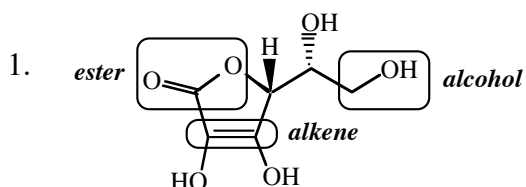


Statistics: High score = 99; Average score = 69.4; Low score = 31
Standard deviation = Irrelevant as it does not control grade distribution in this class.

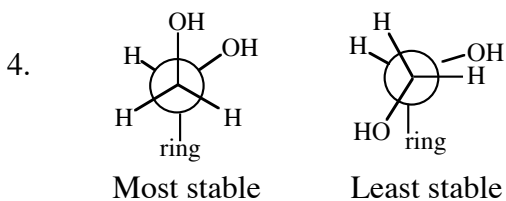
A note about exam keys: The answers presented here are usually significantly longer than expected from a student taking the exam. This exam key serves not only to reveal what was expected, but also as an instructional archive for current and future students.

Exam key posted noon, Friday, August 1, 2003

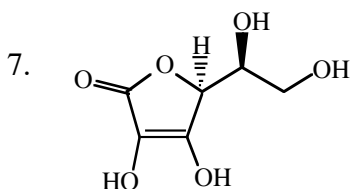
To see the final course grade cutoffs consult “If Grades Were Assigned Today” at the Chem 30A web site.

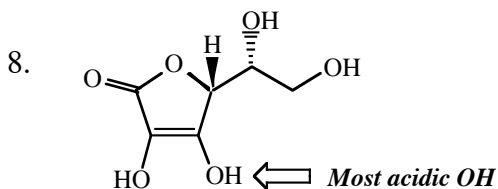


2. The best estimate for the O-C-C bond angle at the CH₂OH group is **a bit more than 109.5** degrees.
3. Ascorbic acid has **8** *sp*³ atoms and **8** hydrogen atoms.

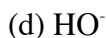
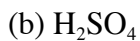
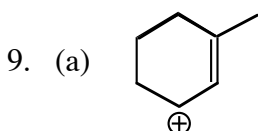


5. In the previous question, the most stable structure has the lowest energy because it has the least amount of **electron repulsion** or **torsional strain**.
6. (a) The stereochemistry of ascorbic acid is ***R,R***.
- (b) Ascorbic acid is **chiral**.
- (c) The optical rotation of ascorbic acid **cannot be determined**.
- (d) The number of ascorbic acid stereoisomers is **4**.





Deprotonation of either of the alcohols (sp^3 C-OH) forms a conjugate base with no resonance stabilization. Deprotonation of the enol OH (C=C-OH) closest to the carbonyl group affords a conjugate base with two significant resonance contributors, whereas deprotonation of the other enol OH affords a conjugate base with three resonance contributors. Since the most stable conjugate base arises from removal of the most acidic proton, the enol OH furthest from the carbonyl is the most acidic OH group.



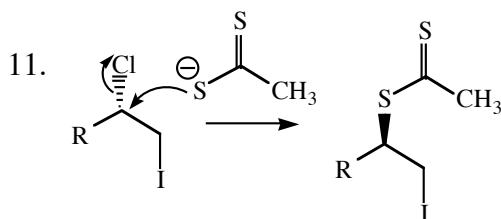
10. Reason #1: Iodide ion is a better leaving group than chloride ion.

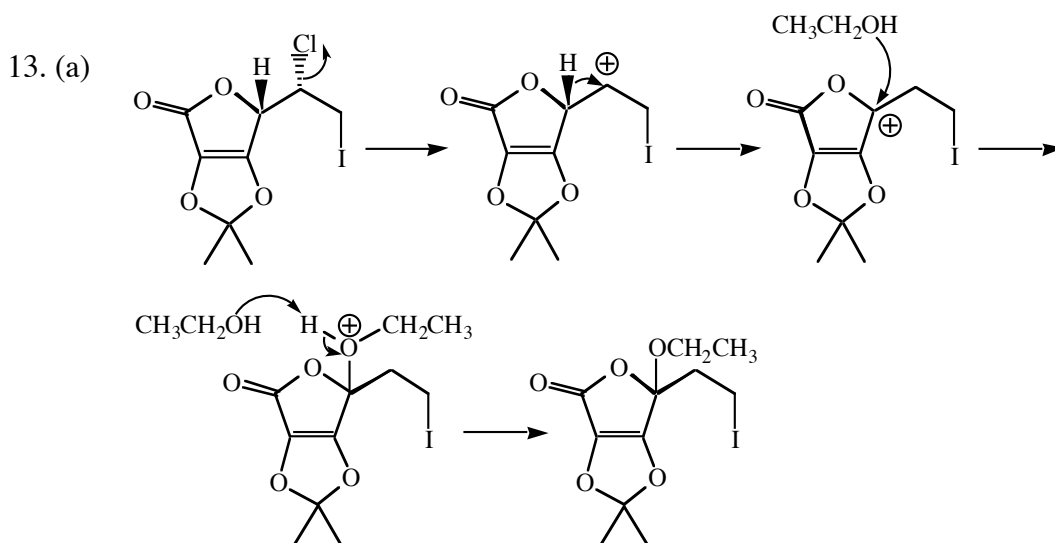
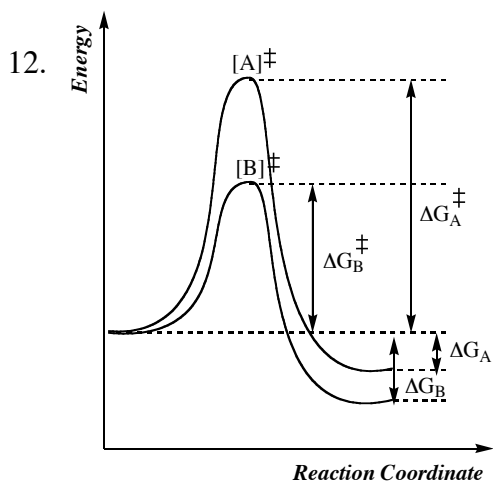
Reason #2: Reaction A occurs at a primary carbon whereas reaction B occurs at a secondary carbon.

Reason #3: CH_3S^- is a stronger nucleophile than CH_3CS_2^- due to the lack of resonance delocalization of charge in CH_3S^- .

Reason #4: DMF is aprotic whereas ethanol is protic.

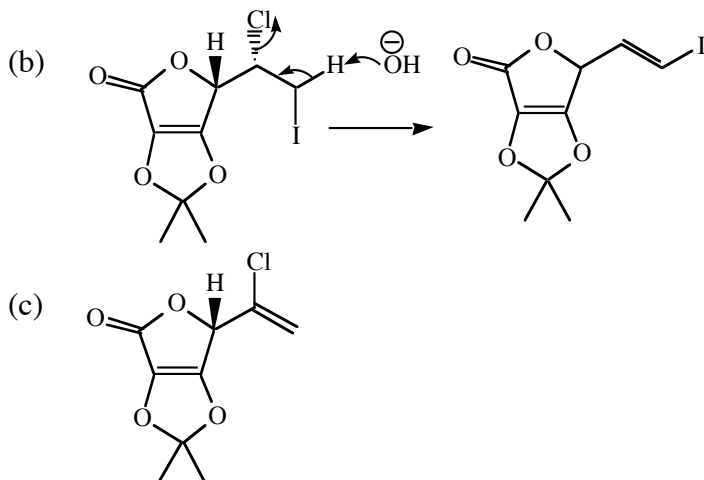
Reason #5: DMF is more polar than ethanol.





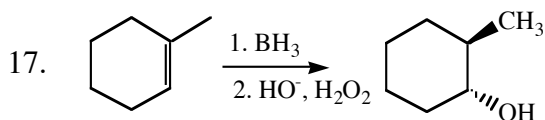
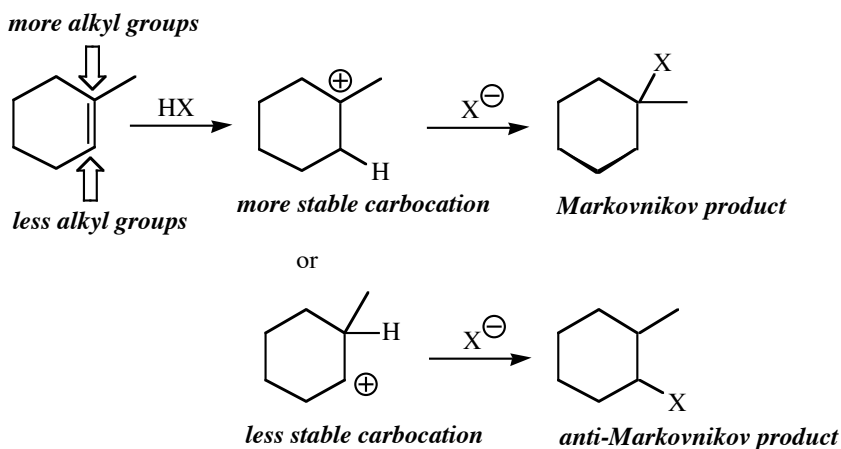
(b) (2 points) If $\text{CH}_3\text{CH}_2\text{OH}$ is replaced with $\text{CH}_3\text{CH}_2\text{O}^-$ but the reaction product remains the same, then rate of this reaction **has no measurable change**.

14. (a) The major reaction product is **D**.

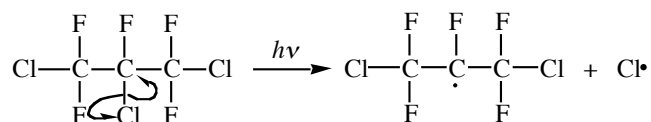


15. Markovnikov's Rule: When a hydrogen halide (HX) adds to an alkene or alkyne, the hydrogen atom of HX becomes bonded to the end of the carbon-carbon π bond bearing the least number of alkyl groups.

16. Addition of H-X to a carbon-carbon π bond proceeds to give the most stable carbocation. Everything else being equal the carbocation bearing the most alkyl groups is more stable. Thus π bond protonation occurs at the end with the least number of alkyl groups (most hydrogens), putting the positive charge on the carbon bearing the most alkyl groups.



18. (a) Homolytic cleavage of the secondary C-Cl bond, leading to a more stable secondary radical, is a more likely mechanism step:



(b) Curved arrows are missing:

