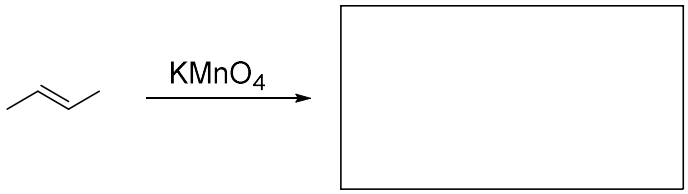
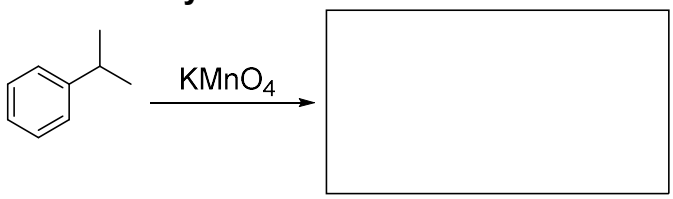
20.1-2 Carboxylic Acid Intro & Nomenclature	**20.3** Structure & Properties	**20.4** Carb. acid Preparation
20.5 Reactions of carb. acids	**20.6** Intro to Carb. Acid Friends (Derivatives)	**20.7** Reactivity of Carb. Acid Derivatives
20.8 Acid Chloride Rxns	**20.9** Acid Anhydride Rxns	**20.10** Ester Preparation
20.11 Rxns of Esters	**20.12** Amide Rxns	**20.13** Nitrile Reactions
20.14 Synthesis Strategies for Carboxylic Acids & Friends		

TBT – each product below contains a carboxylic acid or nitrile…

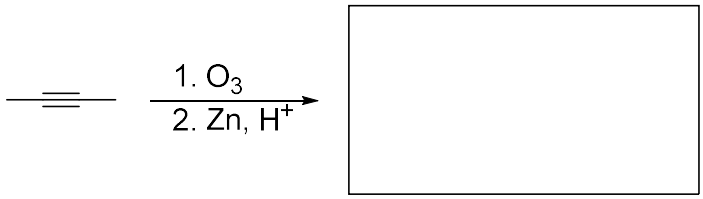
Ch 8 – Alkenes



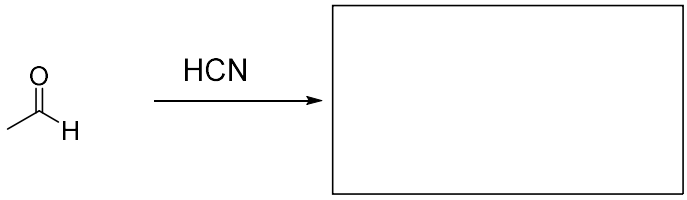
Ch 17 – Benzylic Rxns



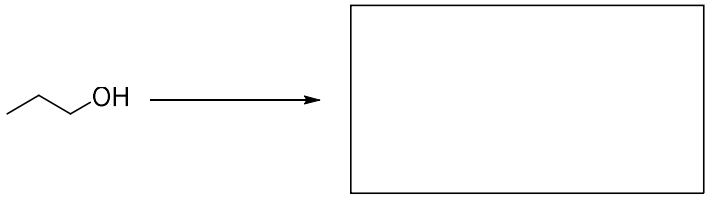
Ch 9 – Alkynes



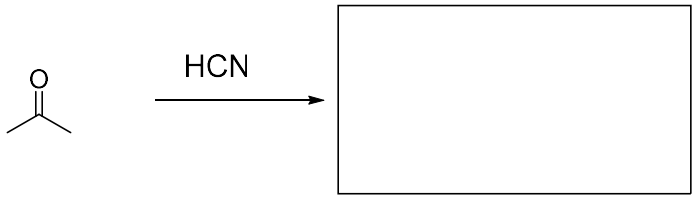
Ch 19 - Aldehydes



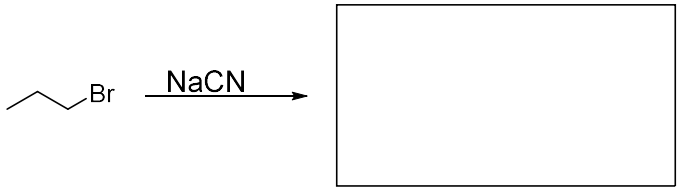
Ch 12 – Alcohols



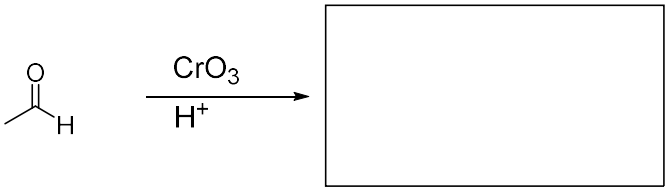
Ch 19 - Ketones



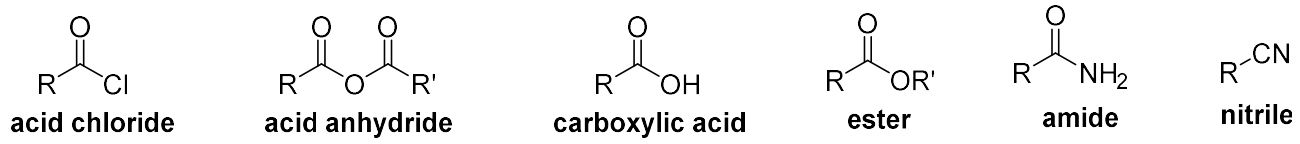
Ch 6 – Alkyl Halides



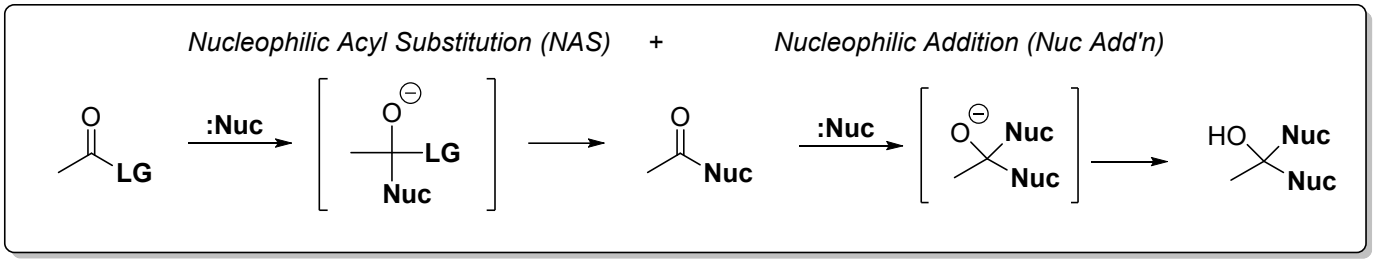
Ch 12 / 19 - Aldehydes



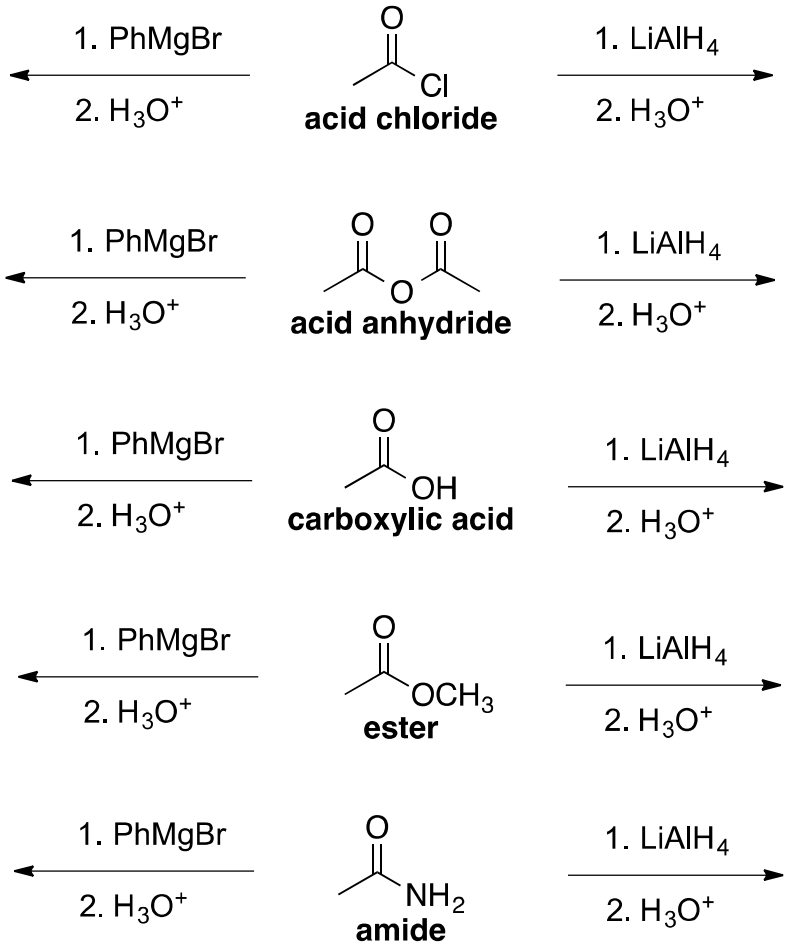
[20.6] Carboxylic Acid Friends = Derivatives



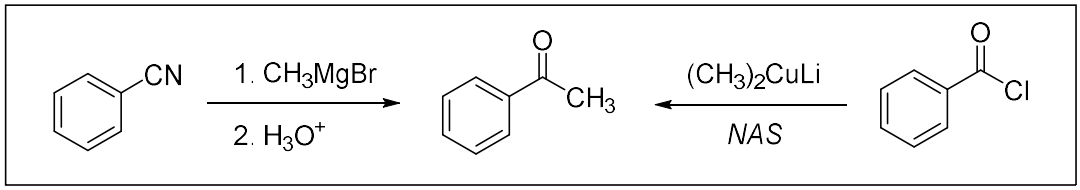
Addition of Hydrides & Grignards to Carb Acids & Friends



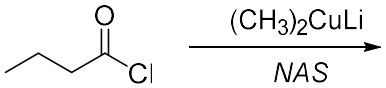
Grignards and LAH *add to (almost) all the acid derivatives to make similar products!!!*

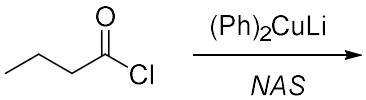


Making Ketones with ***Mr. Grignard*** and ***Mr. Gilman*** (we missed you)

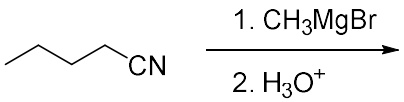


Ketones from acid chlorides



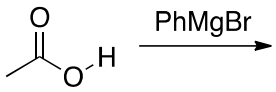


Ketones from nitriles

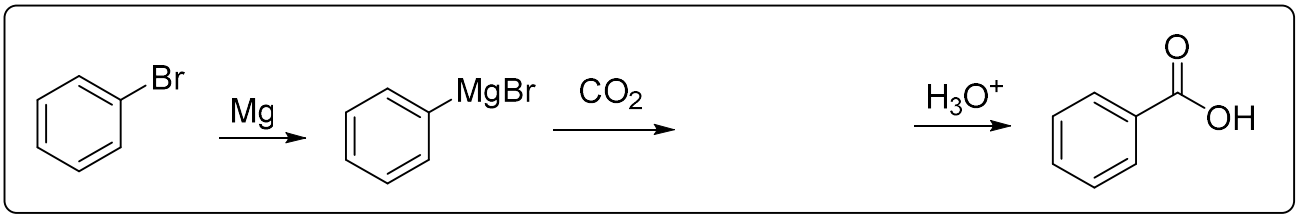


Grignards & Carboxylic Acids – it's a love / hate relationship

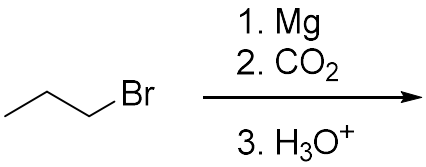
Carb. Acid + Grignard = ☹



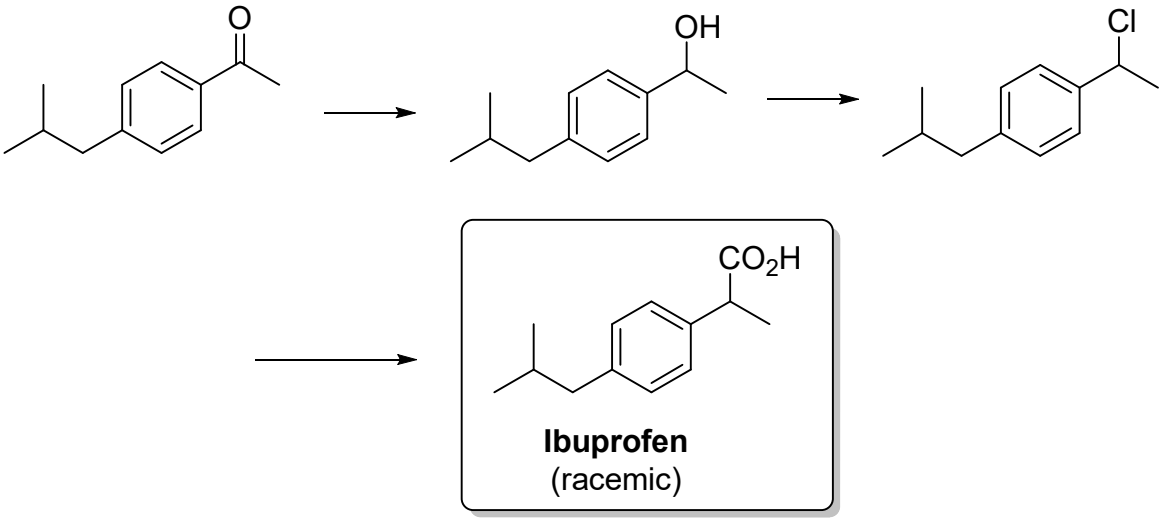
[20.4] New Way to Make Carb Acids while adding a Carbon



Predict the product



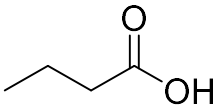
Synthesis of **Ibuprofen** (CHEM 146A – advanced organic lab) – *add reagents*



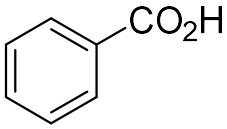
[20.4-5] CARBOXYLIC ACID REACTIONS

NOMENCLATURE

butan**oic acid**

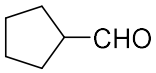


benz**oic acid**

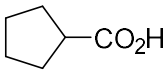


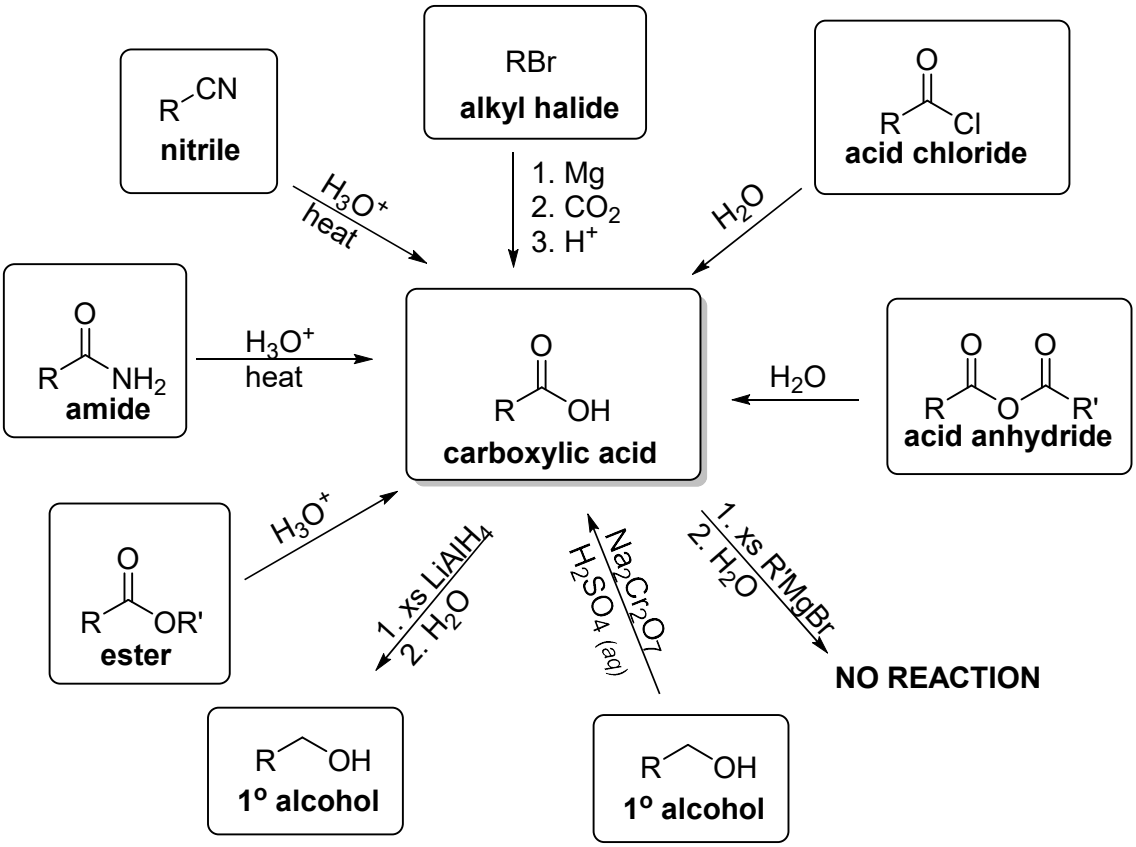
What if there's a CARBONYL OUTSIDE A RING??

Cyclopentane carb**aldehyde**

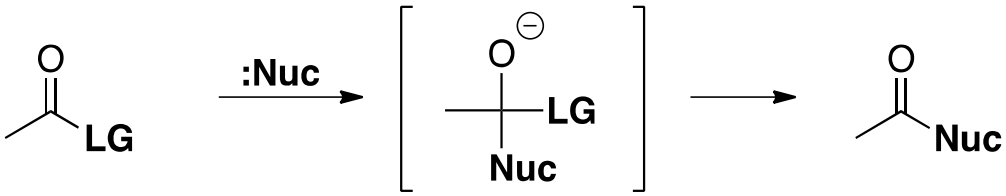


cyclopentane **carboxylic acid**



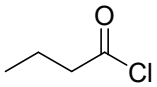


NUCLEOPHILIC ACYL SUBSTITUTION (NAS)

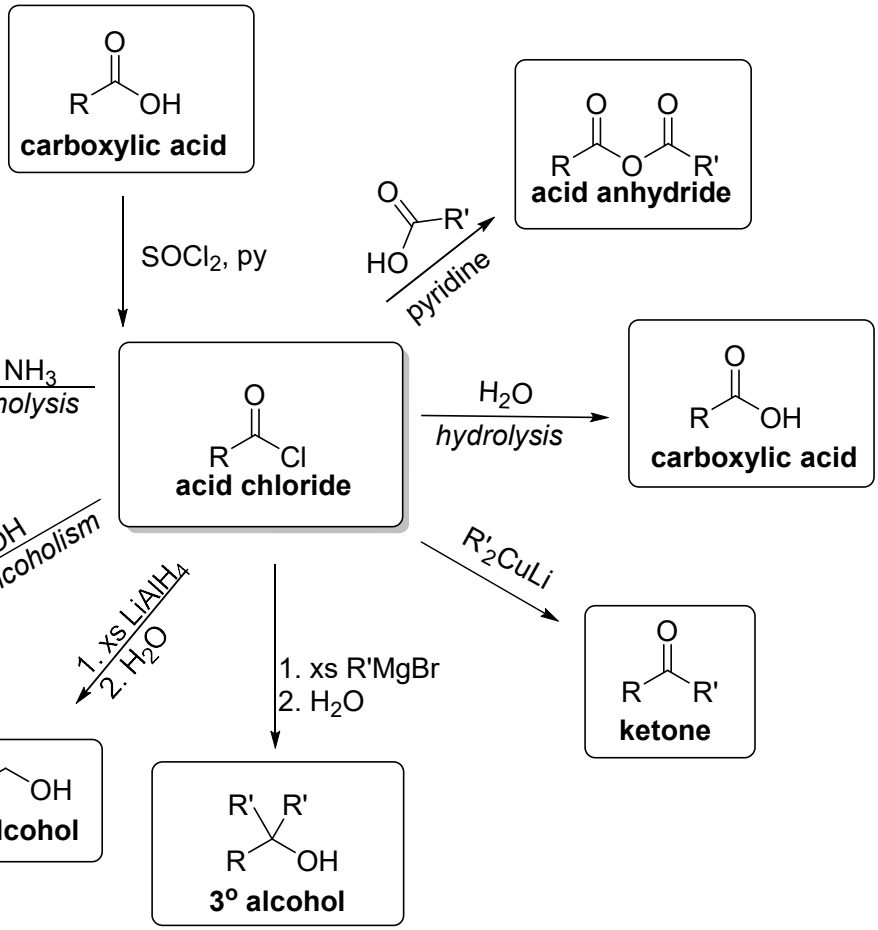


[20.8] Acid Chlorides - the gateway acyl derivative

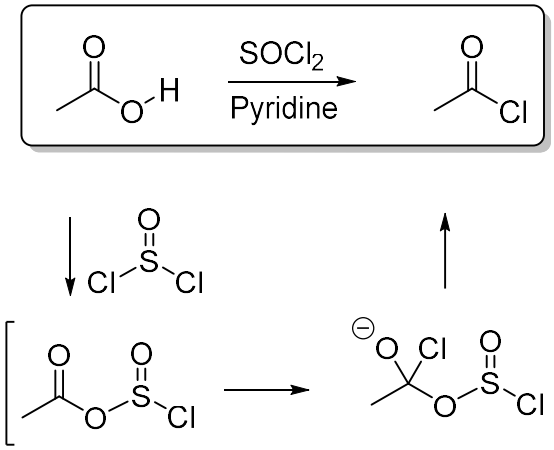
butan**oyl chloride**



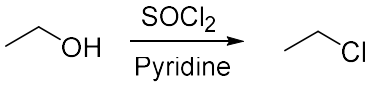
benz**oyl chloride**



How to make an acid chloride

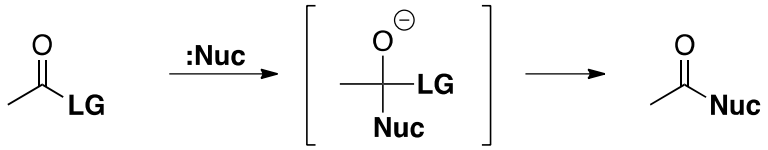


Analogous to:



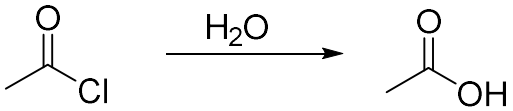
[20.8] Acid Chlorides (cont'd)

NUCLEOPHILIC ACYL SUBSTITUTION (NUC ACYL SUB / NAS)

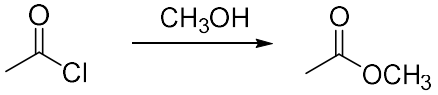


Acylation of Acid Chloride

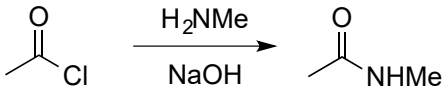
Hydrolysis of Acid Chloride



- Alcoholism of Acid Chloride



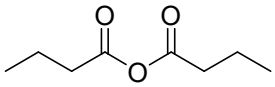
- Amides from Acid Chlorides



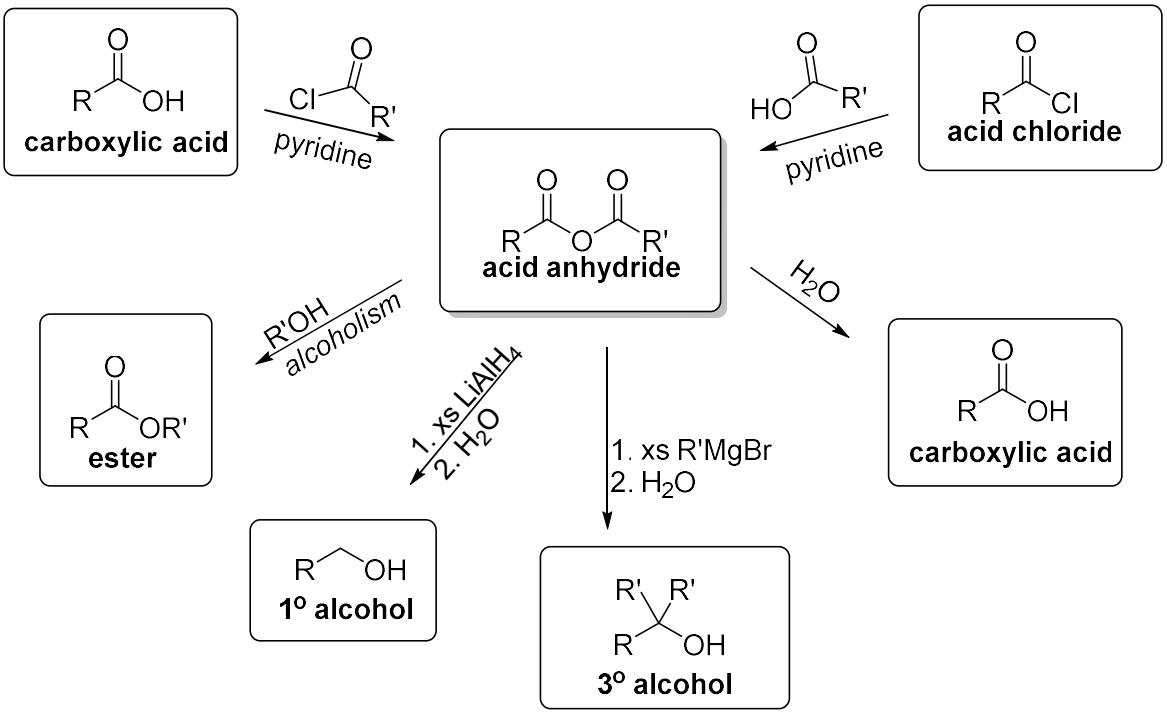
[20.9] Acid Anhydrides

butan**oic anhydride**

benz**oic anhydride**



Butan**oic** benz**oic anhydride**

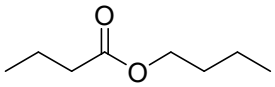


Acid anhydride hydrolysis

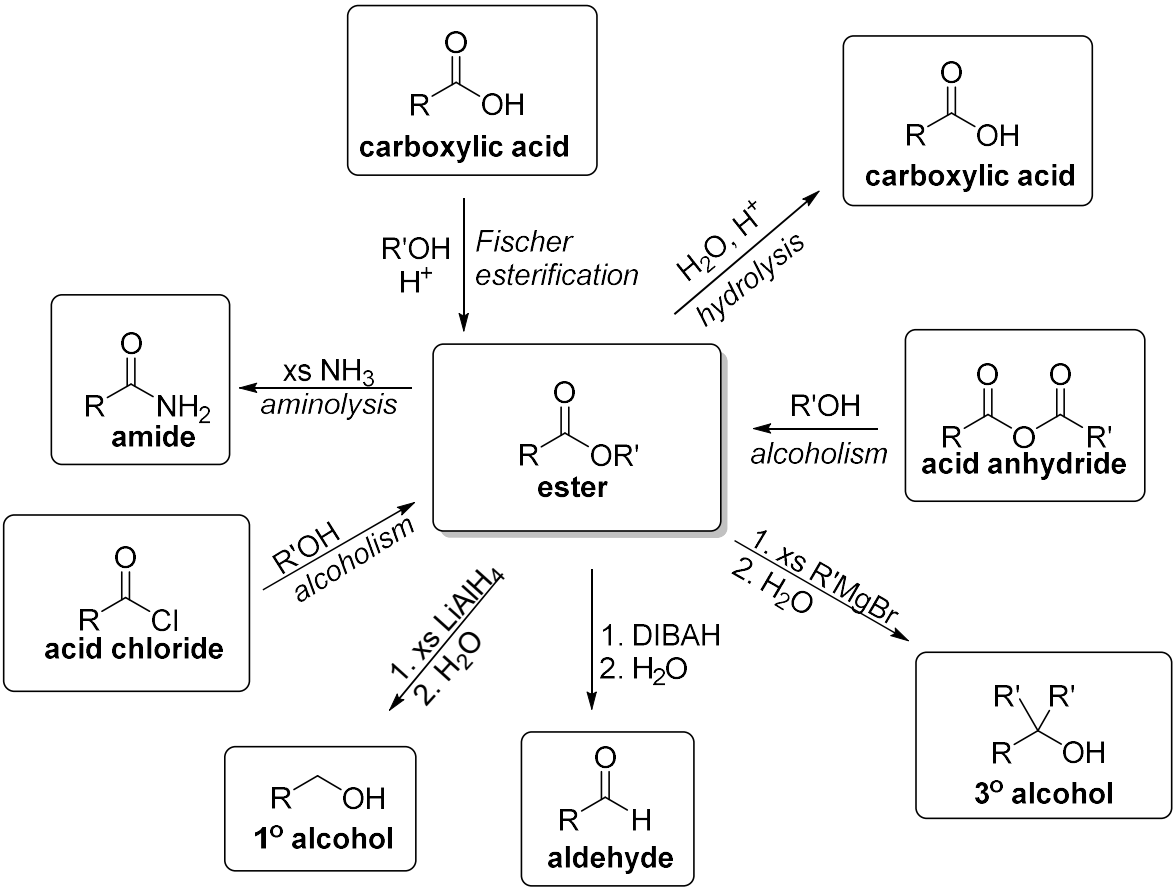
Alcoholism

[20.10-11] Esters

butyl butan**oate** butyl benz**oate** phenyl benz**oate**

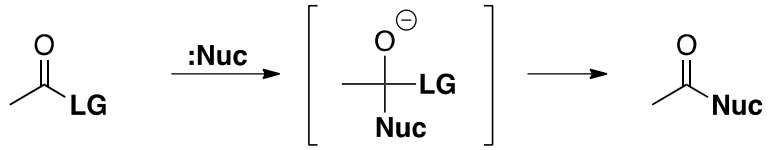


Ester outside the ring: methyl cyclopentane **carboxylate**

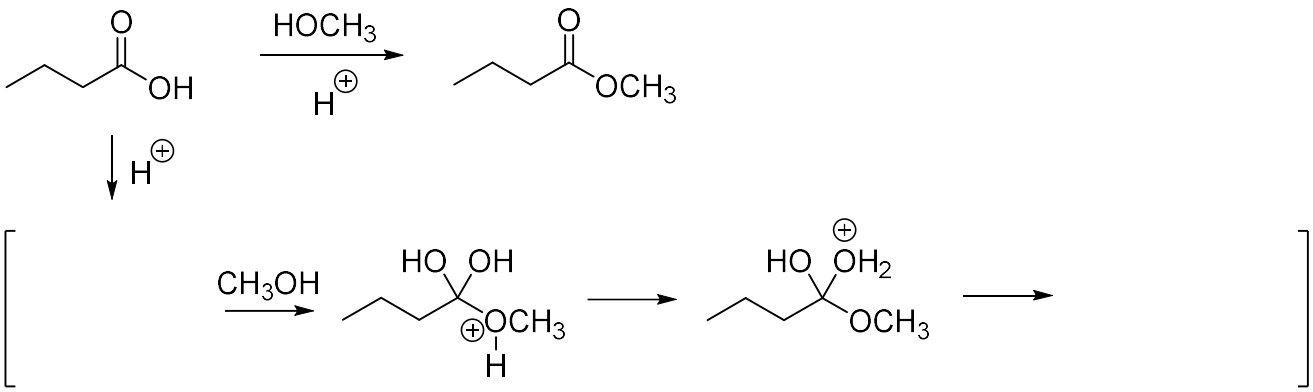


[20.10-11] Esters (cont'd)

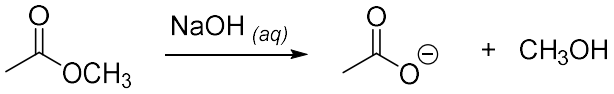
NUCLEOPHILIC ACYL SUBSTITUTION (NUC ACYL SUB / NAS)



Fischer Esterification



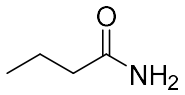
- Basic ester hydrolysis

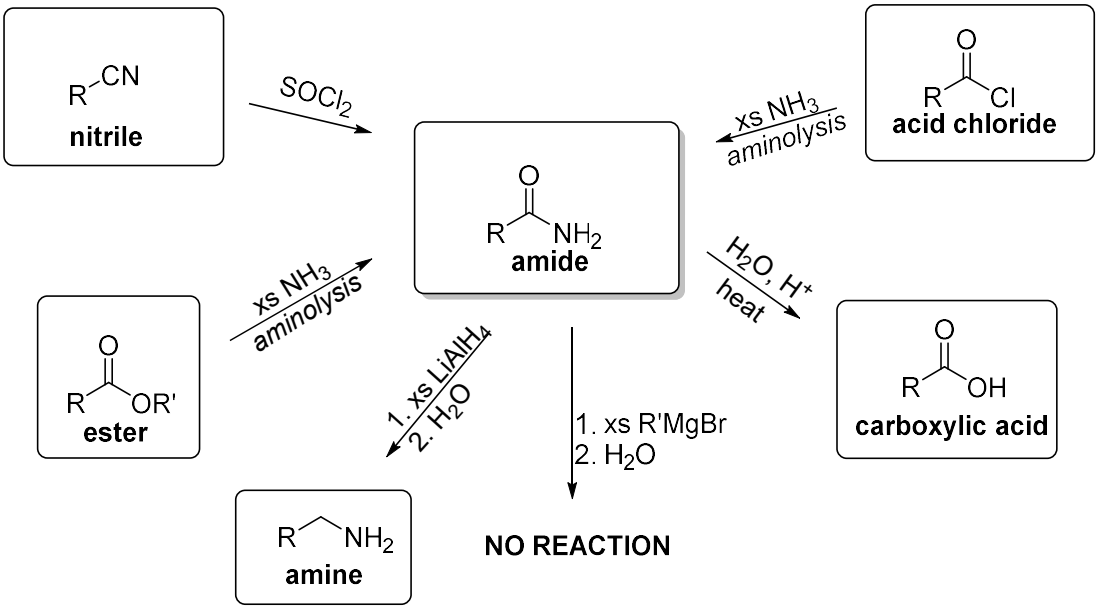


- Partial reduction with DIBAH

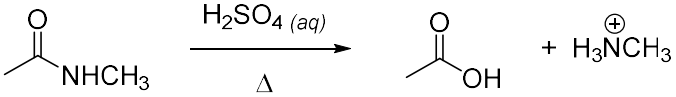
[20.12] AMIDES

Butan**amide** *N*-methyl-*N*-phenylbenz**amide**



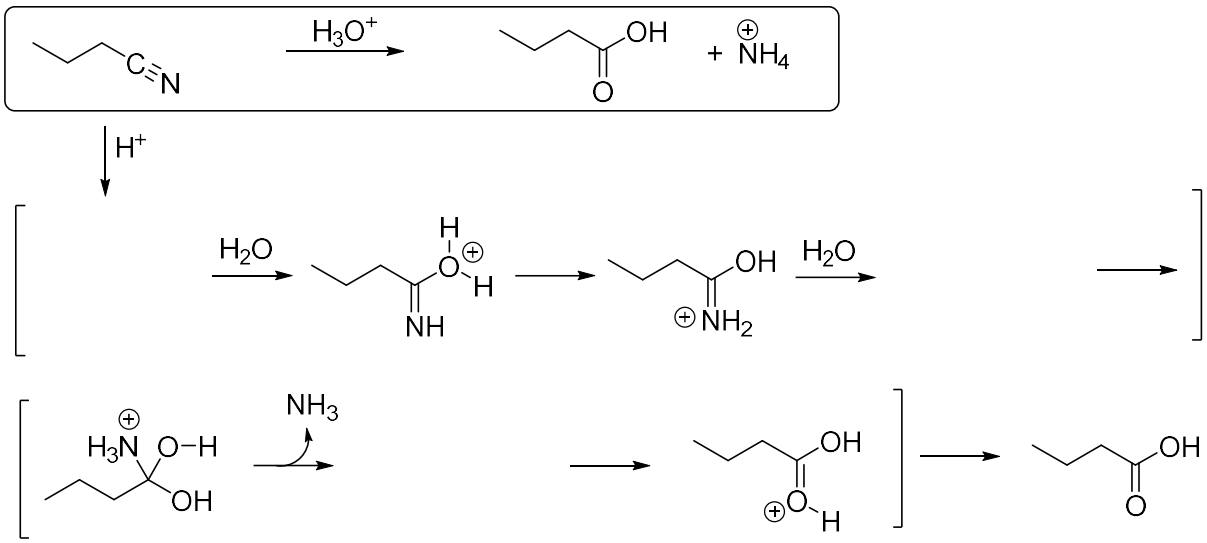


- Amide hydrolysis



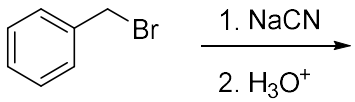
[20.13] NITRILE REACTIONS

Nitrile Hydrolysis

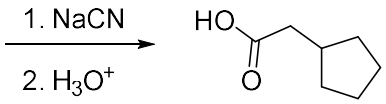


<u>Nitrile Synthesis & Hydrolysis</u> (alternative to Grignard reagent)

Predict the product

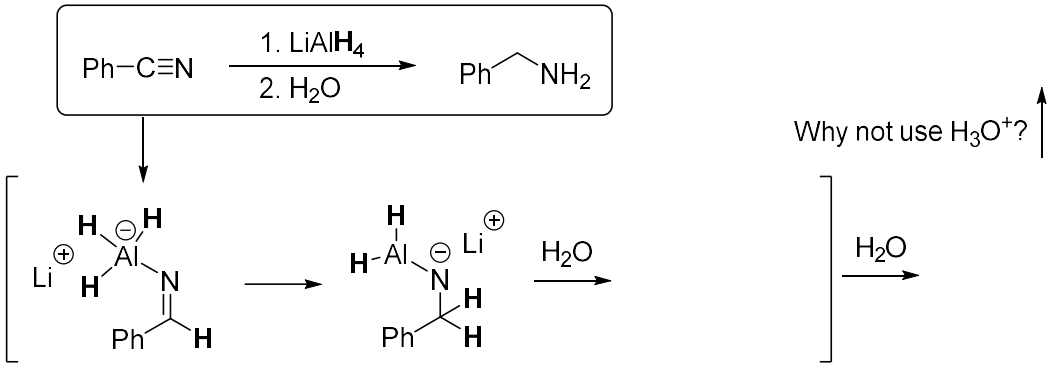


From what alkyl halide would this carboxylic acid be made?

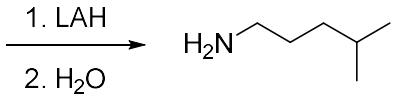


[20.13] NITRILE REACTIONS (CONT'D)

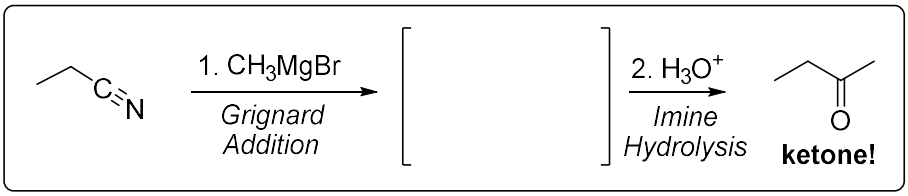
Reduction of Nitriles



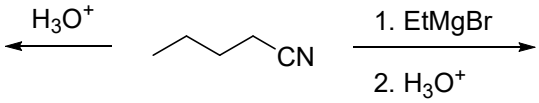
What nitrile would reduce to this amine?



Grignards and Nitriles



Predict the products



Reaction Puzzle