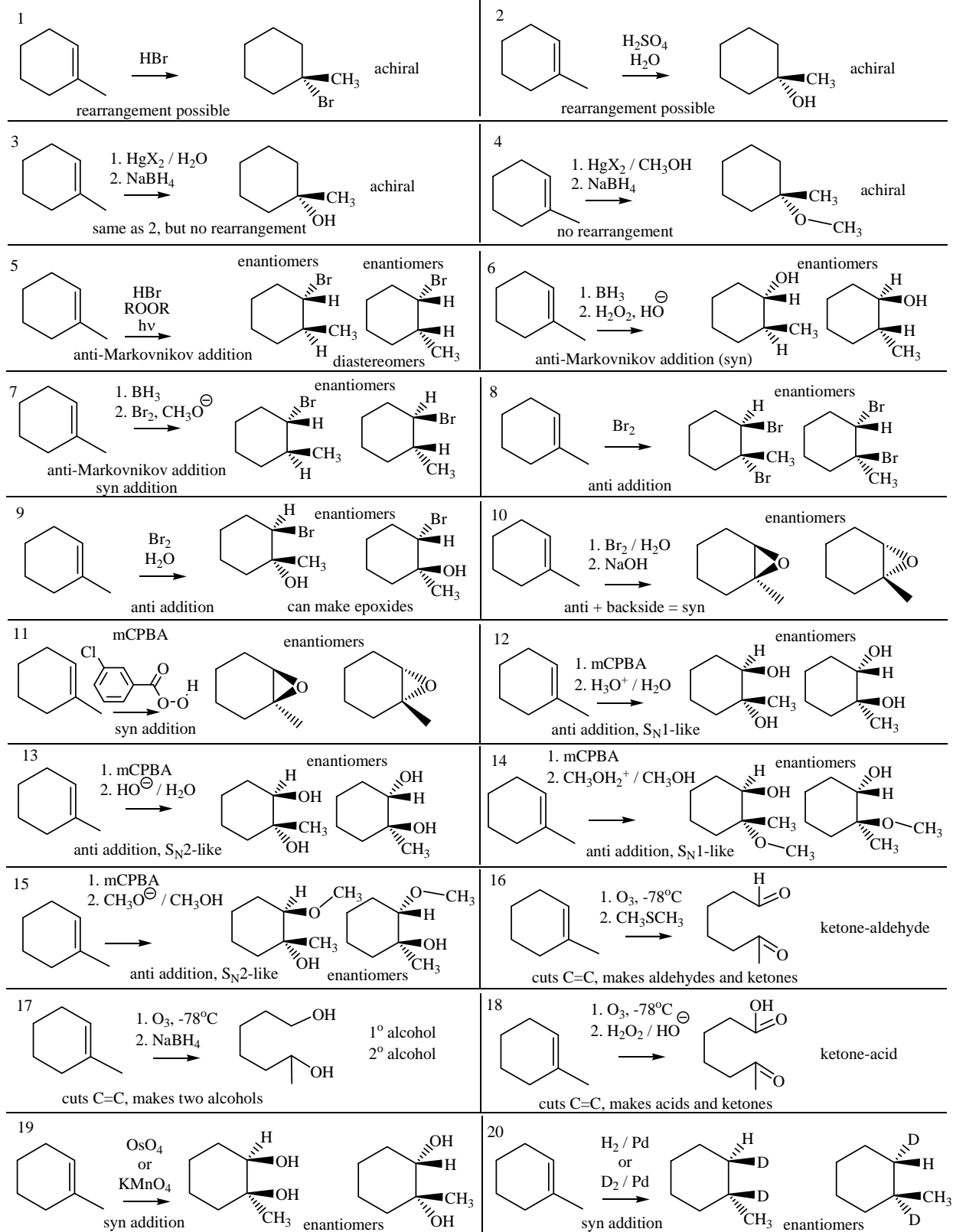
Alkene reactions

Cyclohexene – shows stereoselectivity but not regioselectivity



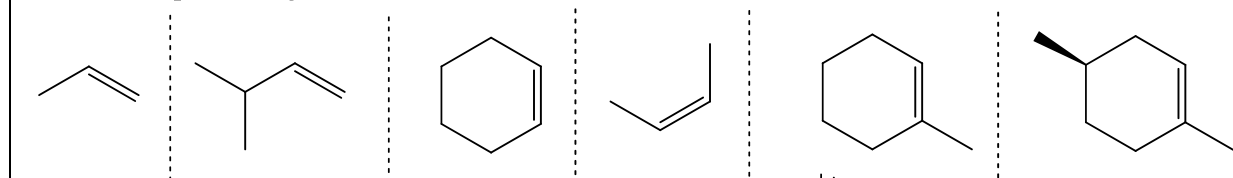
Alkene reactions

1-methylcyclohexene – shows stereoselectivity and regioselectivity

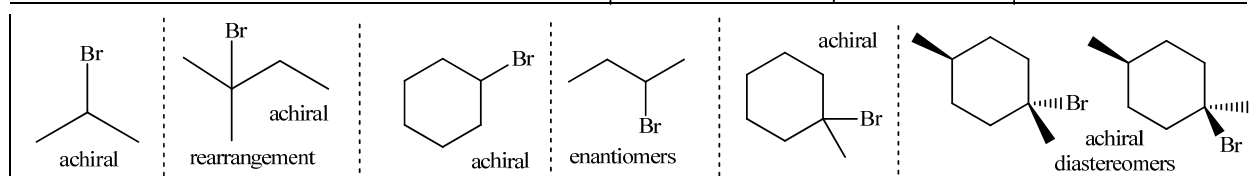
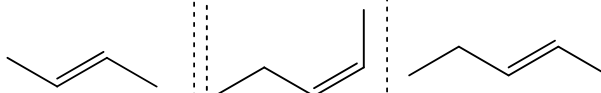


Alkene Reactions

alkene examples for regioselectivity and stereoselectivity



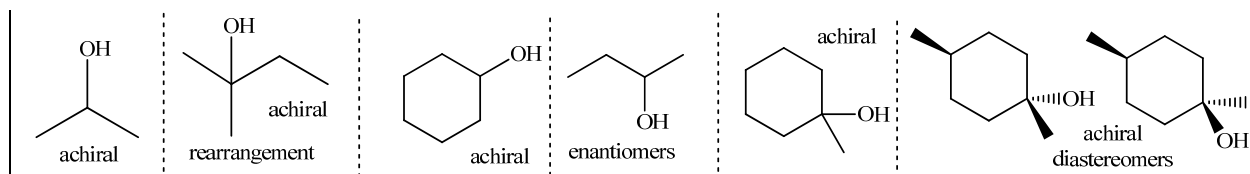
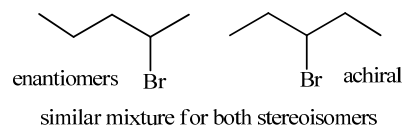
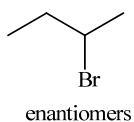
Reaction
Conditions
(reagents)



HBr

Markovnikov
addition

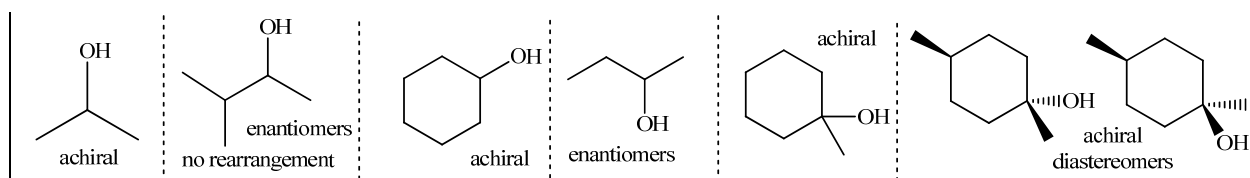
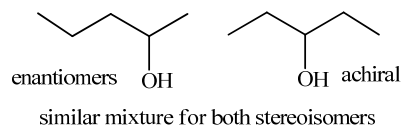
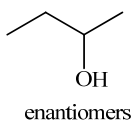
rearrangements
are possible



H₂SO₄
H₂O

Markovnikov
addition

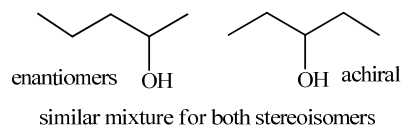
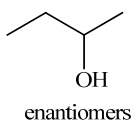
rearrangements
are possible

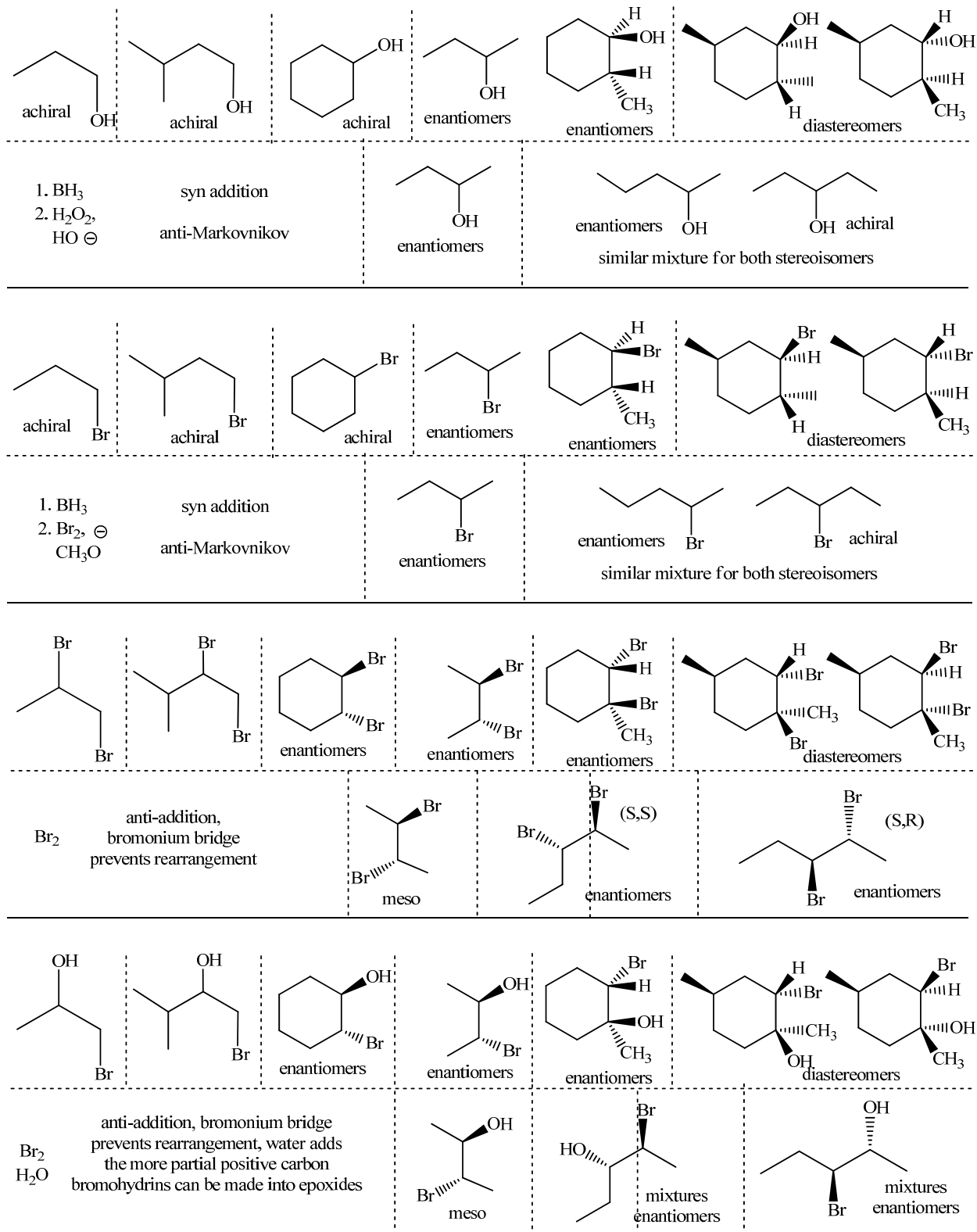


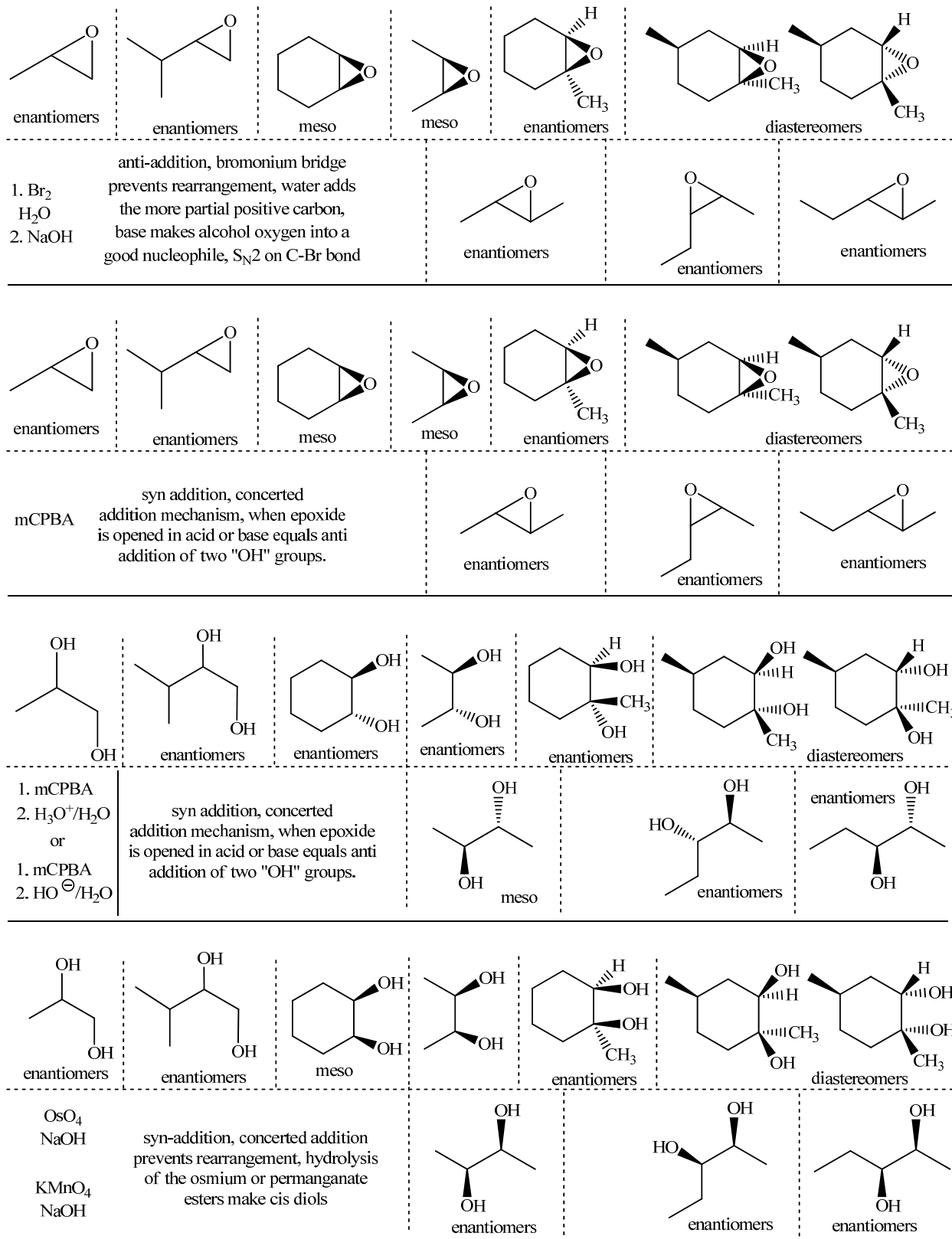
1. HgX₂,
H₂O
2. NaBH₄

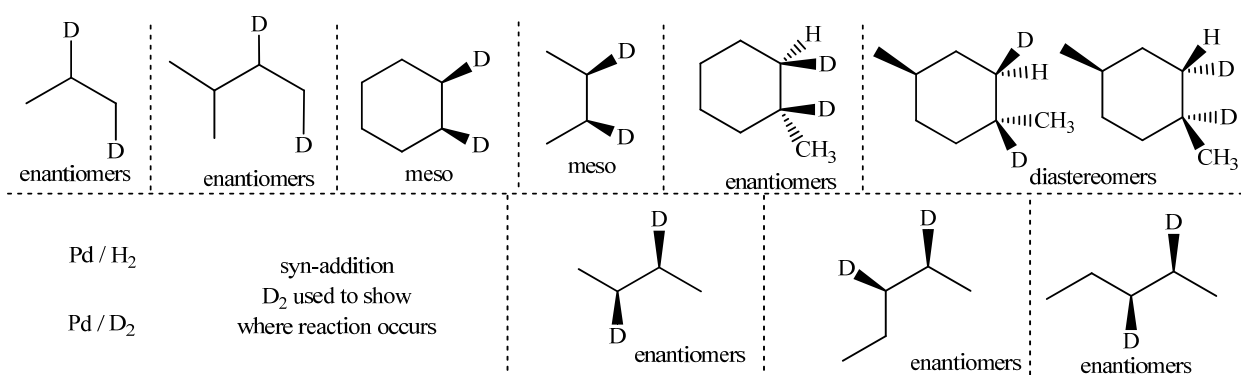
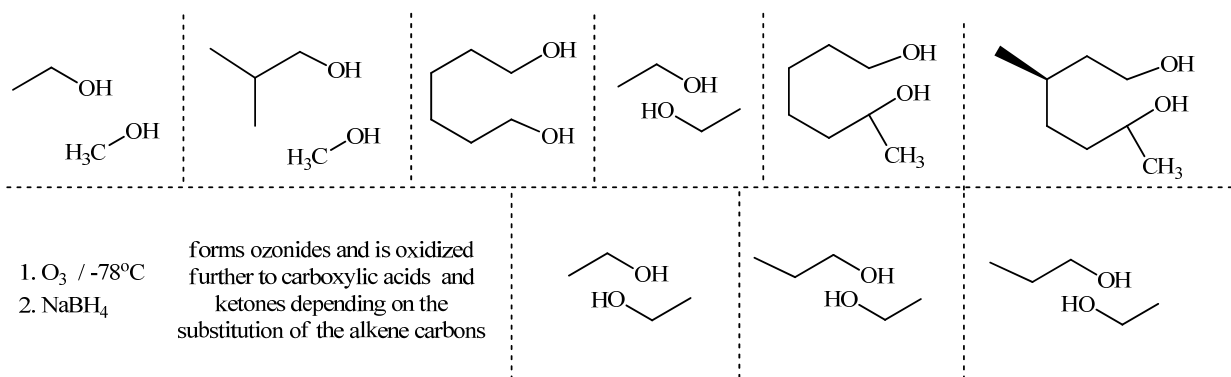
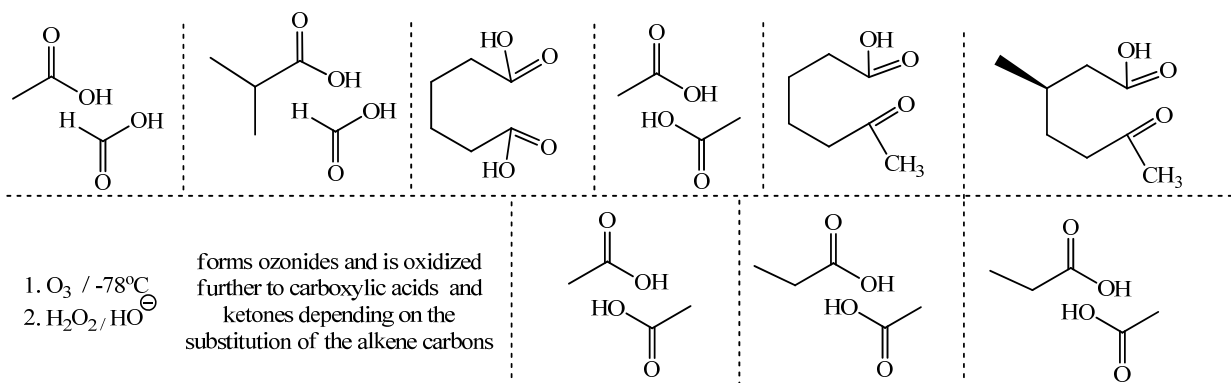
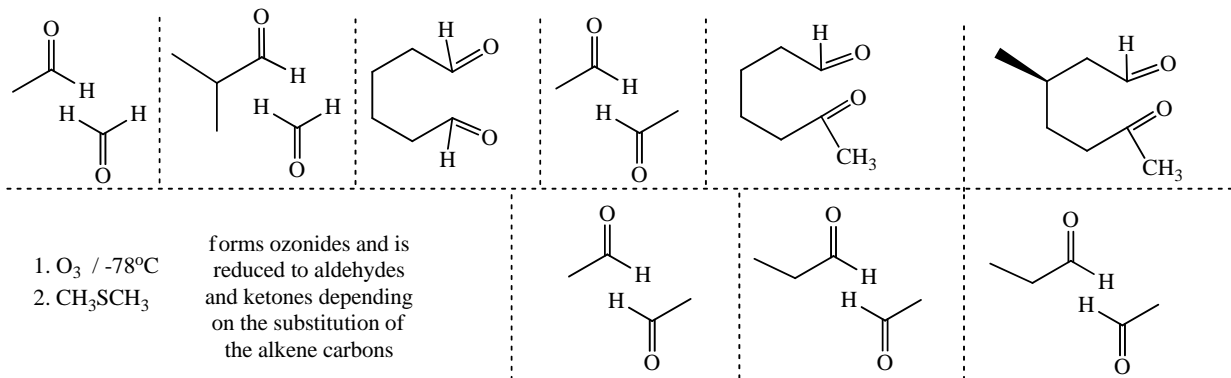
Markovnikov
addition

rearrangements are
not expected

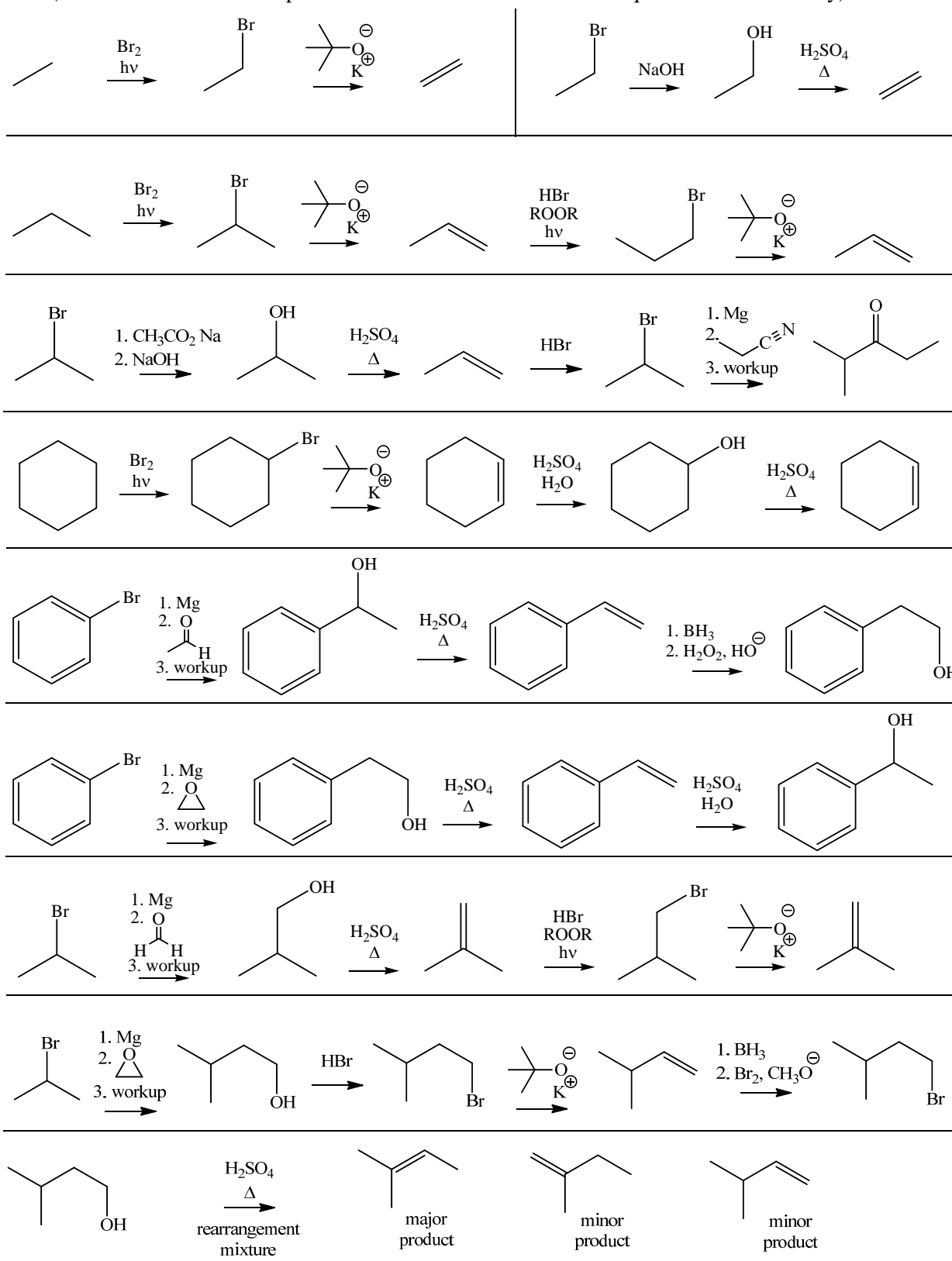


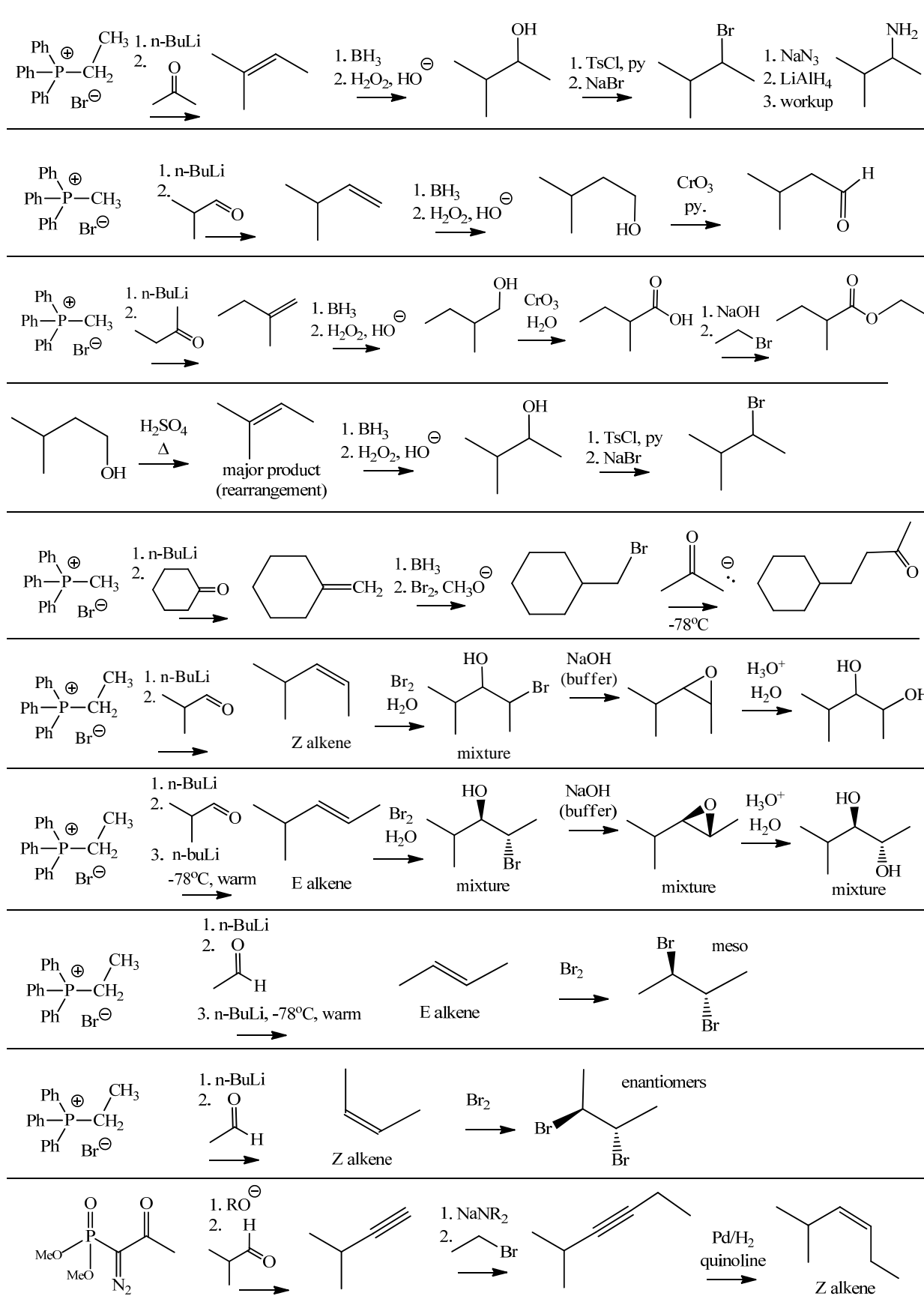


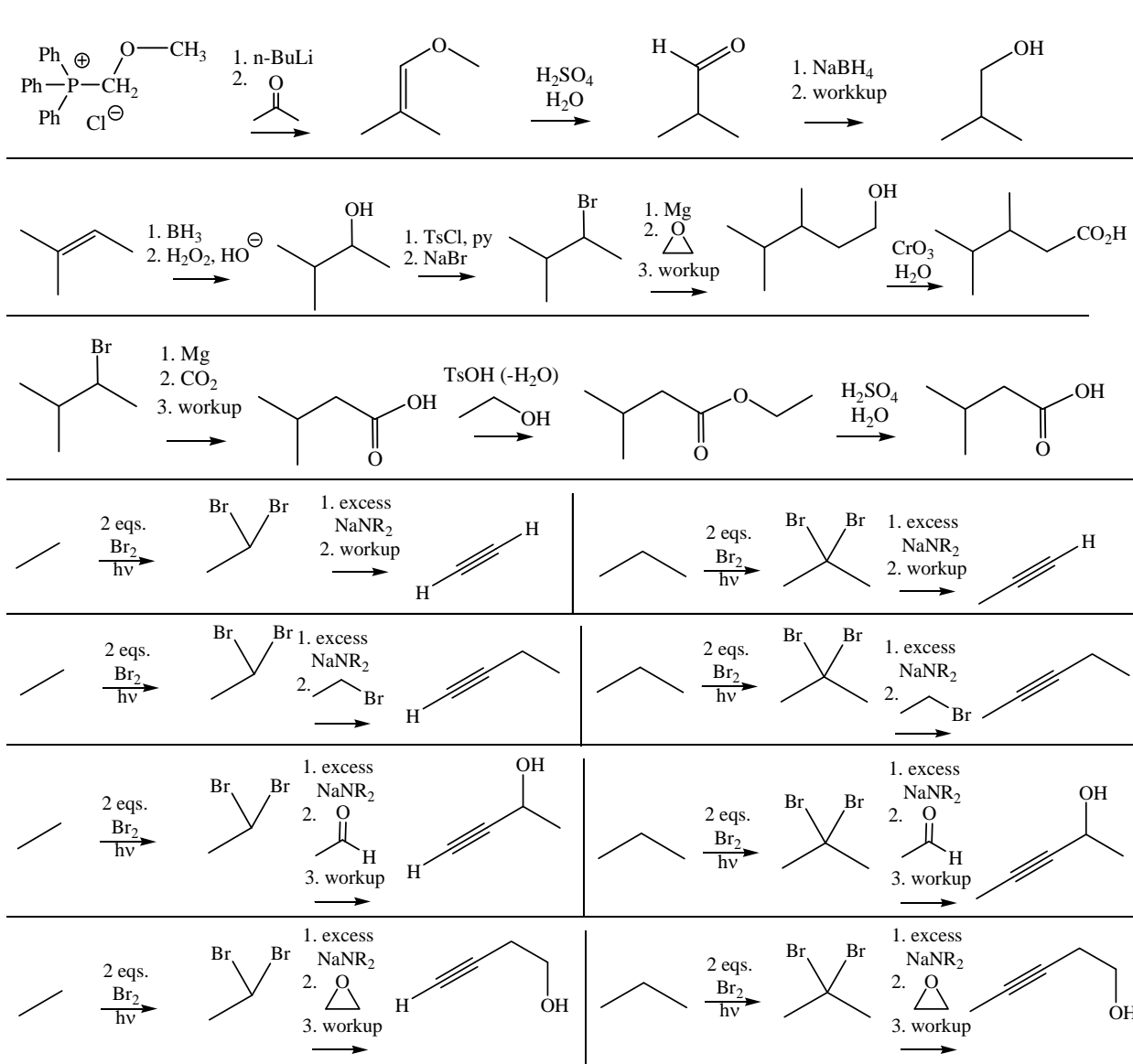




Random course reactions, focusing more on alkene and alkyne reactions. A few other reactions are mixed in. The only point of synthetic sequences is to show reactions. The sequences are not always logical from a synthetic point of view (sometimes the same compound is made more than once in a sequence to show variety).

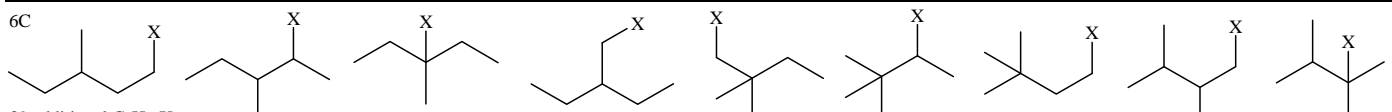
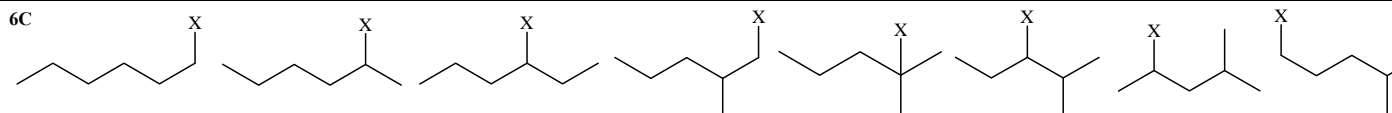
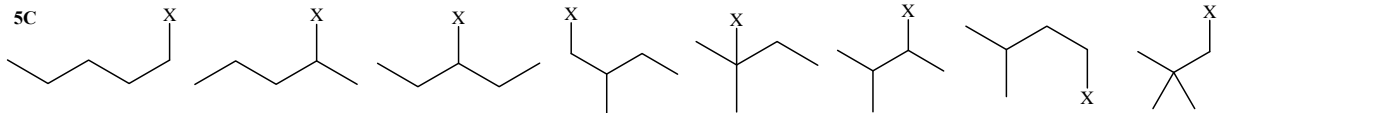
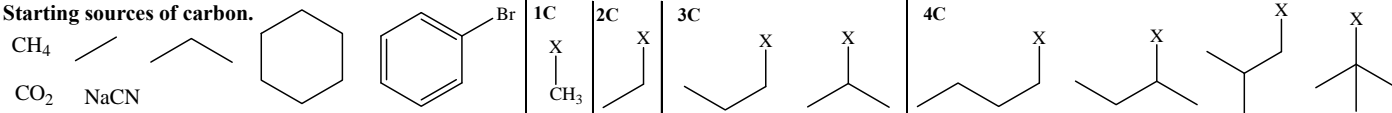






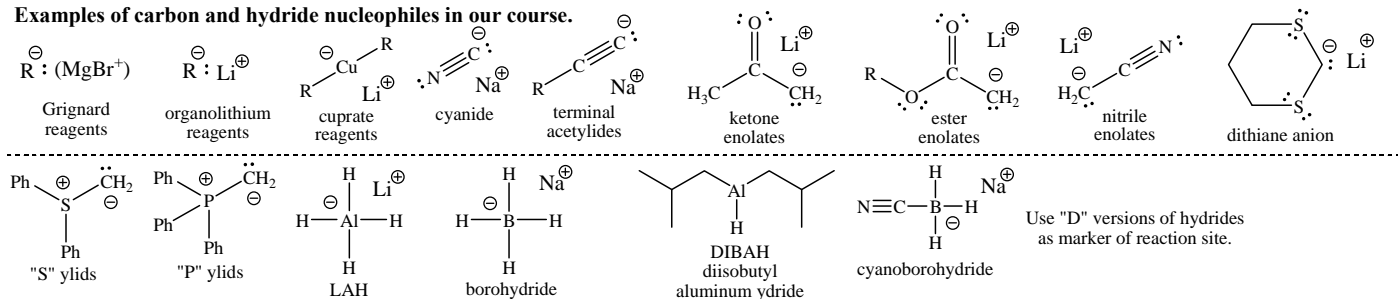
C1→C6 target molecules with "X" functionality at unique positional and skeletal positions. (X = Br, OH are particularly versital groups).

Starting sources of carbon.

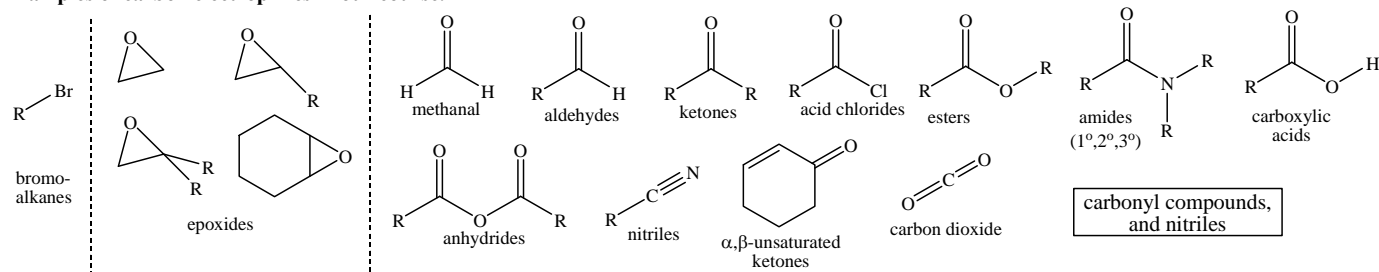


39 additional C₇H₁₅X

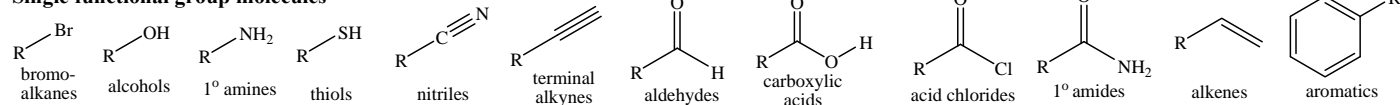
Examples of carbon and hydride nucleophiles in our course.



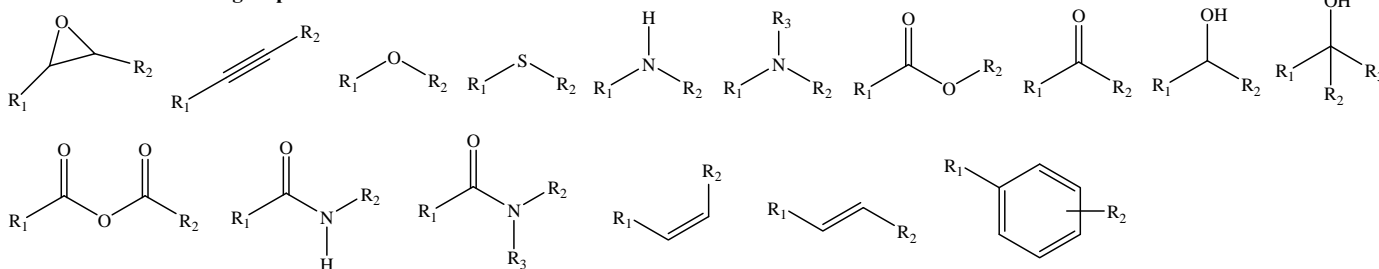
Examples of carbon electrophiles in our course.



Single functional group molecules



Combination functional group molecules



C1, C2, C3 → know the reactions of these carbon skeletons, many examples are provided in the "Courses" web page link on Chem 315 C1, C2, C3 synthesis.

C4 = (1+3) (2+2) (1+1+2) (1+1+1+1)

C5 = (1+4) (2+3) (1+1+3) (1+2+2) (etc.)

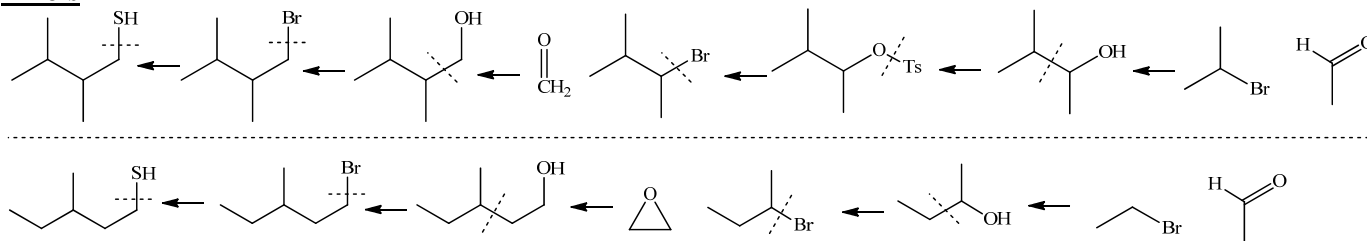
C6 = (1+5) (2+4) (3+3) (1+1+4) (1+2+3) (2+2+2) (etc.)

C7 = (1+6) (2+5) (3+4) (1+1+5) (1+2+4) (2+2+3) (etc.)

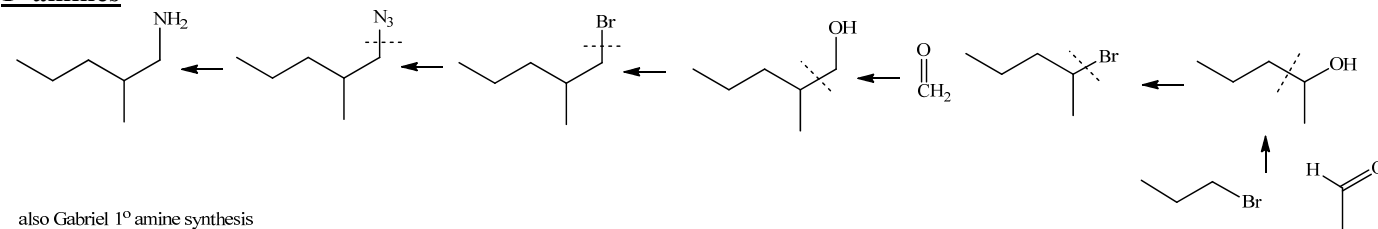
The following examples are presented without full details. Possible structures to accomplish a transformation are provided, assuming that you can deduce the nucleophile and the electrophiles from the context given. It is also assumed that you are familiar with the C1, C2 and C3 example reactions at the start of this topic and once a precursor of that size is reached, no further details are given. If that is not the case, you need to review the above material so that you can make the necessary connections to see the 'logic' of the proposed approaches. Once a structure is prepared, it is used without resynthesizing it. Dashed lines are drawn to show nucleophile/electrophiles disconnections. Finally, there may be several acceptable approaches, but due to limited space and time only one or a couple are given.

Functional Group Target Molecules (single and multiple carbon skeletons)

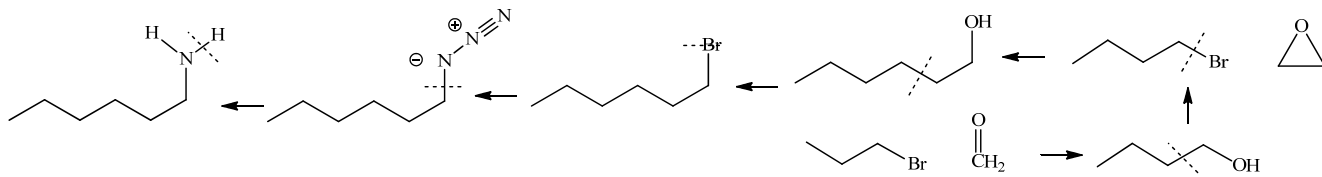
Thiols



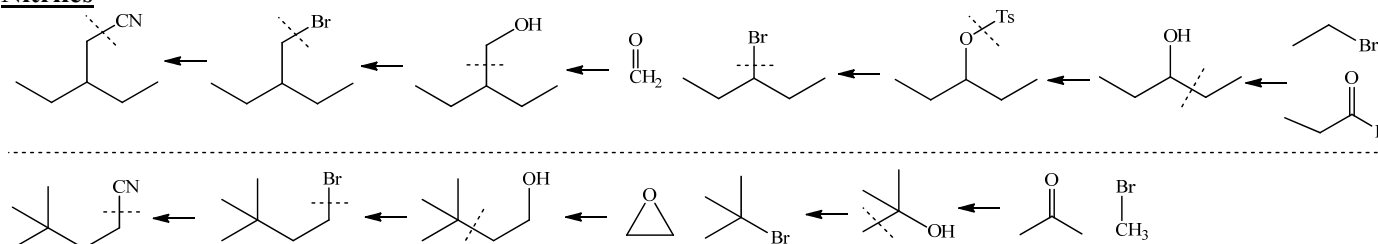
1° amines



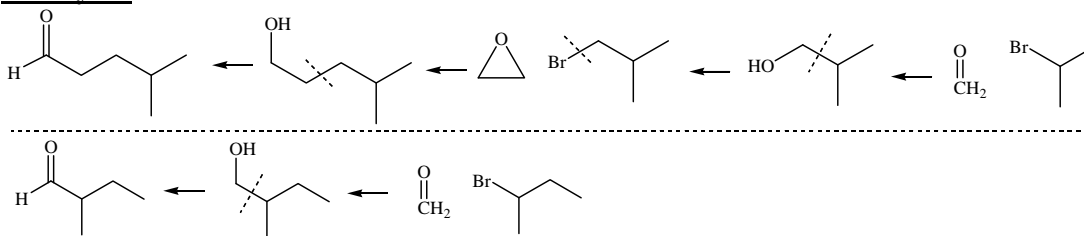
also Gabriel 1° amine synthesis

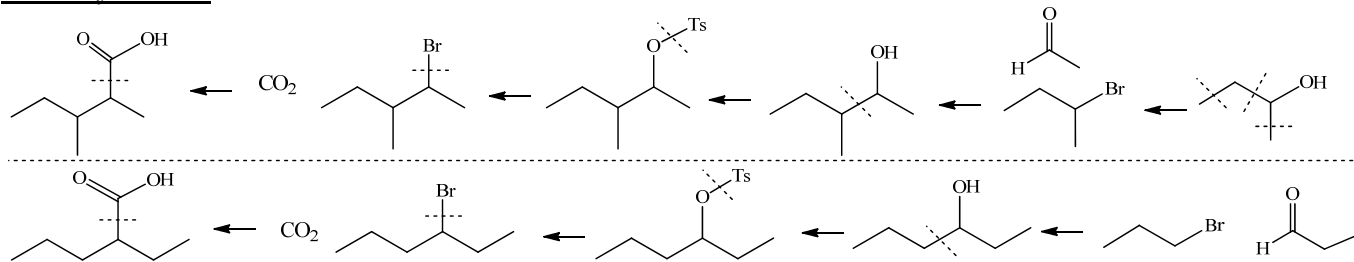
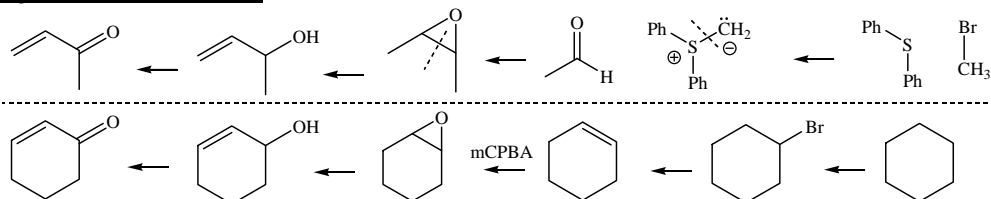
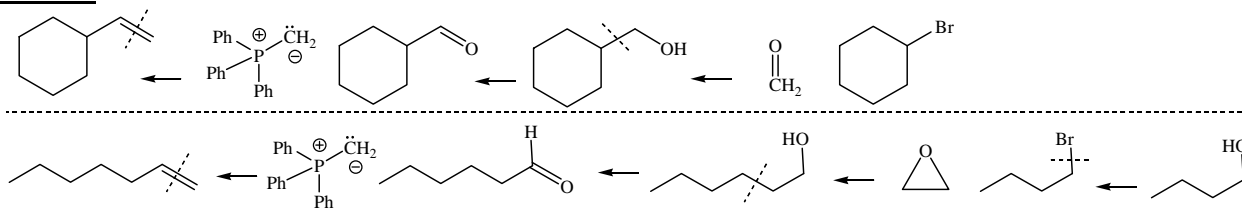
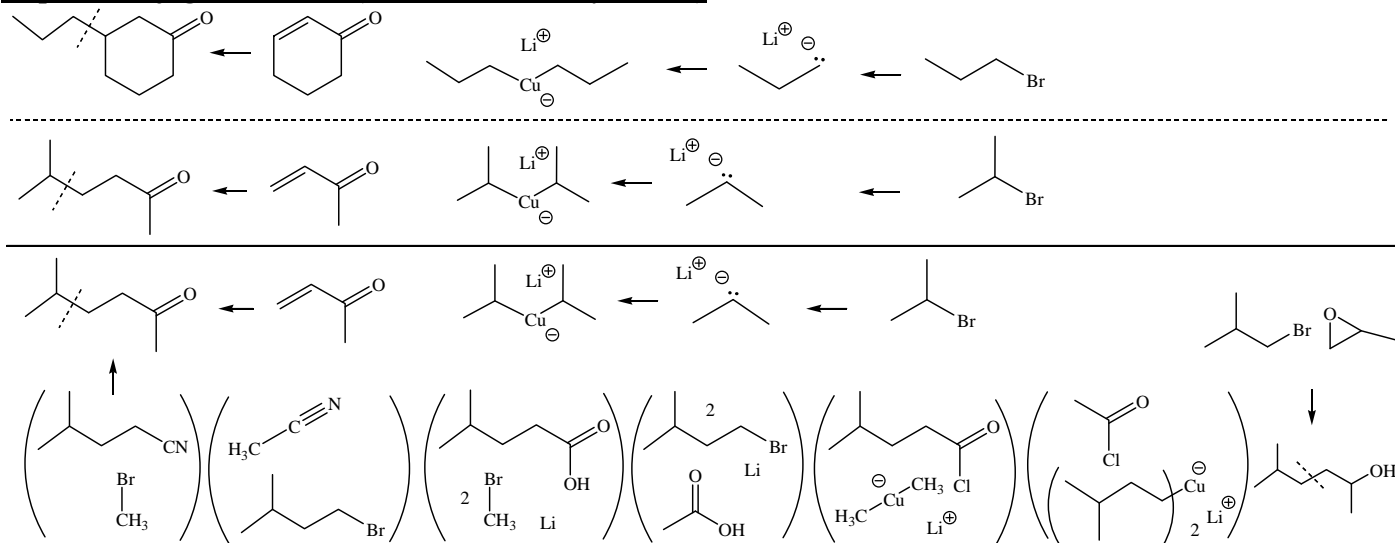
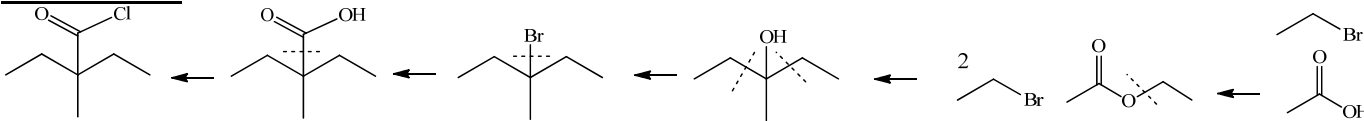


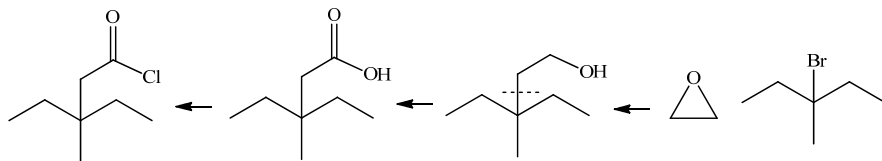
Nitriles



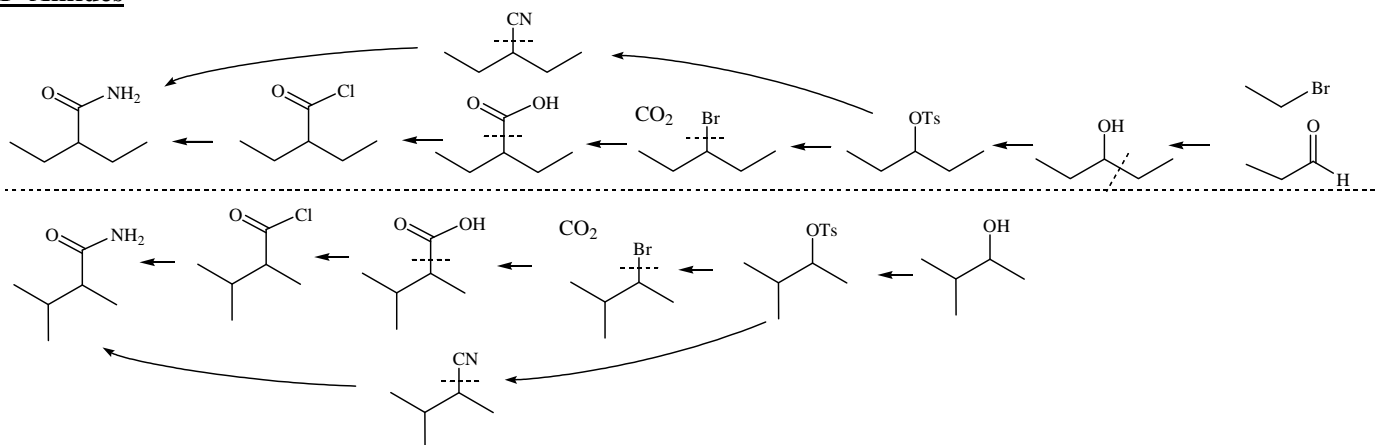
Aldehydes



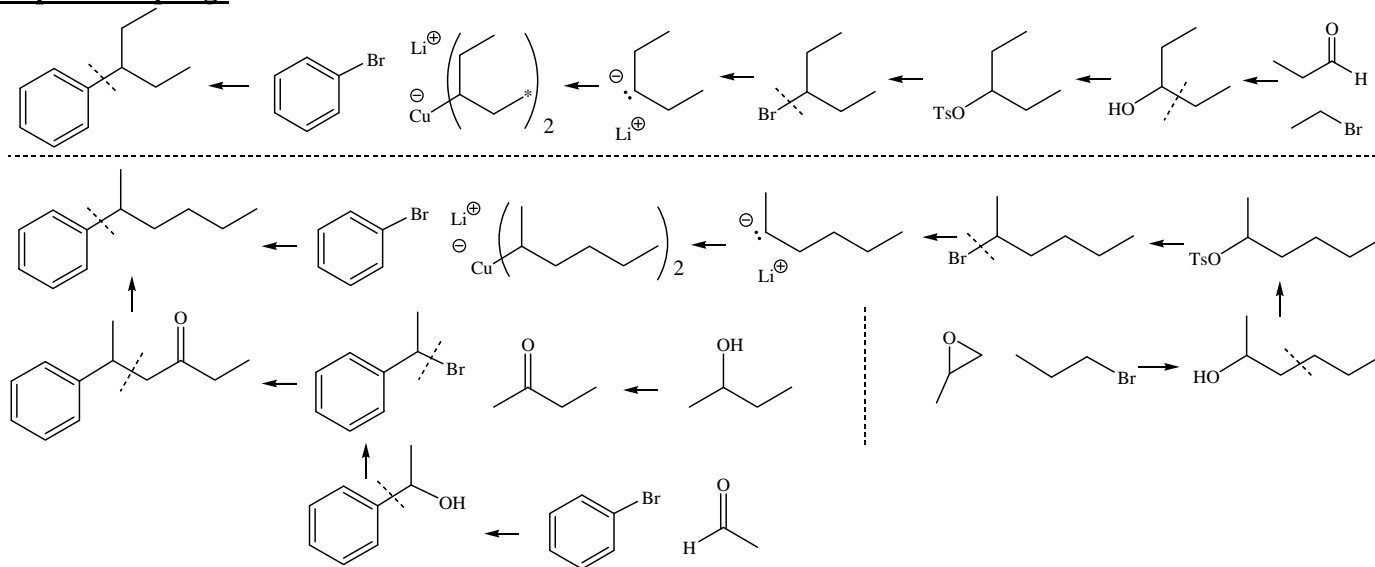
Carboxylic acids **α,β -unsaturated C=O****Alkenes****Cuprate RBr/RBr coupling****Cuprate conjugate addition (and some ketone syntheses)****Acid chlorides**



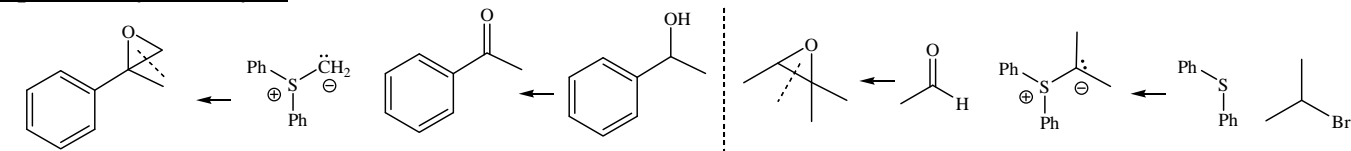
1° Amides



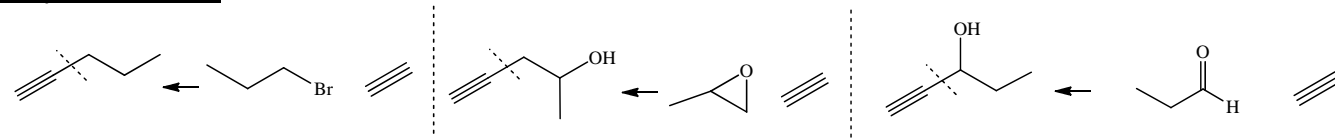
Cuprate couplings

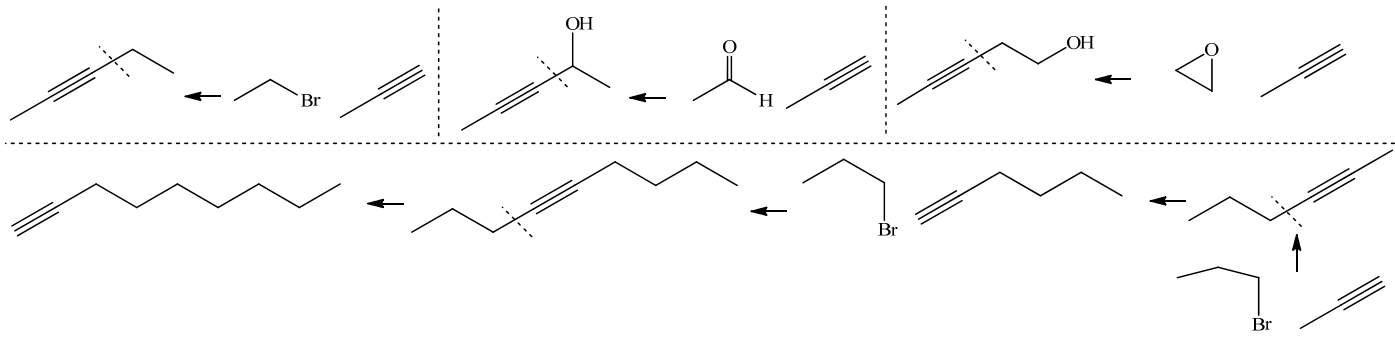


Epoxides by sulfur ylid

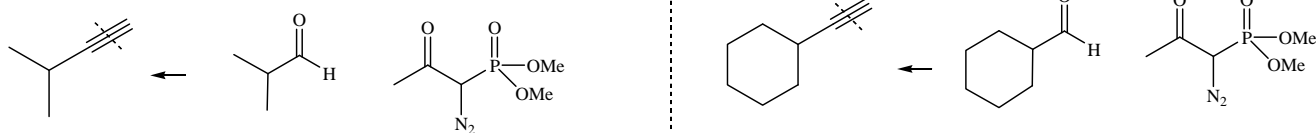


Alkyne variations

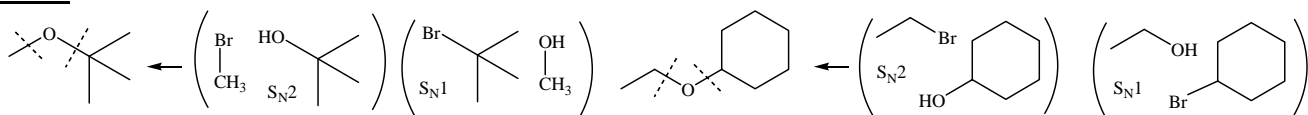




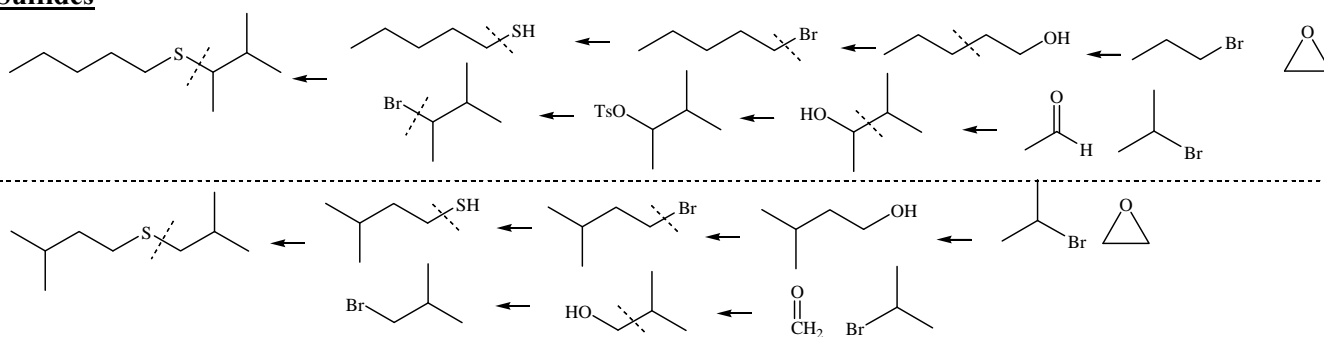
alkynes at a branch point - use a variation of the Wittig reaction



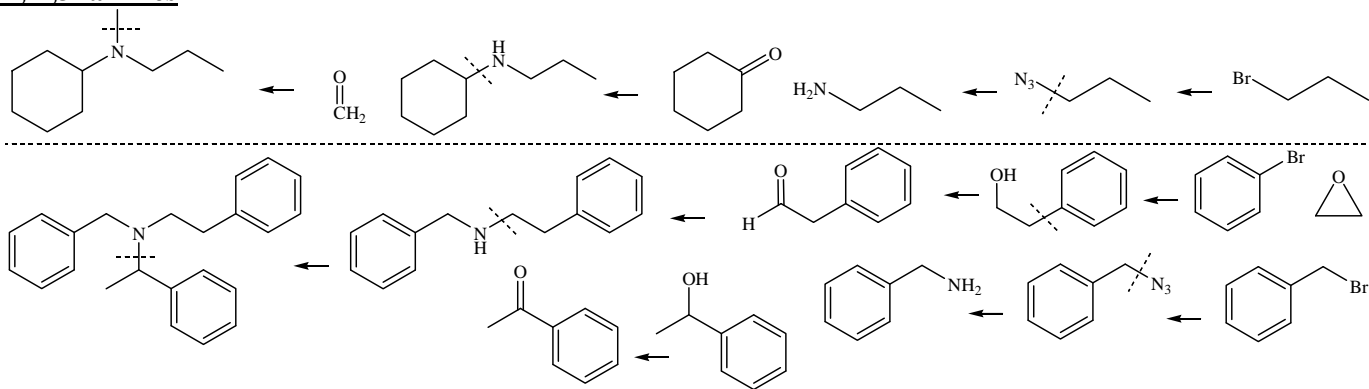
Ethers

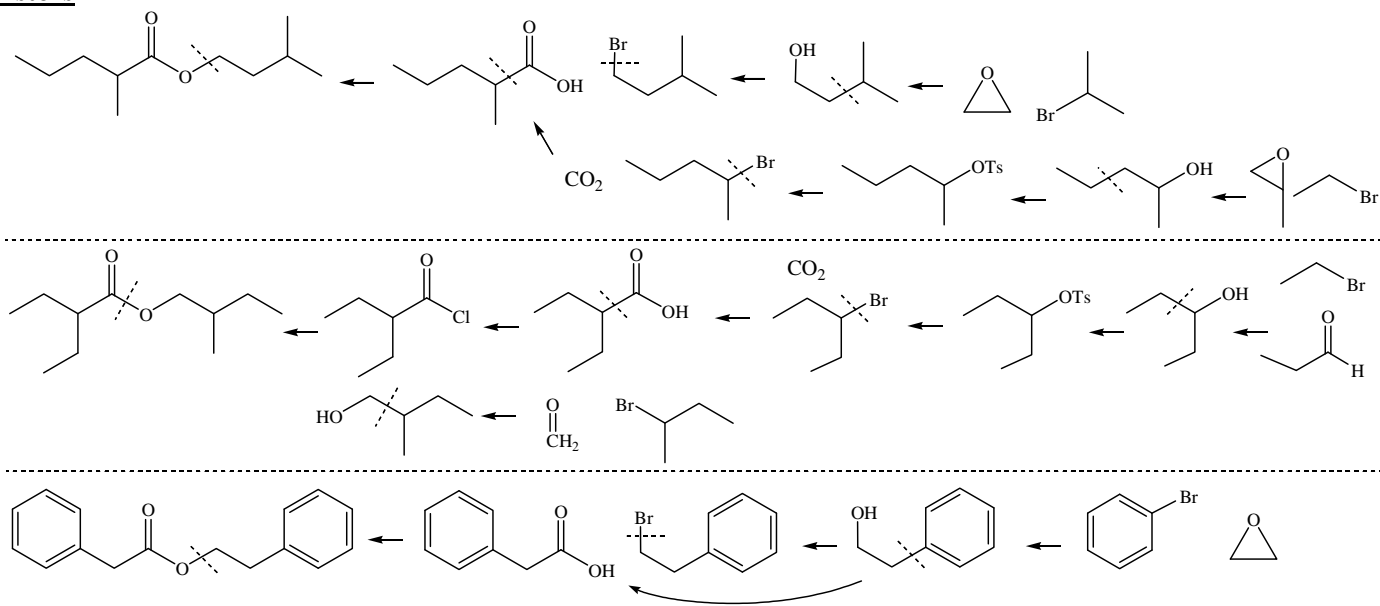
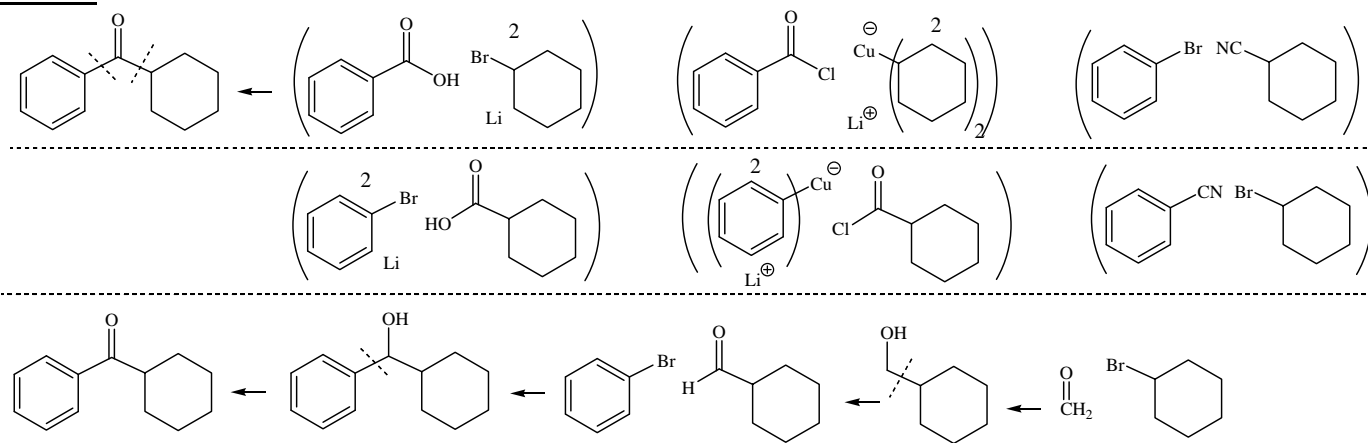


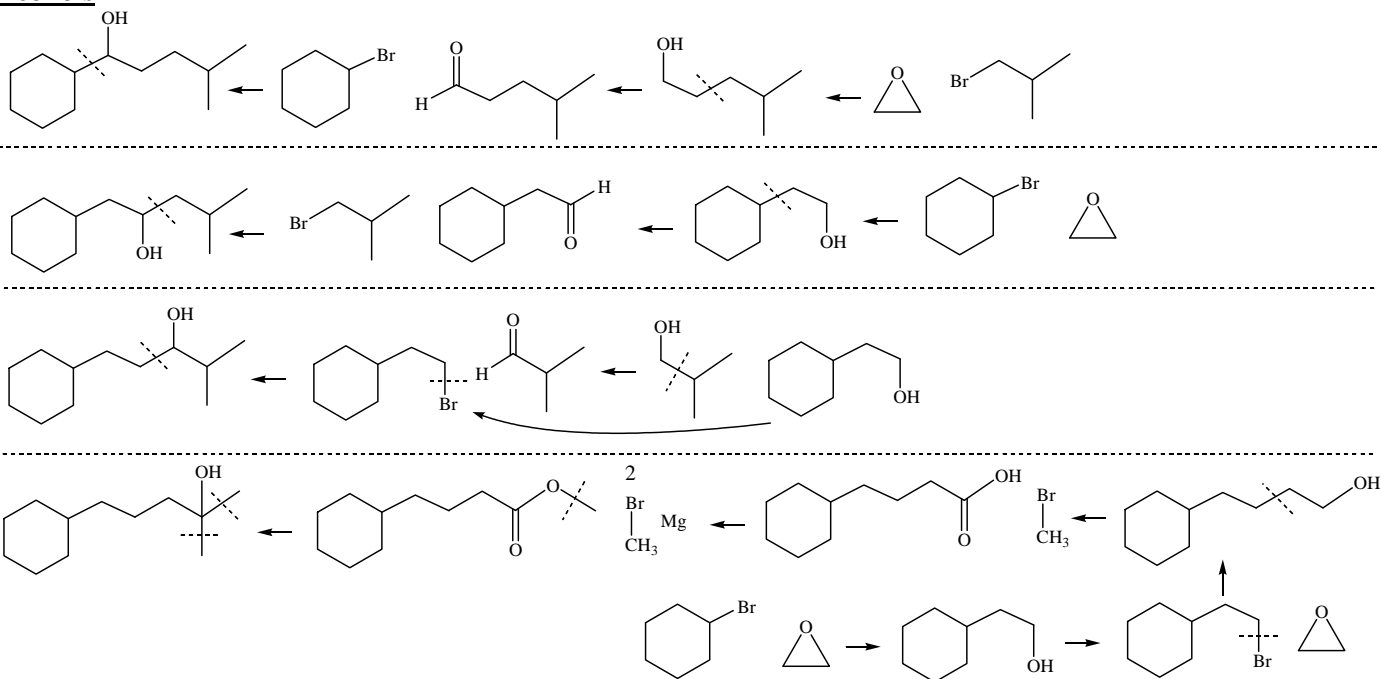
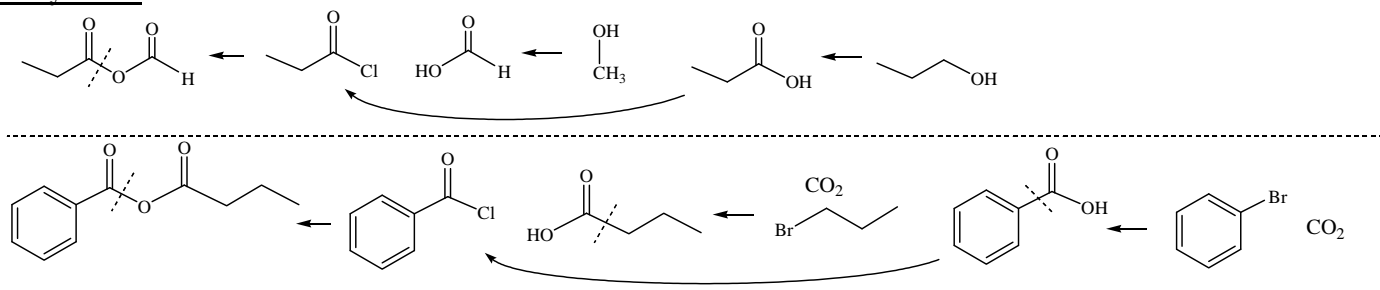
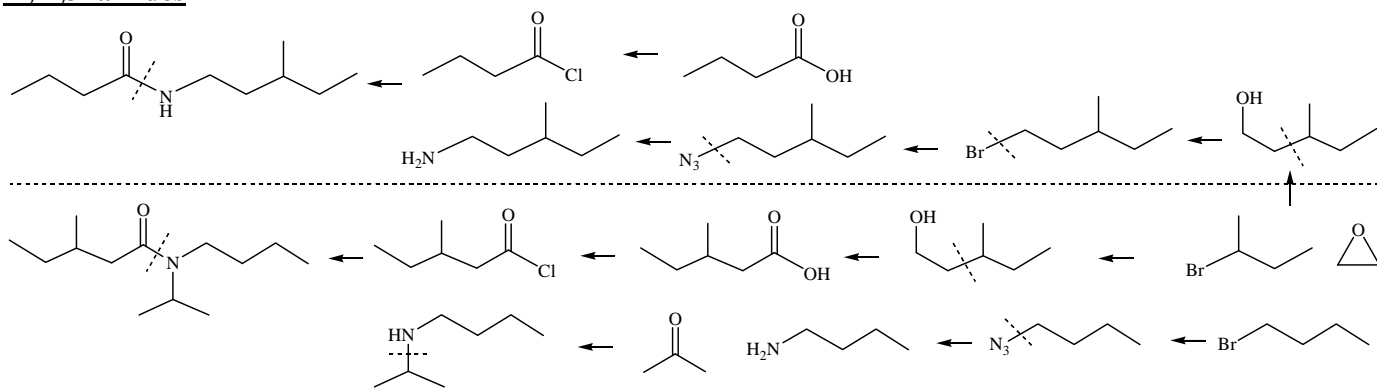
Sulfides



1°,2°,3° amines



Esters**Ketones**

Alcohols**Anhydrides****1°,2°,3° amides**

Alkenes by Wittig

