

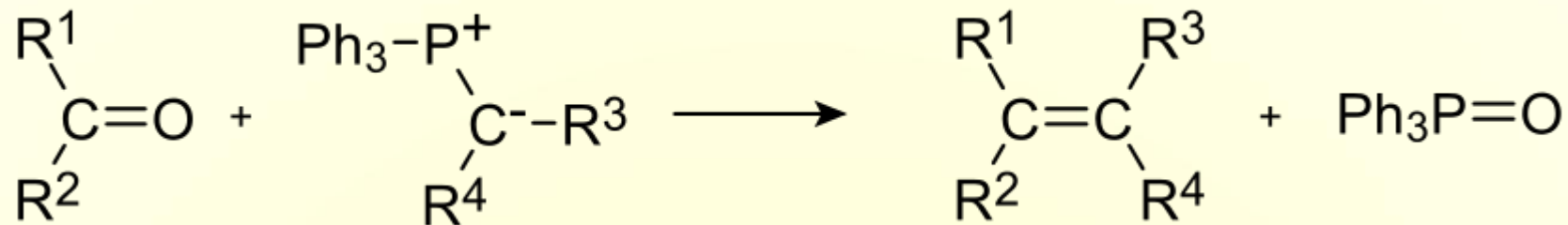
Horner–Wadsworth–  
Emmons reaction  
(HWE reaction or  
Wittig-Horner reaction)

2015-10-20

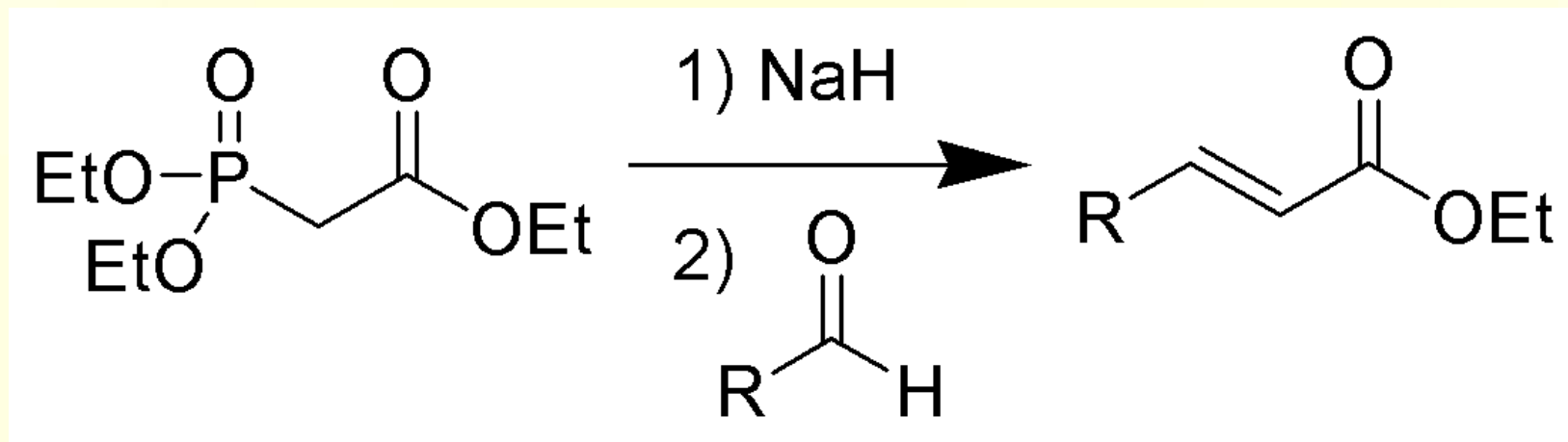
WZQ

# Horner–Wadsworth–Emmons reaction

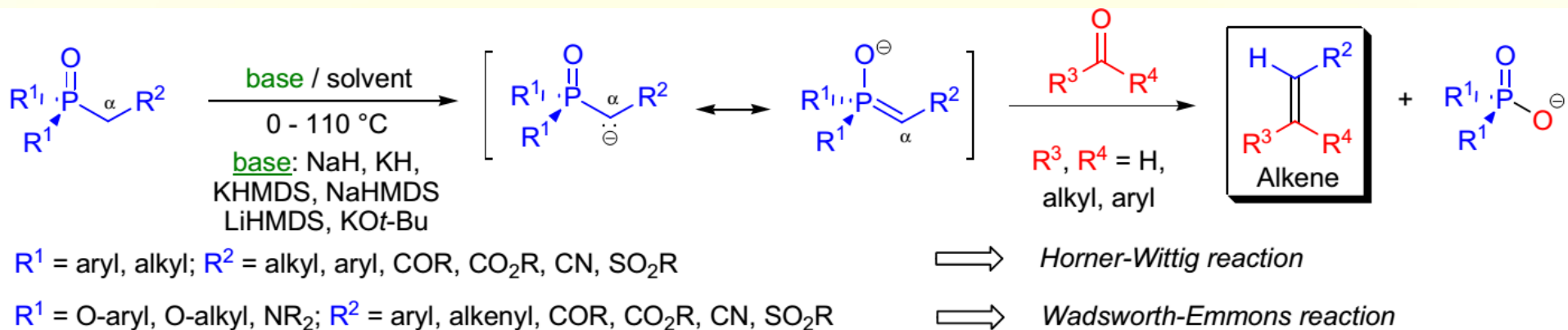
Wittig reaction



Horner–Wadsworth–Emmons reaction



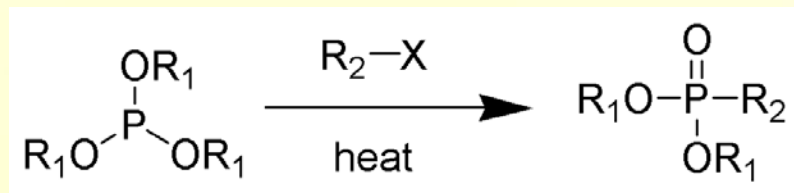
# Horner–Wadsworth–Emmons reaction



Advantages:

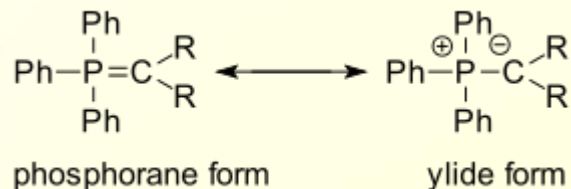
1) the preparation of the starting alkyl phosphonates is easier and cheaper than the preparation of phosphonium salts

Michaelis–Arbuzov reaction:

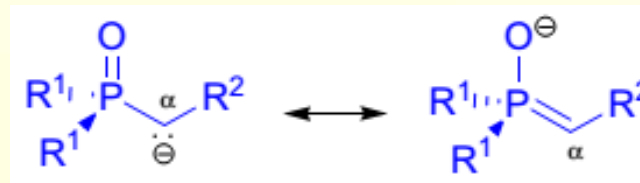


2) the phosphonate carbanions are more nucleophilic than the corresponding phosphorous ylides, so they readily react with practically all aldehydes and ketones under milder reaction conditions

# Horner–Wadsworth–Emmons reaction



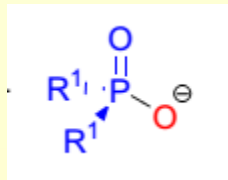
VS



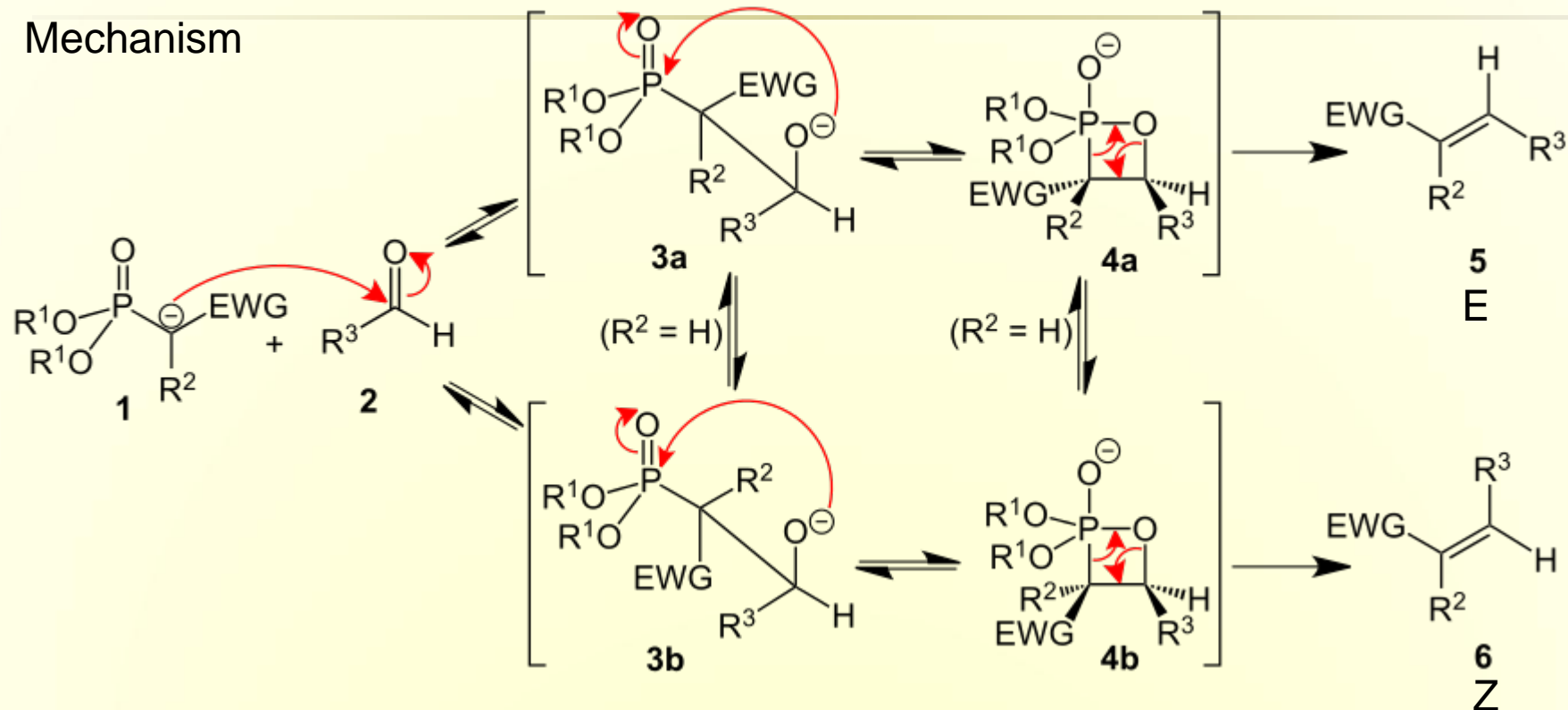
3) hindered ketones that are unreactive in Wittig reactions react readily in HWE olefinations

4) the  $\alpha$ -carbon of the phosphonate anions can be further functionalized with various electrophiles (e.g., alkyl halides) prior to the olefination, but phosphorous ylides usually do not undergo smooth alkylation

5) the by-product dialkyl phosphates are water-soluble, so it is much easier to separate them from the alkene products than from the water-insoluble triphenylphosphine oxide



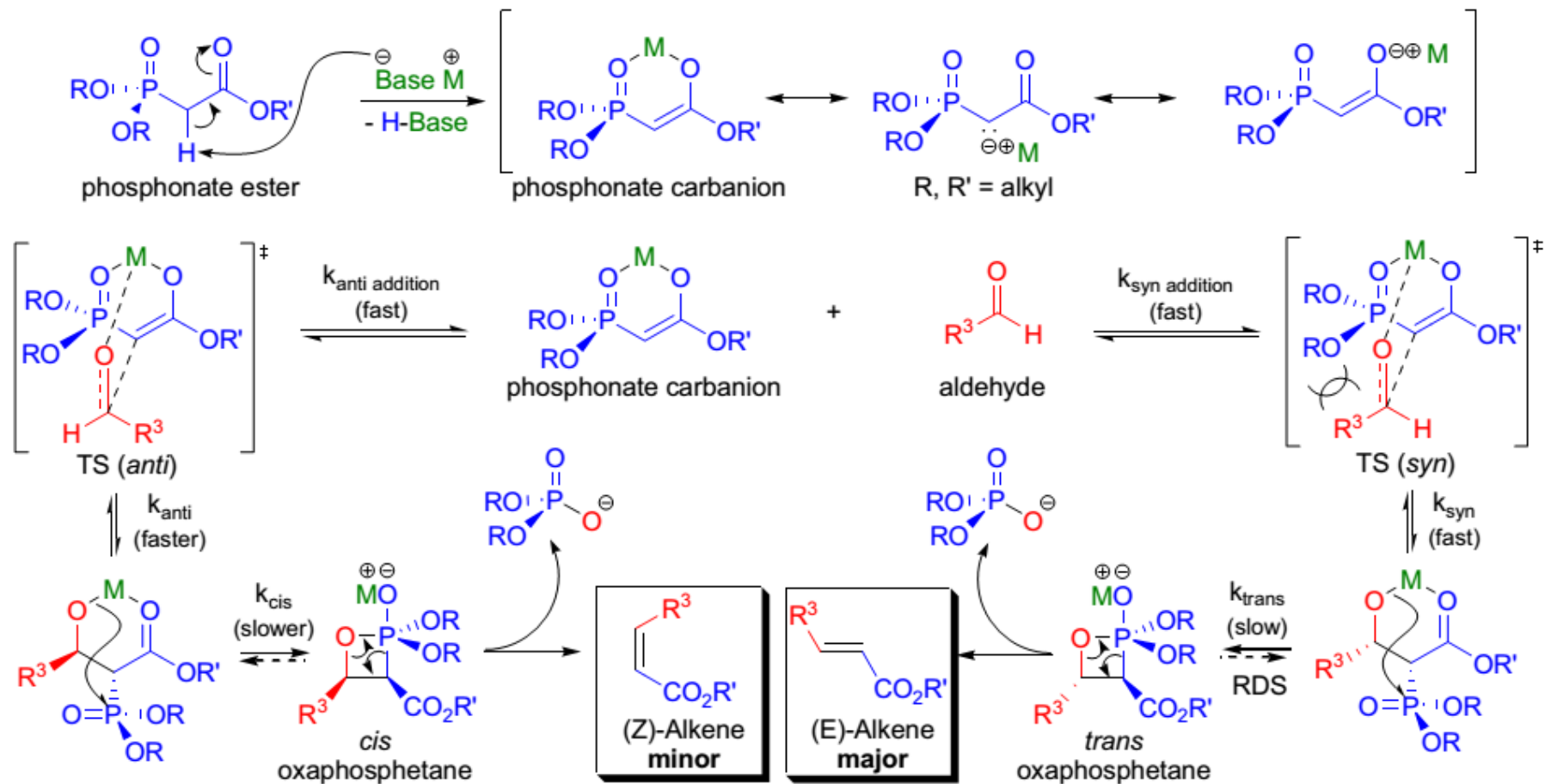
# Horner–Wadsworth–Emmons reaction



The ratio of alkene isomers **5** and **6** is dependent upon the [stereochemical](#) outcome of the initial carbanion addition and upon the ability of the intermediates to [equilibrate](#).

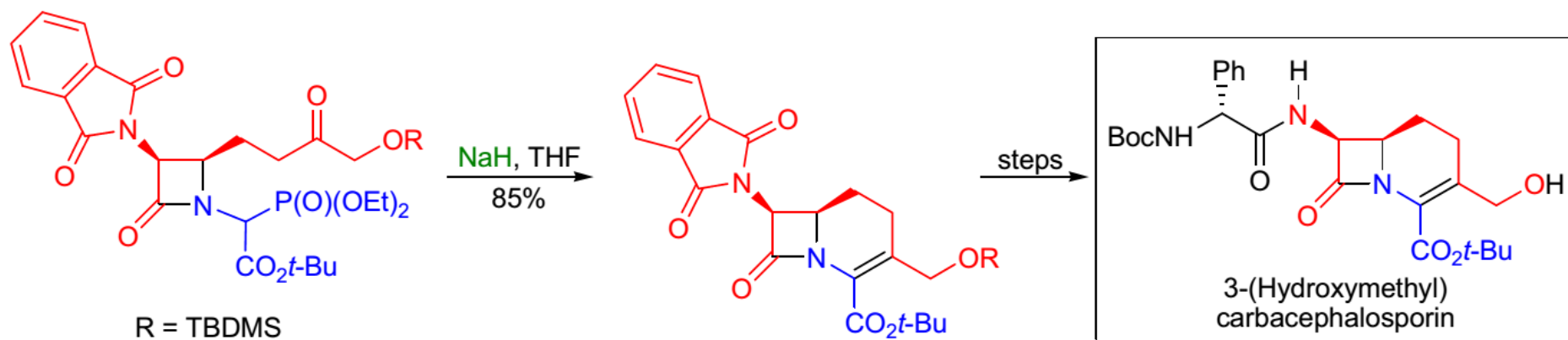
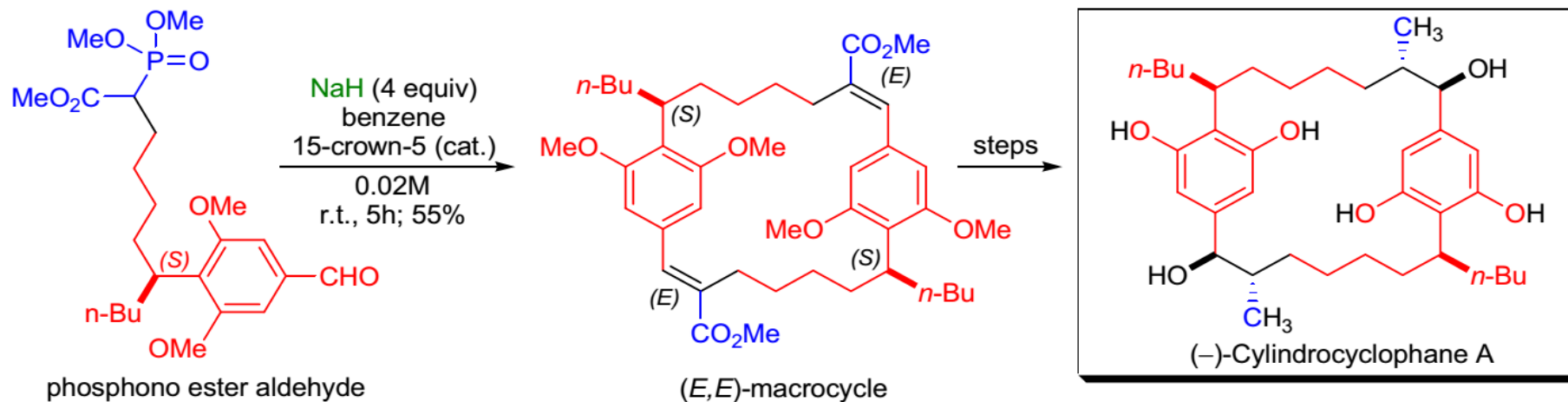
# Horner–Wadsworth–Emmons reaction

**Mechanism:** 47,9,48,11



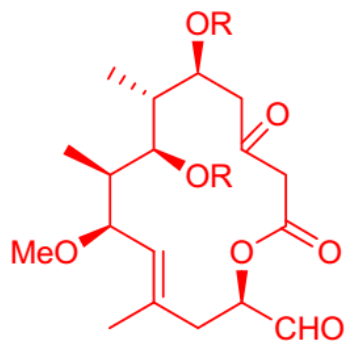
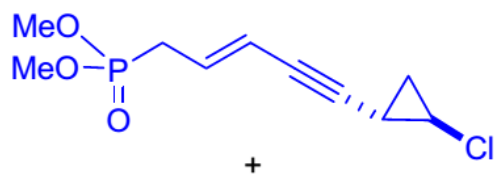
# Horner–Wadsworth–Emmons reaction

## Synthetic Examples



# Horner–Wadsworth–Emmons reaction

## Synthetic Examples

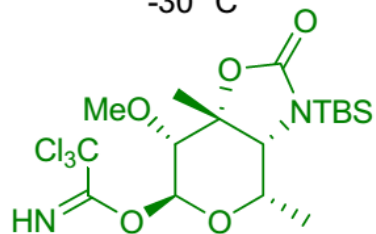


R = TBS

1. LiHMDS, THF,  $-78\text{ }^{\circ}\text{C}$   
then  $-40\text{ }^{\circ}\text{C}$  then  $25\text{ }^{\circ}\text{C}$
2. HF-pyridine, MeOH  
 $0\text{ }^{\circ}\text{C}$

50% for 2 steps  
(*E:Z* = 4:1)

3. TMSOTf, 4Å, 1,2-DCE  
 $-30\text{ }^{\circ}\text{C}$



4. TBAF, AcOH, THF, r.t.
- 70% for 2 steps

