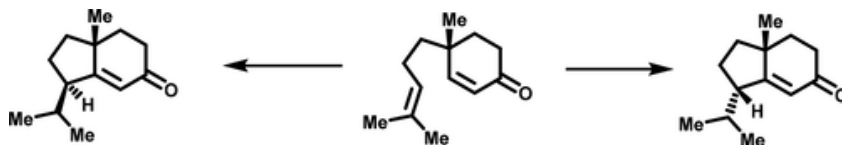


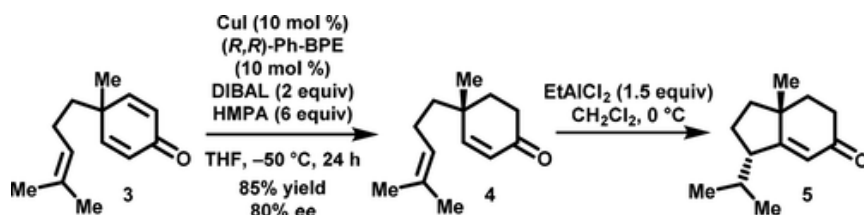
# Organic Cumulative Exam (February 6, 2020)

## Daesung Lee

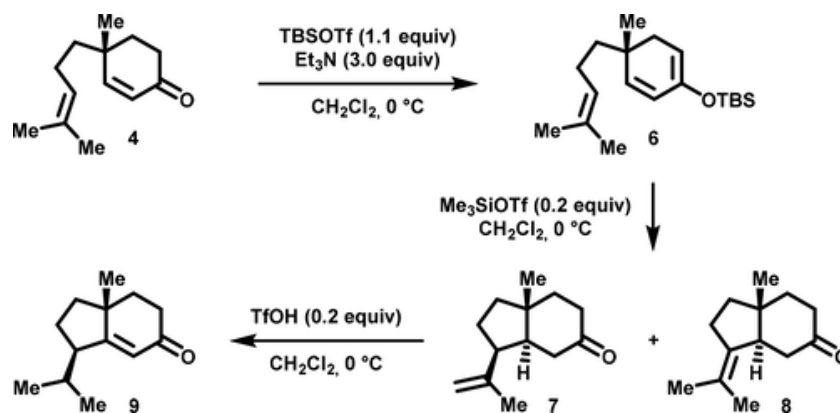
1. (50 Points) The preparation of hydridane/hydrindene derivatives are important platform to develop new synthetic transformations and reaction mechanisms. Corey and coworkers reported the following transformations and proposed mechanistic rationale for the formation of these diastereomeric products under slightly different reaction conditions. (Corey et al. *Organic Letters* 2017, 19, 6686)



(a) (20 Points) For the formation of diastereomer **5**, precursor **4** was treated with relatively mild Lewis acid ( $\text{EtAlCl}_2$ ) at  $0^\circ\text{C}$ . Provide an electron-pushing mechanism for this transformation that reflects that stability of cis and trans ring junction stereochemistry in the intermediate.



**(b) (20 Points)** For the formation of diastereomer **9**, precursor **6** was treated with a different Lewis acid (TMSOTf; this can be considered as a source of  $H^+$  under the conditions) to generate a mixture of **7** and **8**. Provide an electron-pushing mechanism for this transformation that reflects that stability of cis and trans ring junction stereochemistry in the intermediate.



**(c) (10 Points)** Provide detailed electron-pushing mechanisms for the conversion of **7** and **8** to the final product **9**.

**2. (50 Points)** The Mitsunobu reaction is one of the most useful method for inversion of alcohol stereochemistry. Although useful, this reaction is not very atom economical, meaning it generates a large amount of byproduct. To make this reaction more atom economical and thus green process Denton and coworkers has developed a catalytic protocol (R. M. Denton *et al*, *Science* **2019**, 365, 910)

**(a) (25 Points)** The following scheme represents a prototypic Mitsunobu reaction where Nu-H is normally carboxylic acid. Provide an electron-pushing mechanism for this reaction by using acetic acid as Nu-H.

The 1967 Mitsunobu inversion protocol



**(b) (5 Points)** Provide a reasonable mechanism/catalytic cycle for the following transformation where Nu-H is acetic acid.

**Redox-free catalytic Mitsunobu inversion**

