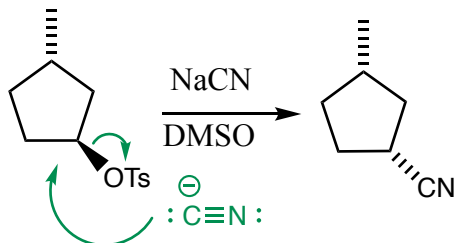


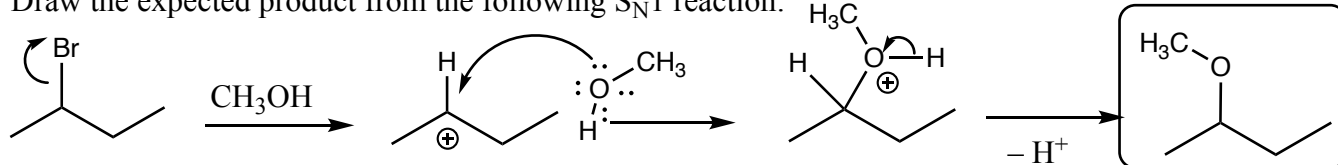
DUE: Friday January 12 in class

1. Draw the expected product of the following S_N2 reaction (include stereochemistry):



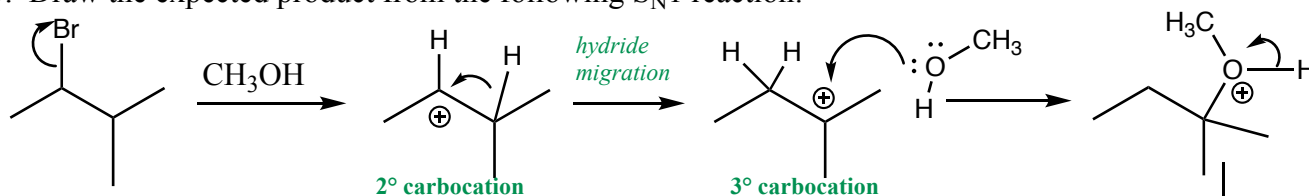
- remove the Na^+ spectator ion to reveal the active nucleophile, cyanide
- both the nitrogen and the carbon of cyanide have lone pairs and hence both atoms could potentially act as the nucleophilic atom
- carbon is MORE nucleophilic than nitrogen because it is less electronegative and it is negatively charged
- S_N2 reactions occur via backside attack of the nucleophile on the substrate containing the leaving group (in this case, OTs, or tosylate)
- the result is inversion of configuration and the CN ends up on the opposite side of the ring
- notice that the substrate is 2° (the OTs is attached to a 2° carbon). S_N2 reactions proceed fastest with methyl substrates, then 1° and then 2° . Remember that 3° substrates do NOT react via S_N2

2. Draw the expected product from the following S_N1 reaction:



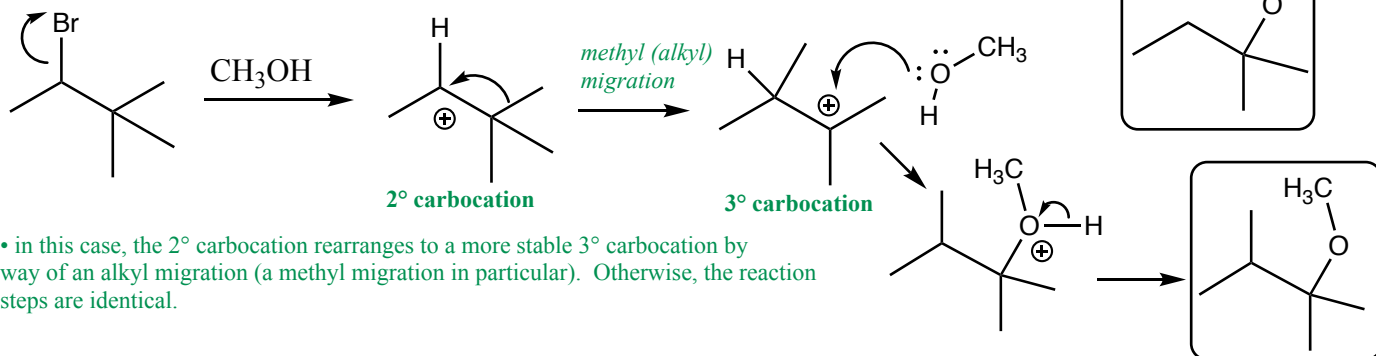
- S_N1 reactions ALWAYS begin by loss of the leaving group (in this case Br^-). A secondary carbocation is formed. Remember that for S_N1 reactions, only 3° and 2° carbocations will be formed (methyl and 1° are too unstable). In this case, the carbocation will NOT rearrange since there is not a more stable carbocation for it to rearrange to. Following this the nucleophile (methanol) reacts with the carbocation by donating a lone pair from the oxygen. Finally, loss of a proton (H^+) forms the final product.

3. Draw the expected product from the following S_N1 reaction:



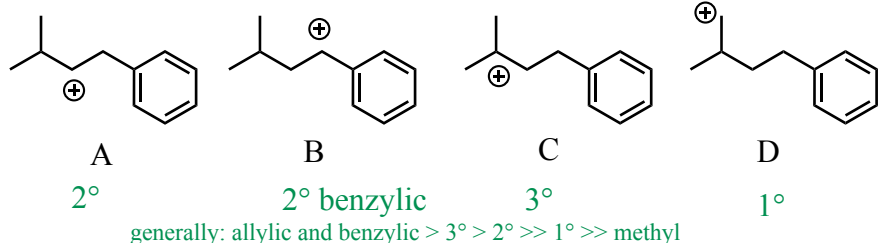
- same reaction as in Q2, but a rearrangement occurs via a hydride migration to give a more stable carbocation intermediate. Such rearrangements will ALWAYS occur when a carbocation intermediate is formed and a more stable carbocation is possible.

4. Draw the expected product from the following S_N1 reaction:



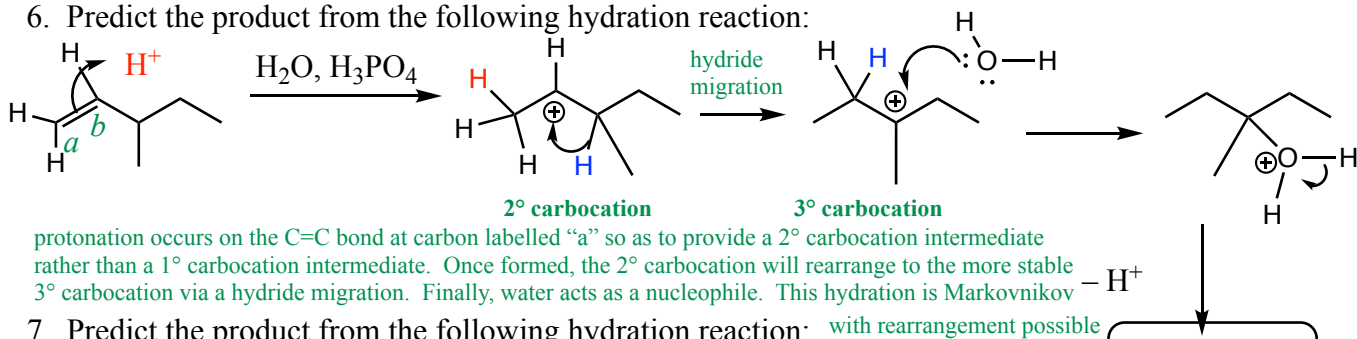
- in this case, the 2° carbocation rearranges to a more stable 3° carbocation by way of an alkyl migration (a methyl migration in particular). Otherwise, the reaction steps are identical.

5. Which one of the following properly ranks the carbocations below in order of their stability from most stable to least stable?

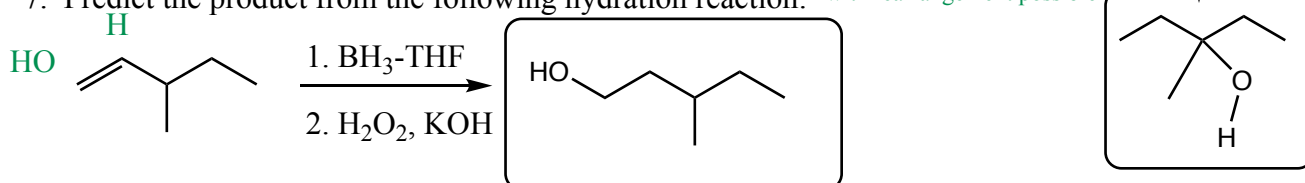


- A. $C > B > A > D$
 B. $B > C > A > D$
 C. $C > A > B > D$
 D. $D > C > B > A$
 E. $B > A > C > D$

6. Predict the product from the following hydration reaction:

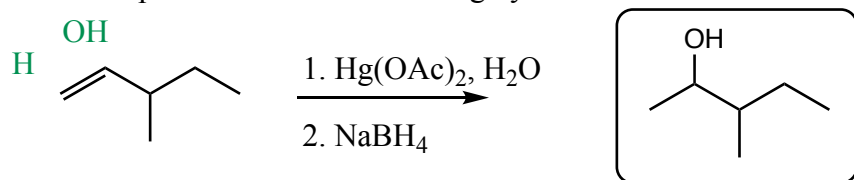


7. Predict the product from the following hydration reaction:



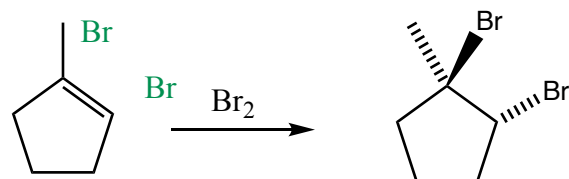
these are conditions for an anti-markovnikov hydroboration reaction.. It is a "hydration" so an H and OH will be added across the C=C bond. Since it is anti-Markovnikov in nature, the OH will be added at the less substituted carbon atom of the C=C bond. There is a 1° carbon and a 2° carbon atom in the C=C bond. Therefore, the OH adds to the 1° and the H to the 2°. There is NO possibility of rearrangement in this reaction!

8. Predict the product from the following hydration reaction:



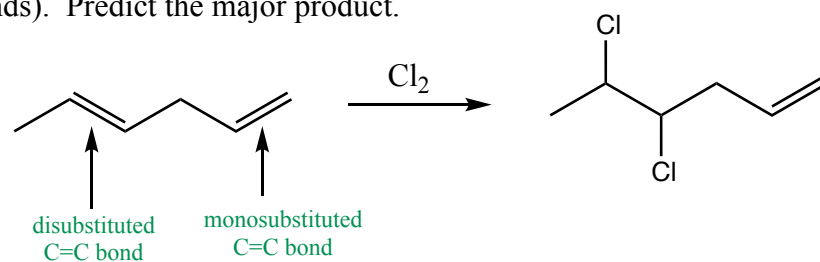
these are conditions for a Markovnikov hydroboration reaction.. It is a "hydration" so an H and OH will be added across the C=C bond. Since it is Markovnikov in nature, the OH will be added at the more substituted carbon atom of the C=C bond. There is a 1° carbon and a 2° carbon atom in the C=C bond. Therefore, the OH adds to the 2° and the H to the 1°. There is NO possibility of rearrangement in this reaction!

9. Predict the product from the following reaction (include stereochemistry):



Halogenations occur with Br₂ and Cl₂. The reactions result in the addition of two atoms of the halogen across the C=C bond. The process is "anti" in that the two atoms add on opposite sides of the ring. Therefore, the two Br atoms are on opposite sides as drawn. The methyl group that was originally present on the ring must be pointing away from us as drawn.

10. Only 1 equivalent of reagent is added to the diene below (i.e. enough to react with ONE of the double bonds). Predict the major product.



Electrophilic additions to compounds with multiple C=C bonds will occur fastest with the more highly substituted double bond since increasing substitution leads to increased electron density of the pi bond. In this case, the disubstituted C=C bond will react much faster than the monosubstituted C=C bond.