

# Reactivity in Organic Chemistry

Exam 08-04-2011

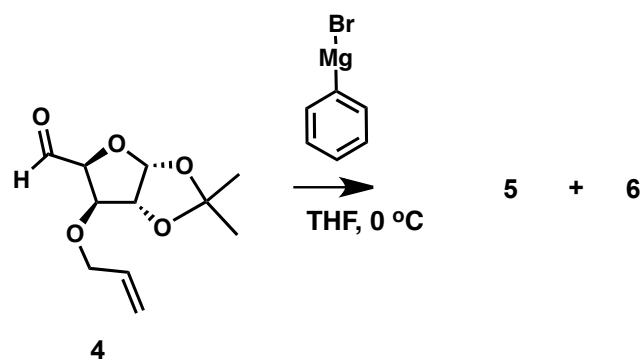
## Problem 1

Optically active crotyl silanes can be obtained from vinyl silanes through an silyl enol ether intermediate. Which silyl enol ether (**2**) has to be generated from vinyl silane **1** to provide crotyl silane **3**? Provide a plausible transition state for the transformation of **2** into **3**.



## Problem 2

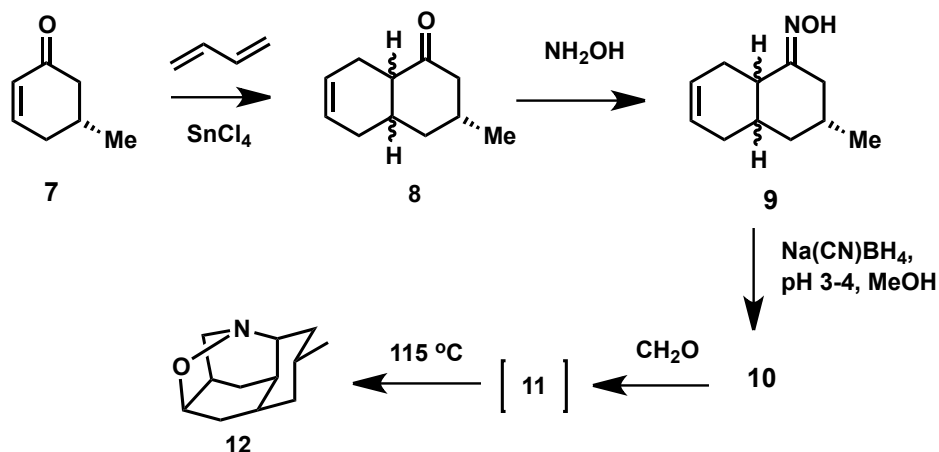
Glucose derivative **4** was treated with phenylmagnesium bromide. A mixture of stereoisomeric products **5** and **6** was formed in ratio 1:4. Predict which diastereomer is the major one. Justify your prediction by analysis of the transition state of the reaction.



### Problem 3

A) Which diastereomer of compound **8** is formed and why?

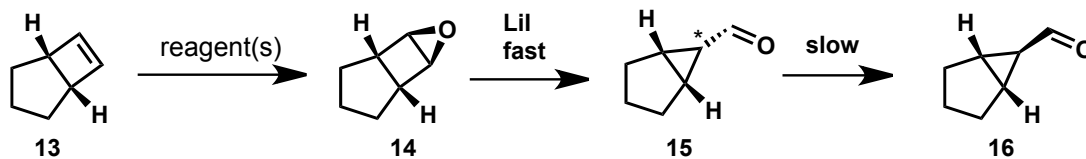
B) Provide the structures of compounds **10** and **11** and a mechanistic explanation for their formation. Provide a mechanism for the formation of **12** from **11** (the regiochemistry in this reaction does not have to be explained).



### Problem 4

A) How would you affect the stereoselective transformation of bicycle **13** into tricycle **14** (one or more steps can be possible)?

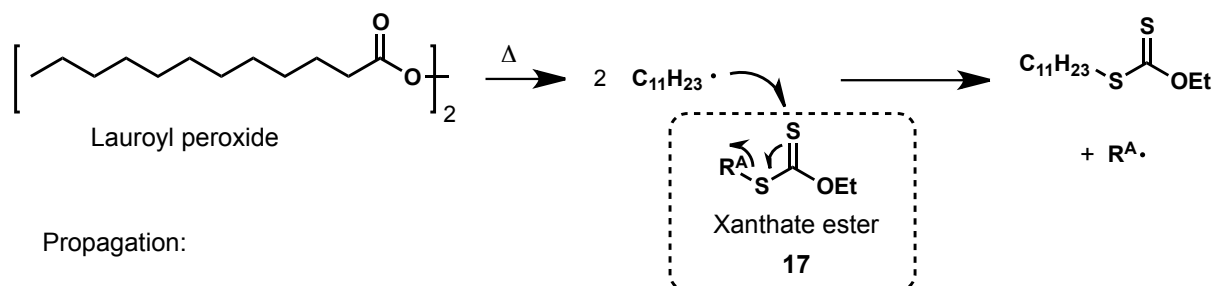
B) Give a mechanism for the formation of **15** from **14** and for the transformation of **16** from **15**. Explain the observed stereochemistry.



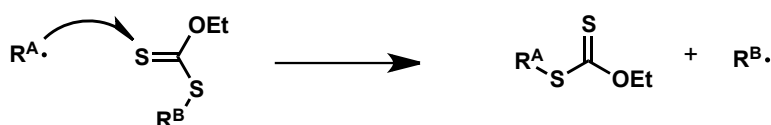
### Problem 5

Xanthate esters (see general structure **17**) can be used in radical reactions in which the xanthate ester migrates from the starting compound to the product, as is outlined below:

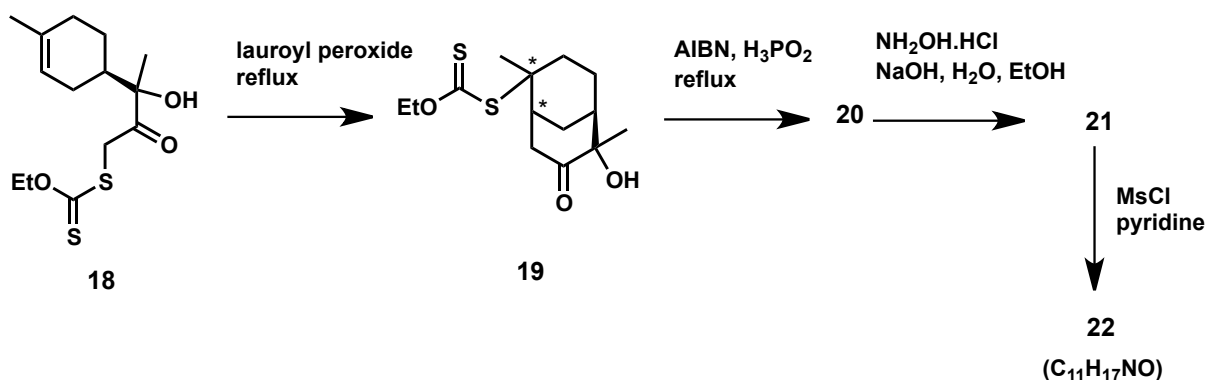
Initiation:



Propagation:

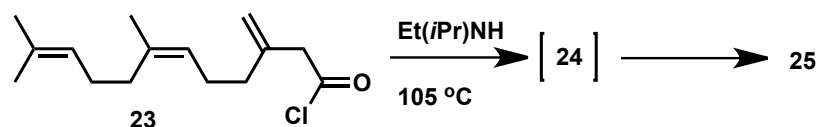


- This strategy has been used in the synthesis depicted below. Provide the mechanism for the transformation of **18** into **19** and predict the stereochemistry of the newly formed stereocenters.
- Next, compound **19** is treated with AIBN and  $H_3PO_2$  (a source of  $H\cdot$ , can be considered as a  $Bu_3SnH$  analogue). Give the structure of the resulting product **20**.
- In the next steps **20** is treated with  $NH_2OH\cdot HCl$  and  $NaOH$  to give an oxime, which is then treated with  $MsCl$  in pyridine. Provide the structures of products **21** and **22** and the mechanism of their formation.



### Problem 6

Provide the structure of compounds **24** and **25**. Give a detailed mechanism for the formation of **25**, explaining the regiochemistry of the reaction.

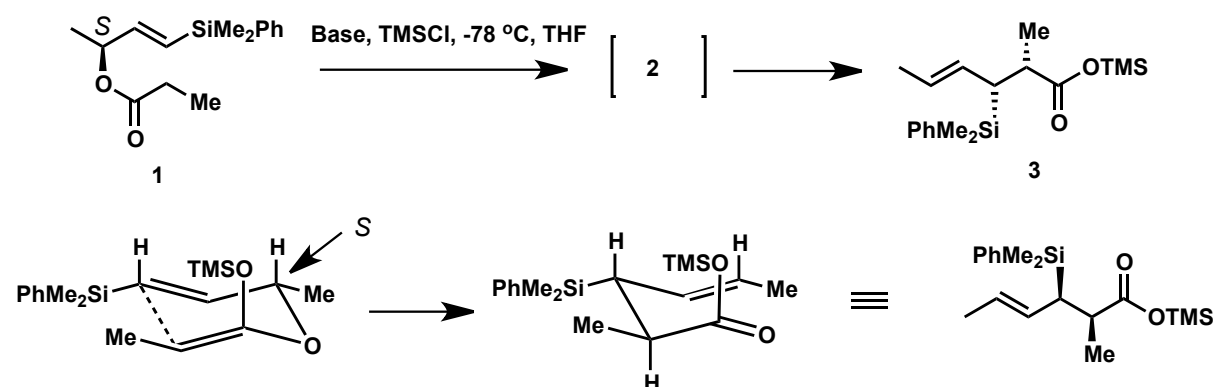


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## Problem 1

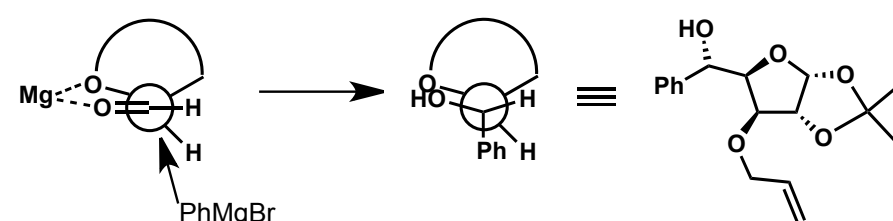
Product formation occurs through a chair like transition state:



Only one chair t.s. is formed, which places the methyl group in an equatorial position. An *Z*-enol ether has to be generated to get the right (*syn*) stereochemistry.

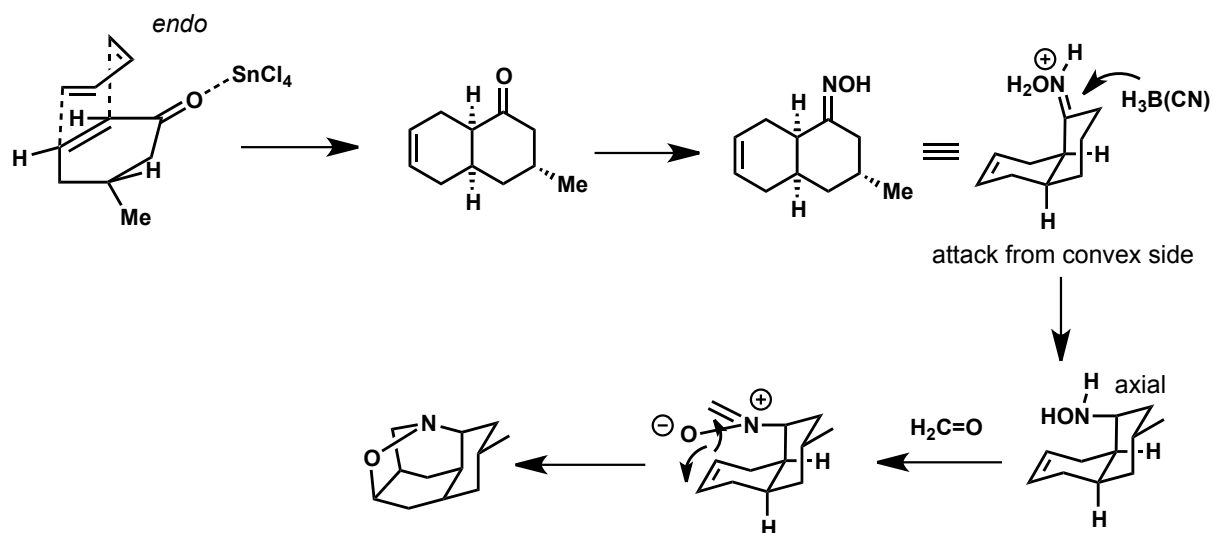
## Problem 2

The major product is formed *via* an Felkin-Ahn addition with chelation. The major product is depicted below. Chelation with the *O*-allyl ether can give rise to the formation of the diastereoisomeric product (not depicted).

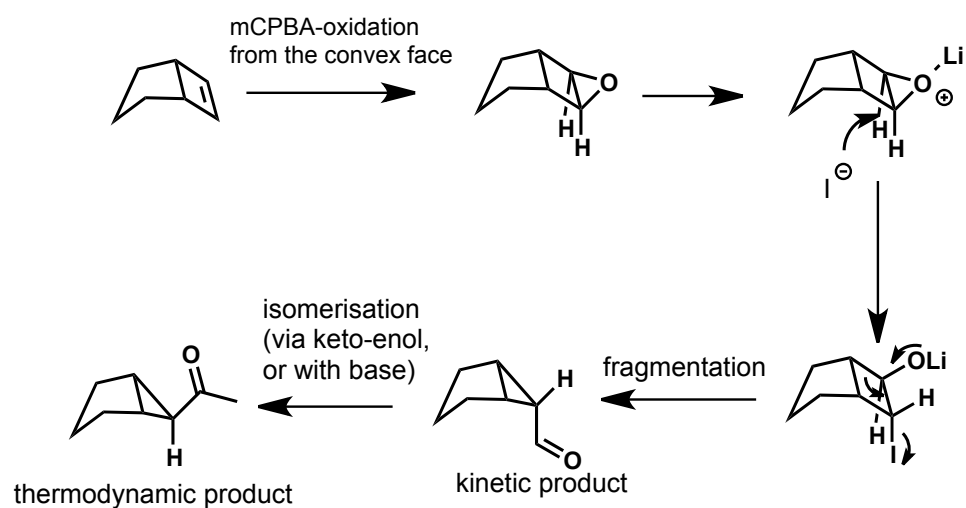


## Problem 3

The first reaction is a Diels-Alder reaction which can take place through the *endo* t.s. depicted below. The diene attacks the dienophile from the face opposite to the methyl group. Reduction of the oxime occurs from the convex face (equatorial attack) to give the axial hydroxylamine. When the hydroxylamine is treated with formaldehyde a nitrone can be formed which can undergo a [3+2] dipolar cycloaddition to give the product (the regioselectivity in this reaction is not explained ...).

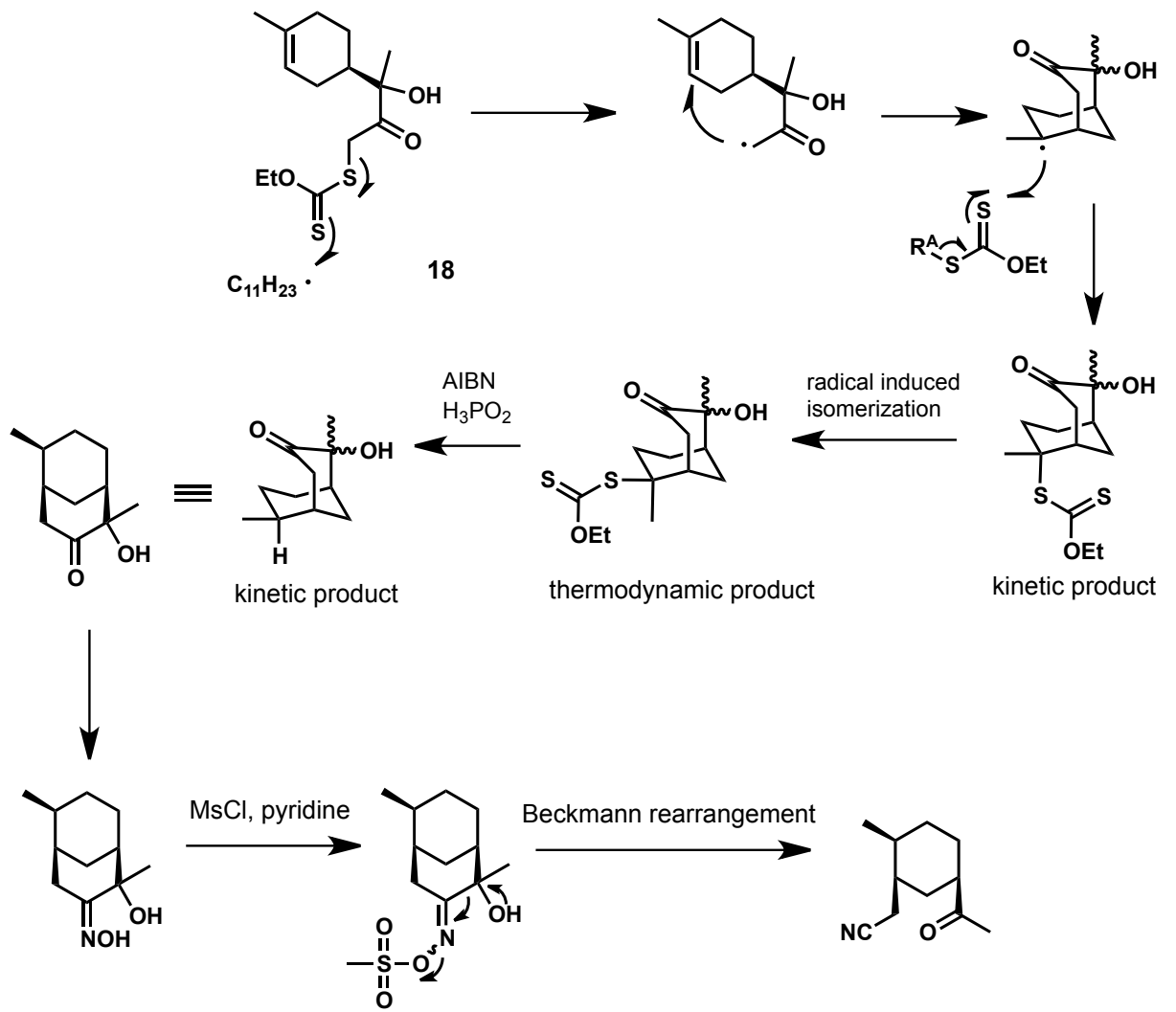


#### Problem 4

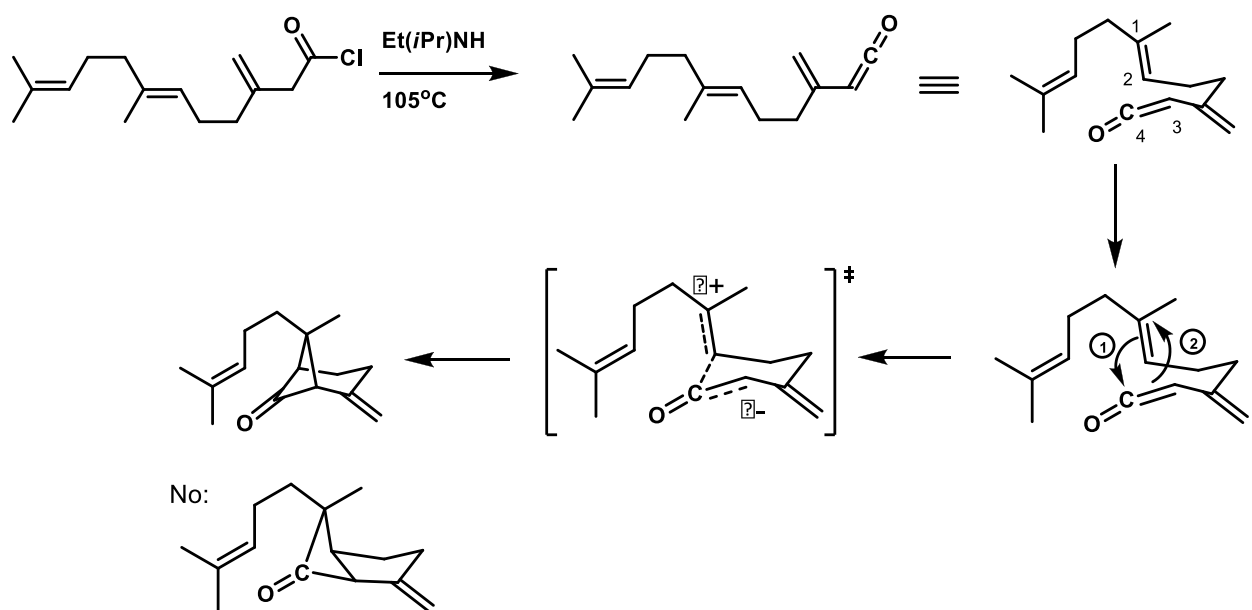


A semi-pinacol rearrangement can also lead to the product. This starts with attack of the  $\text{Li}^+$  ion to the epoxide and ensuing opening, generation of the carbocation and rearrangement. Obviously the rearrangements take readily place because of the strained cyclobutane system.

Problem 5



Problem 6



Deprotonation of the acid chloride leads via  $\beta$ -elimination of the chloride to a ketene, which can undergo a [2+2] cycloaddition. The regioselectivity of this reaction can be explained as follows. Only the middle double bond reacts because [2+2] addition to the other two double bonds is impossible because of the ring size of transition states (too large or too small). The regioselectivity in the formation of the product (C2 is connected to C4 and C1 is connected to C3 in the product, the other regioisomer would be) originates from an asynchronous reaction in which bond formation between C2 and C4 is significantly advanced over the formation of the C1-C3 bond. This results in the development of a partial positive charge, which is best accommodated on the tertiary carbon atom (*i.e.* C1) and the development of a partial negative charge which is best stabilized on C3, because it is next to the carbonyl. The product is a racemate of course.