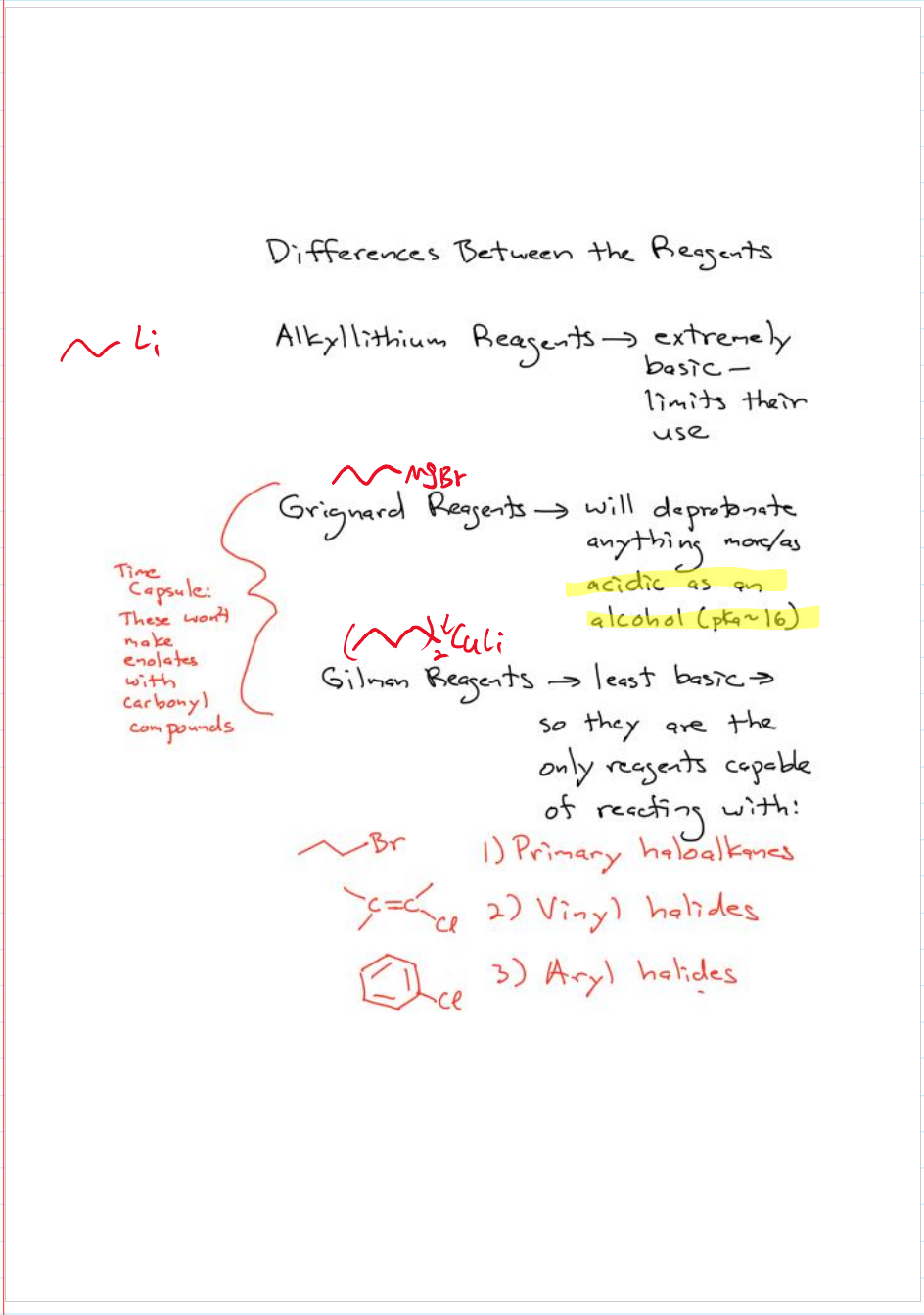
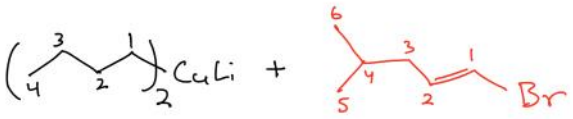
MTW2: 1-23

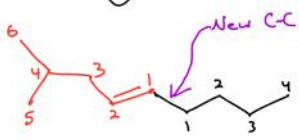
Monday, January 23, 2023 5:50 PM

Week2





(Not an S_N2 mechanism)



Cu salts

(you are not responsible for writing these)

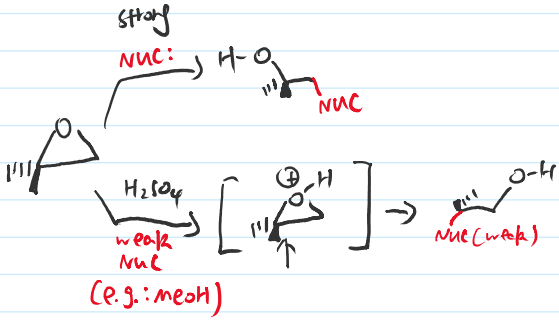
Watch the new video called "Gilman Reagents Explained" after hitting "Helpful Short Videos" on the main course web page (7th from the top on the left column)

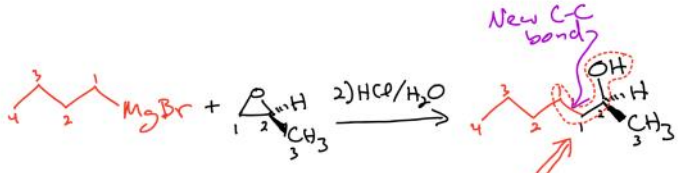
Synthesis → New C-C bonds! →
↳ Generate more complex molecules from simpler ones.

1) Retrosynthetic Analysis → Work backwards from the product.

2) Count the number of carbon atoms in the starting material versus the product → Allows you to identify the location of any new C-C bonds.

3) Learn to recognize the Key Recognition Elements (KRE) in the product → tells you what the final reaction had to be.

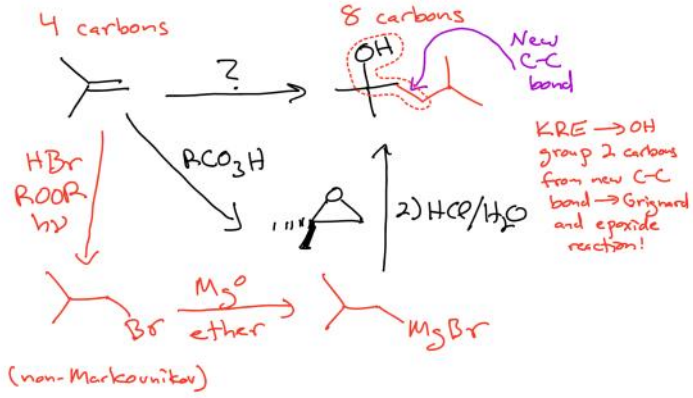




KRE → An alcohol group 2 carbons from a new C-C bond

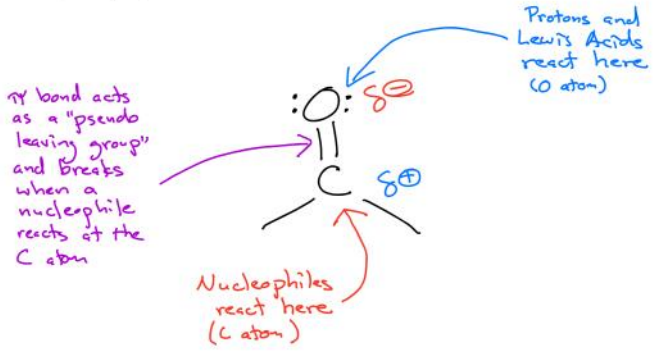
C–C bond

Synthesis Example



Functional groups such as carbonyl groups undergo characteristic reactions.

There are common themes → the different reactions are variations on these themes



There are four common mechanisms seen when carbonyl compounds react with nucleophiles

→ We will call these Mechanism A-D

Here are the keys to understanding mechanisms in 320N!!

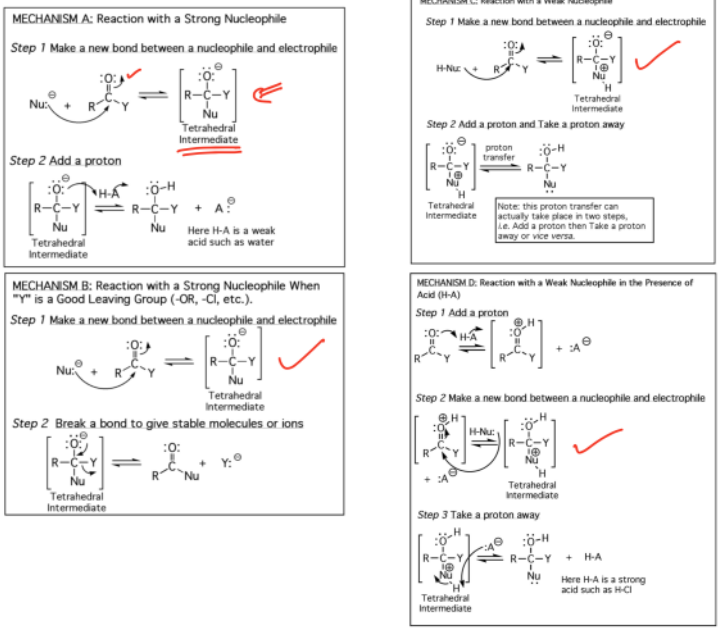
1) There are basically four different mechanisms elements that make up the steps of carbonyl reactions.

A) Make a bond between a nucleophile and an electrophile
B) Break a bond to give stable molecules or ions
C) Add a proton
D) Take a proton away

2) These same four mechanism elements describe most of the other mechanisms you have/will learn!!! (Yes, organic chemistry really is this simple if you look at it this way!!)

There are basically four different mechanisms that describe the vast majority of carbonyl reactions and these mechanisms are different combinations/ordering of the four mechanism elements listed above. In this class, I have termed them "Mechanism A", "Mechanism B", "Mechanism C", and "Mechanism D". They all involve a nucleophile attacking the partially positively charged carbon atom of the carbonyl to create a tetrahedral intermediate. Different reaction mechanisms are distinguished by the timing of protonation of the oxygen atom as well as the presence or absence of a leaving group attached to the carbonyl.

Four Mechanisms for the Reaction of Nucleophiles with Carbonyl Compounds

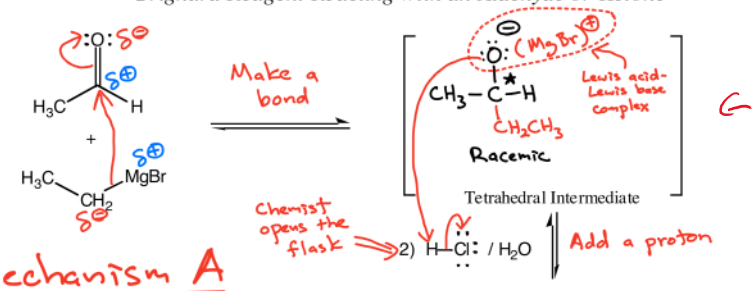


All of these mechanisms have a tetrahedral intermediate ✓

Mechanism A → Use this mechanism with strong nucleophiles

1) Make a bond
2) Add a proton

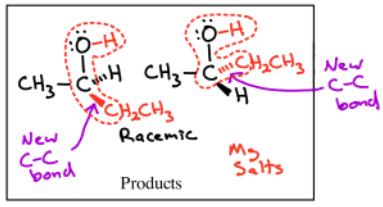
Grignard Reagent Reacting with an Aldehyde or Ketone

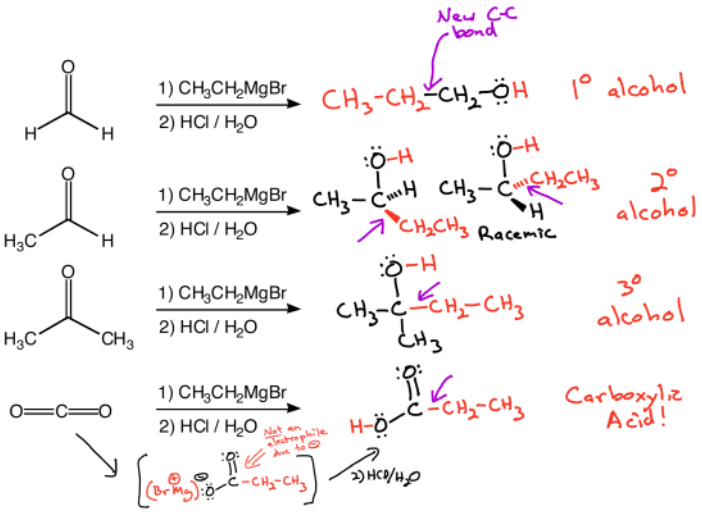


Mechanism A

Key Recognition Element (KRE):

-OH group attached the same C atom as a new C-C bond





VOLUNTEER!

Tutoring Refugees to Understand English

T.R.U.E is a service organization that tutors English to refugees for one hour every week.

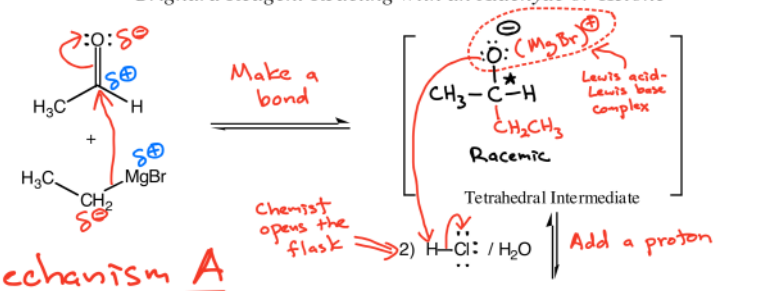
SCAN TO JOIN TODAY!

Lesson for Today:
"The Song"

Strong nucleophiles react directly at the electrophilic C atom of carbonyls to make a bond as the carbonyl π bond breaks. A proton is added to the O atom.

MECHANISM A!

Grignard Reagent Reacting with an Aldehyde or Ketone



Mechanism A

Key Recognition Element (KRE):

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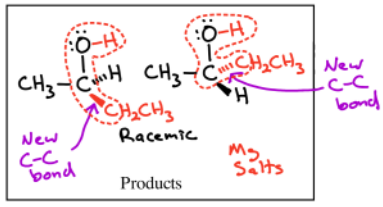
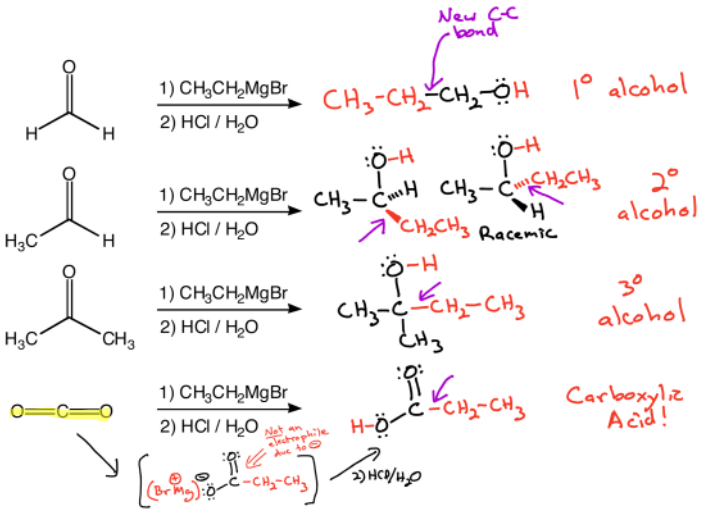
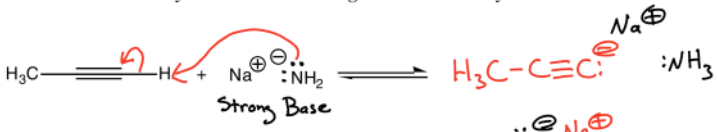
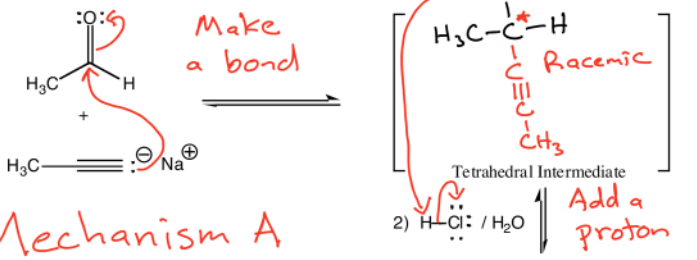




Alkyne Anion Reacting with an Aldehyde or Ketone

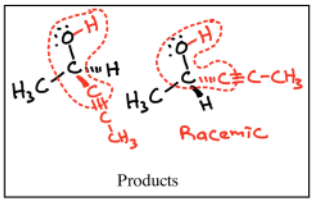




Mechanism A

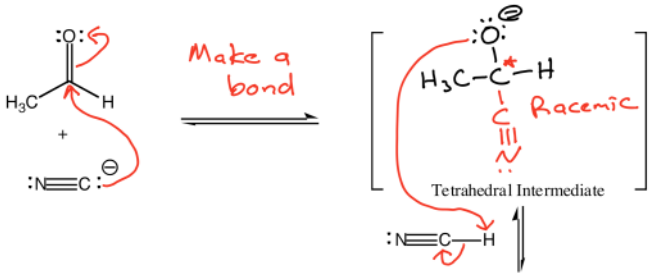
Key Recognition Element (KRE):

OH group on the carbon that makes a new C-C bond to an sp C atom (alkyne)



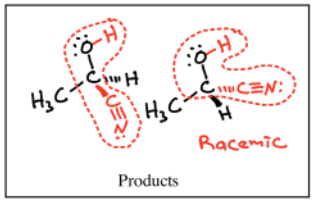
HCN Reacting with an Aldehyde or Ketone

Reacts on the C atom because that makes stronger bonds



Key Recognition Element (KRE):

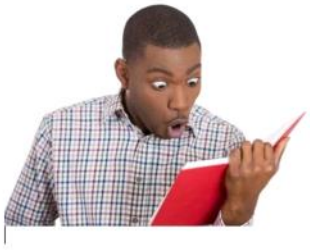
Cyanohydrin → OH on a C atom that made a new C-C bond to −C≡N:



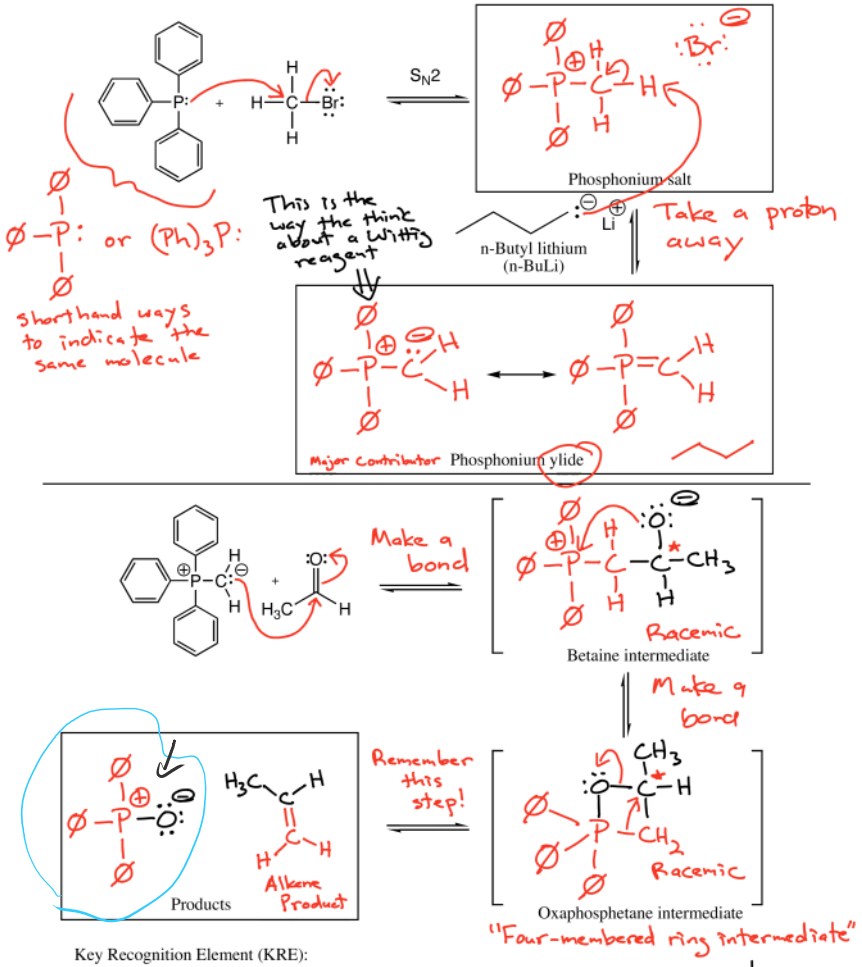
Time capsule → cyanohydrins can be hydrolyzed in H_2SO_4/H_2O to give α-hydroxyacids ("alpha")

This is getting boring.

It is time for a TWIST



Wittig Reaction



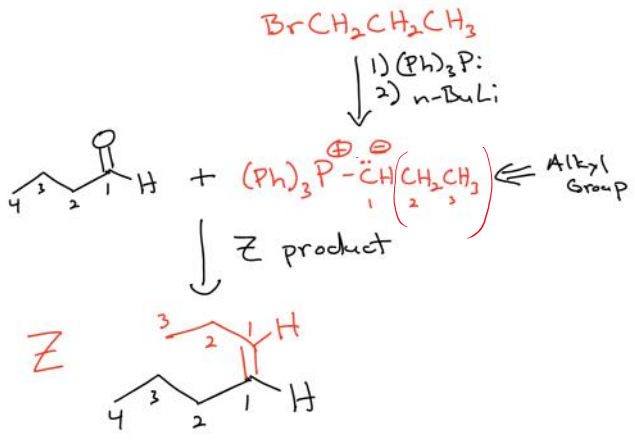
shorthand ways to indicate the same molecule

Key Recognition Element (KRE):

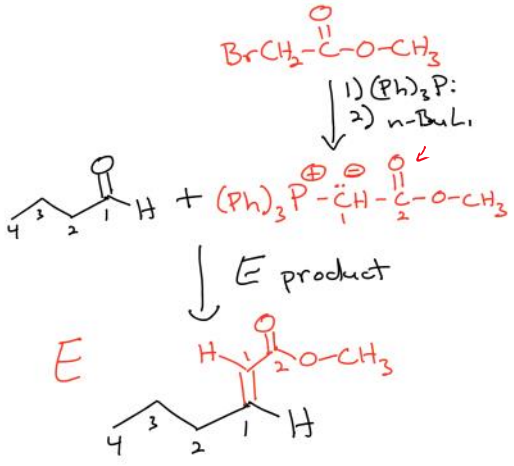
Alkene → New C=C where the C=O was!

E vs. Z → Which product alkene?

1) With alkyl Wittig reagents, the Z alkene product predominates



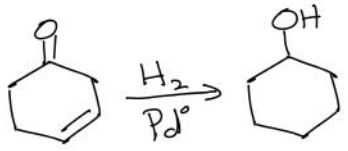
2) When using Wittig reagents that have a carbonyl attached to the C atom that is bonded to the $P^{\oplus}$ atom — E alkenes predominate

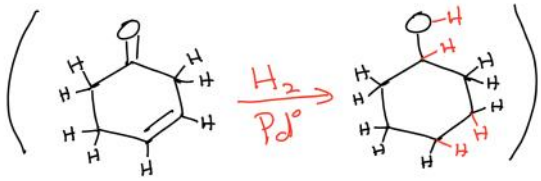


Detour - Hydrogenation of aldehydes and

ketones

H_2 with Pd°, Pt° or Ni° reduces aldehydes and ketones to alcohols → the π bond reacts the same in C=C and C=O

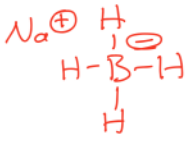




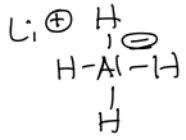
We now return to our regularly scheduled discussion of Mechanism A

Metal Hydride Reduction

⇒ Reduce C=O but not C=C

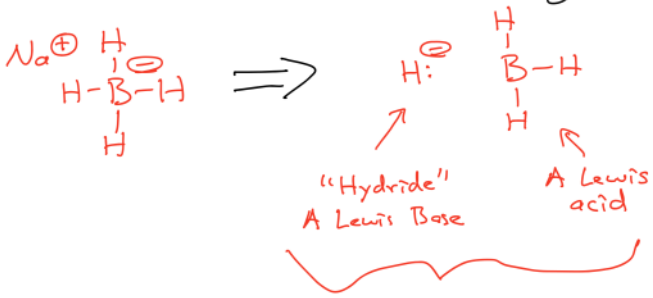


$NaBH_4$



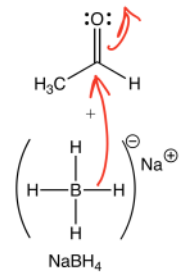
$LiAlH_4$

How to think about the reagent:



You can think of $NaBH_4$ as a Lewis base-Lewis acid complex between hydride ($H:^{\ominus}$) and BH_3

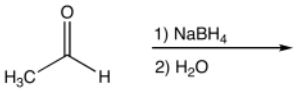
Sodium Borohydride Reacting with an Aldehyde or Ketone

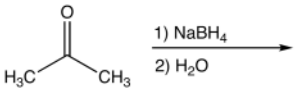


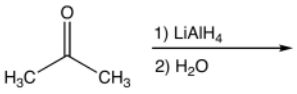
2) H—Ö—H

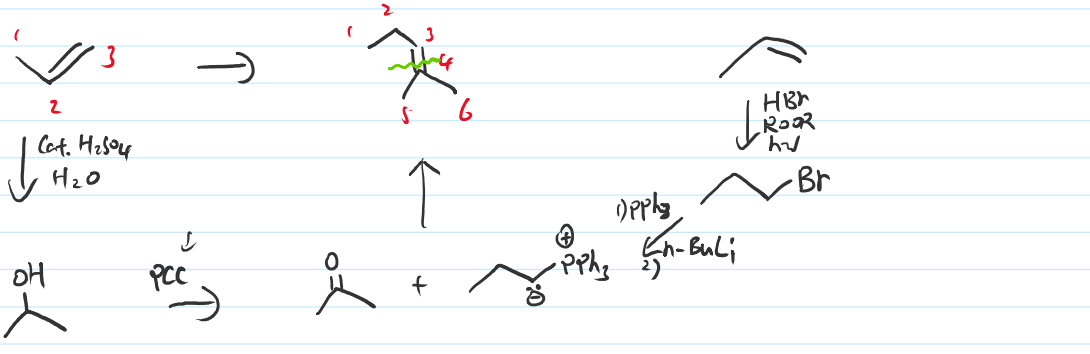
Key Recognition Element (KRE):

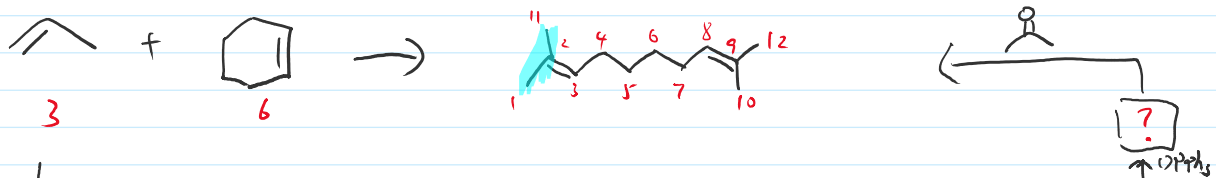
Products

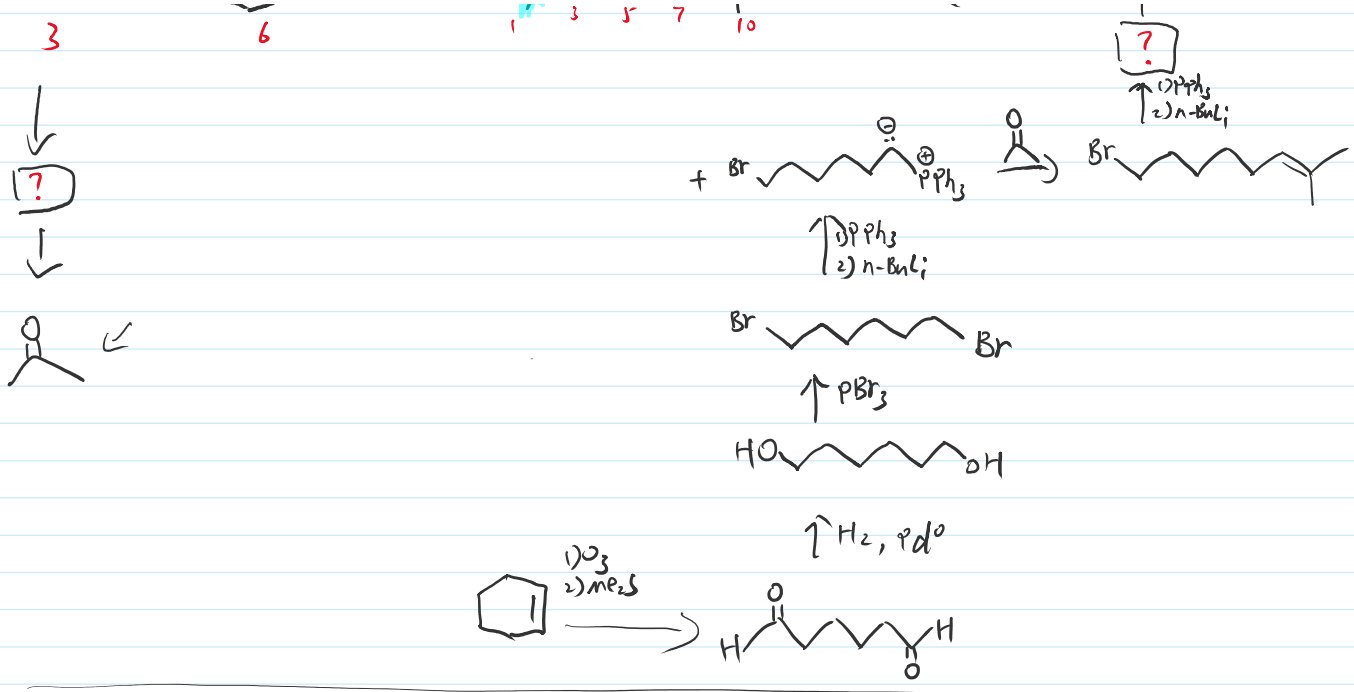








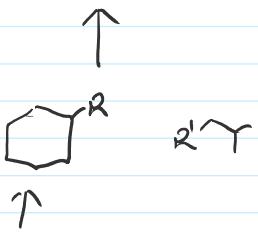


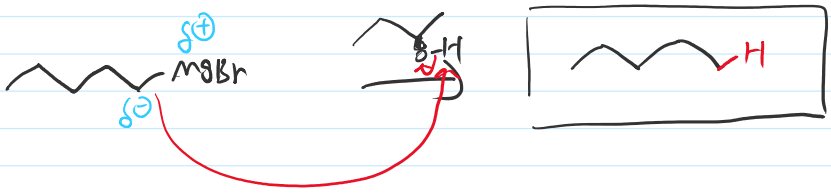


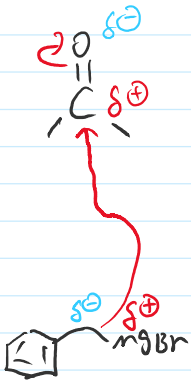
new C-C bond:

1) 1st : $R-C\equiv C:^{\ominus}$ + 1° R Br

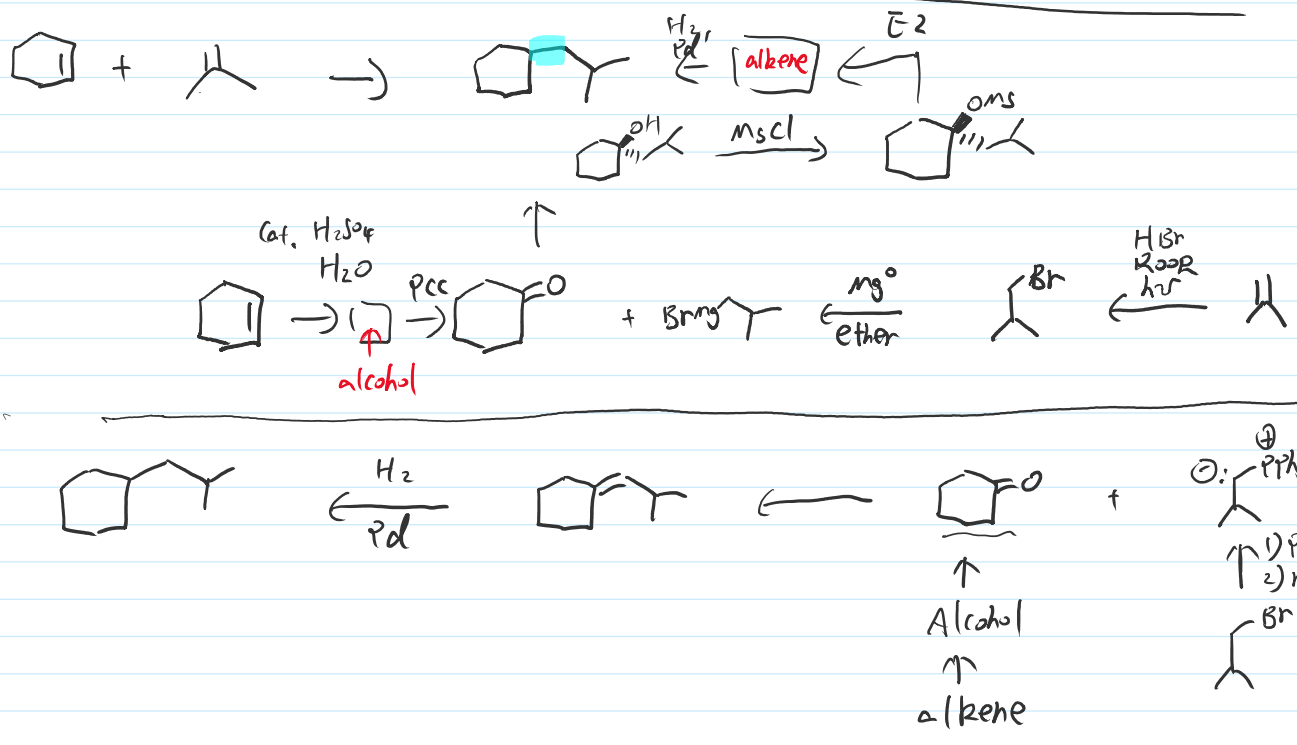
2) 2nd : organometallics + electrophile







E2


alkene
E2
OH
MsCl
OMs
Cat. H_2SO_4
H_2O
PCC
O
alcohol
+ BrMg
Mg°
ether
Br
HBr
ROOR
hv

H_2
Pd
O
+
$\oplus$
PPh3
1) PPh3
2) n-BuLi;
Br
Alcohol
alkene