

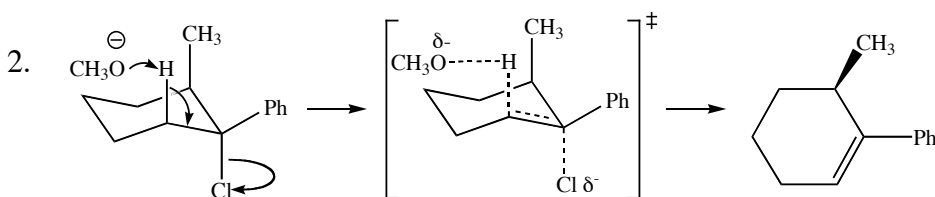
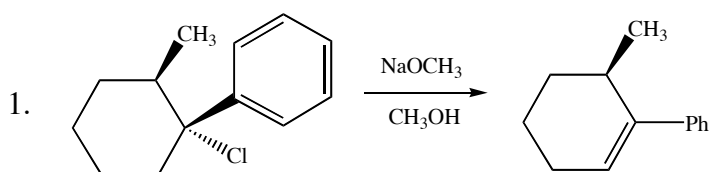
**Statistics:**

High score = 98 Average = 67.4 Low score = 12

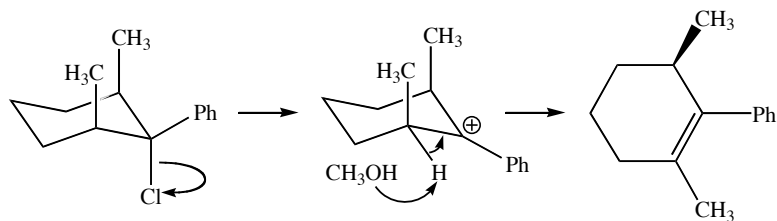
Standard Deviation = Irrelevant as it does not control grade distribution in this class.

A note about exam keys: The answers presented here are usually significantly longer than expected from a student taking the exam. An exam key serves not only to reveal what was expected, but to instruct you as well.

To see the final course grade cutoffs, consult the grading scale on the Chem 30A course web page.



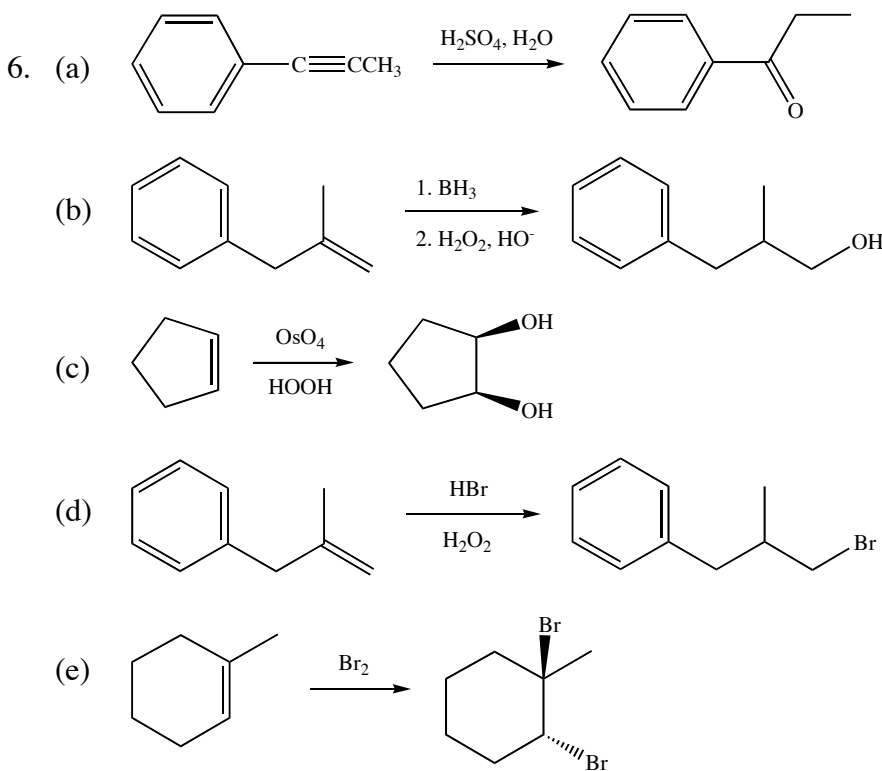
3. This E2 reaction **will** proceed at a reasonable rate because it meets all the requirements for a good E2 reaction: Strong base ( $\text{CH}_3\text{O}^-$ ), moderate leaving group (Cl) and periplanar  $\beta$ -hydrogen (as shown in the mechanism above).
4. A good way to switch the mechanism is to completely shut down the E2 by removing all periplanar  $\beta$ -hydrogens. The  $\beta$ -hydrogen is replaced with a methyl. However, preventing E2 does not automatically allow E1 to happen. In this case, E1 is reasonable (moderate leaving group, polar solvent and the intermediate carbocation is tertiary with benzene ring resonance).



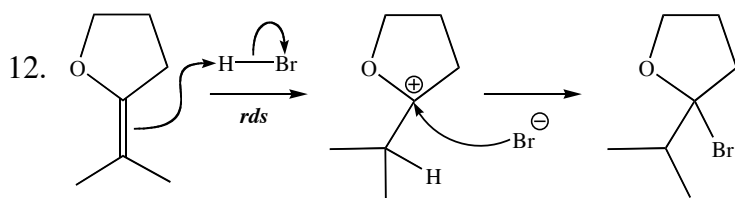
Alternately, simply removing  $\text{NaOCH}_3$  from the reaction also prevents E2.

5. (a) The revised reaction does not occur by the E2 mechanism because **the new molecule does not have any  $\beta$ -hydrogens that are periplanar to the leaving group.**

(b) The product I've written is the major product **because removal of any hydrogen  $\beta$  to the carbocation yields the same alkene!** (Or if your reaction E1 reaction could form more than one alkene then the major product is the more stable/more highly substituted alkene.)

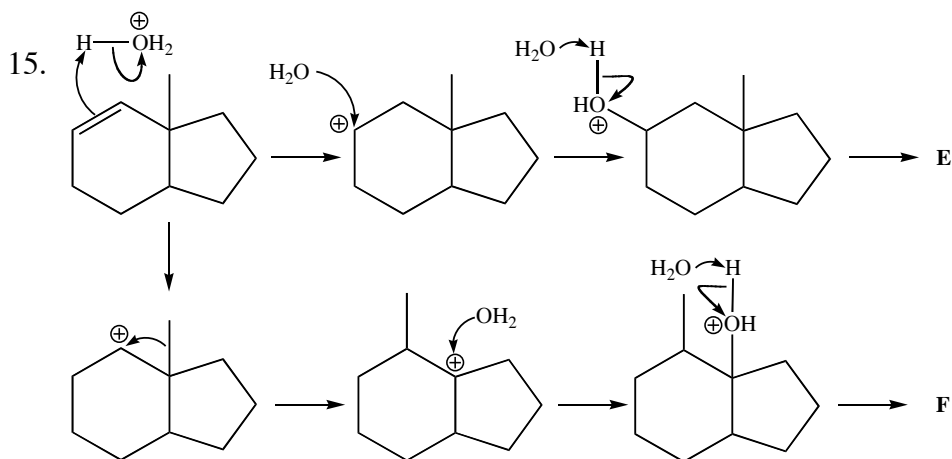
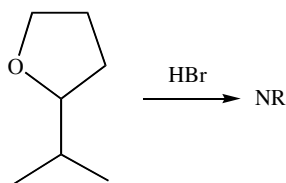


7. (a) The reaction of  $\text{BH}_3$  with a carbon-carbon pi bond is called **hydroboration**.
- (b)  $\text{BH}_3$  is an electrophile because **boron has an open octet**.
- (c)  $\text{HBr}$  is an electrophile because bromine is more electronegative than hydrogen, resulting in a polar bond:  $\delta^+ \text{H}-\text{Br} \delta^-$ .
8. (a) The reaction of  $\text{BH}_3$  with an alkene is **anti-Markovnikov**.
- (b) The reaction of  $\text{BH}_3$  with an alkene **never** involves a carbocation.
9. Syn; not electrophilic; stepwise. *The mechanism involves two steps: Absorption of  $\text{H}_2$  onto the Pt, then C-H bond formation. The two C-H bond formation steps are probably not concerted, but may occur very close together.*
10. This is an addition reaction because **the product (B or C) includes all the atoms of the reactants (A and  $\text{HBr}$ )**.
11. The major product is B. *The precursor of molecule B is a resonance-stabilized carbocation, which is more stable than the tertiary carbocation precursor to molecule C.*



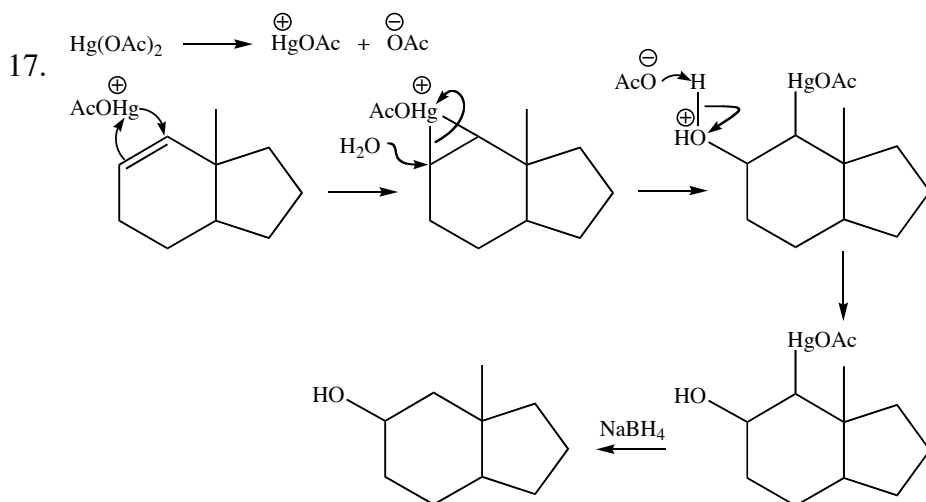
13. Markovnikov's Rule is **not applicable** here because neither end of the alkene has a hydrogen atom. *Markovnikov's Rule describes the position of the new C-H bond in relation to the number of hydrogens on each carbon of the alkene. This, in turn, is controlled by carbocation stability. However, Markovnikov's Rule is not "most stable carbocation."*

14. Completely removing the alkene drops the rate of addition to zero! (A rate of zero is less than a rate of "slow.")

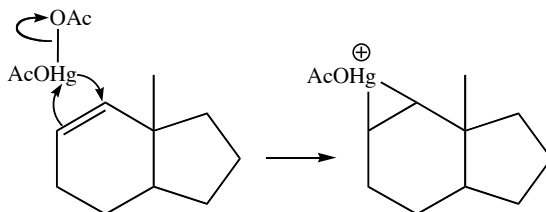


16. (a) No reaction occurs if pure  $\text{H}_2\text{O}$  is used instead of  $\text{H}_2\text{SO}_4/\text{H}_2\text{O}$  because  **$\text{H}_2\text{O}$  is not sufficiently acidic/electrophilic to react with an alkene.**

(b) No reaction occurs if  $\text{KOH}/\text{H}_2\text{O}$  is used instead of  $\text{H}_2\text{SO}_4/\text{H}_2\text{O}$  because a **nucleophile ( $\text{HO}^-$ ) does not react with another nucleophile (the alkene).**



It is also acceptable to include the loss of acetate ion and the formation of the mercurinium ion as a single step. (Compare with to the first step of the mechanism for addition of  $\text{Br}_2$  to an alkene.)



18. Formation of F requires a carbocation rearrangement. The oxymercuration mechanism avoids a carbocation, so formation of F is prevented.

19. There is only one resonance contributor because radicals do not gain resonance stabilization from adjacent lone pairs.

