

Statistics:

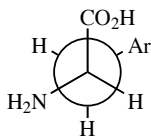
High score = 97 Average = 74.9 Low score = 29

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

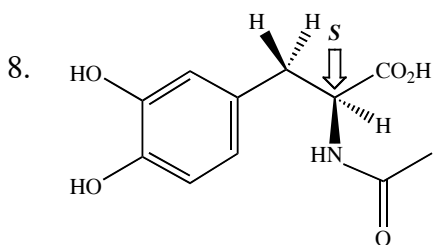
A note about exam keys: The answers presented here are usually significantly longer than expected from a student taking the exam. An exam key serves not only to reveal what was expected, but to instruct you as well.

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

1. Phenol (or benzene ring and alcohol), amine, carboxylic acid.
2. $C_9H_{11}NO_4$
3. L-dopa has **nine** lone pairs.
4. $>109.5^\circ$ but $<120^\circ$
5. Strain: A decrease in molecular stability due to some factor of bonding or geometry.
6. Ar = aromatic ring. The greatest strain is caused by the gauche Ar and CO_2H groups.

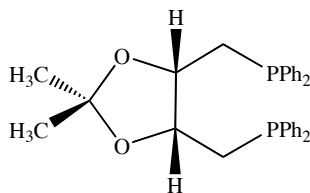


7. L-dopa **does not** have significant ring strain.



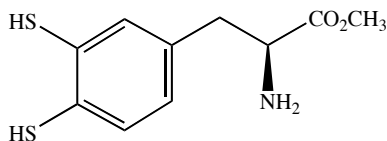
9. Reaction product.
10. Z
11. (a) Same. (b) Cannot determine. (c) Different.

12. The molecule could be made achiral by inverting one stereocenter, making it meso.

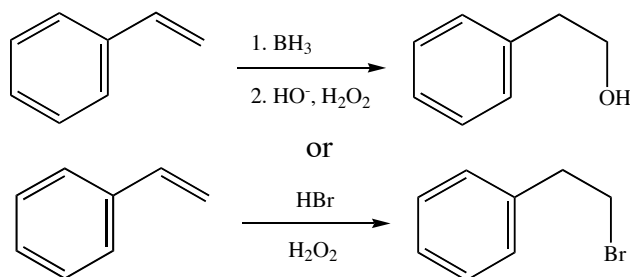


13. The deoxy analog is more acidic so its conjugate base is less basic, and therefore has less electron density at the oxygen atom. This is because the second oxygen atom *increases* electron density due to resonance. In fact, oxygen and nitrogen atoms bonded to sp and sp^2 atoms are electron donors due to resonance, even though they are electronegative atoms. (The second OH group *reduces* electron density due to the inductive effect so this cannot be the explanation.)

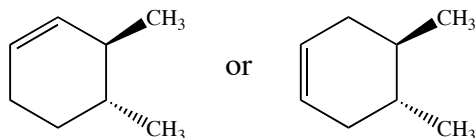
14. Sulfur is a larger atom than oxygen, so in general, an SH group is more acidic than the analogous OH group.



15. We only know two anti-Markovnikov reactions: Hydroboration and HBr/ H_2O_2 , so there are only two acceptable answers:

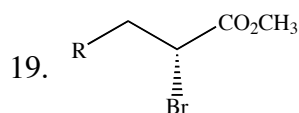
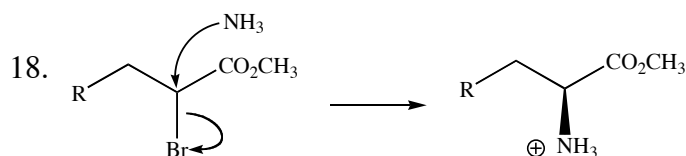


16. Catalytic hydrogen gives a syn product (both of the new C-H bonds are formed on the same face of the ring). This means the starting pi bond cannot be between the two methyl groups. Possible starting alkenes:



Hydrogenation occurs at the more sterically accessible face of the alkene, so hydrogenation of an exocyclic (outside the ring) alkene would give the cis-dimethyl product.

17. Mechanism: A step-by-step account of all the electron and bond changes in a chemical reaction.



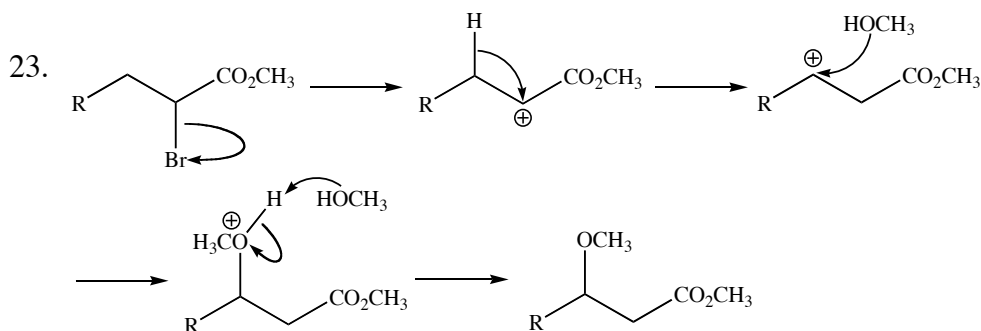
20. DMF (polar, aprotic)

21. (a) Slower. *OH* is not an S_N2 leaving group.

(b) Faster. *H* is smaller than the ester, so steric hindrance is reduced.

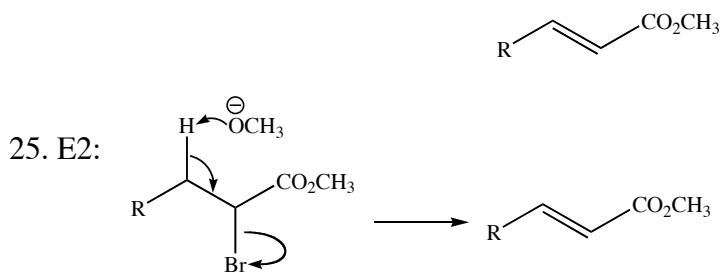
(c) Slower. $(CF_3)_3N$ is a significantly poorer nucleophile due to the inductive effect.

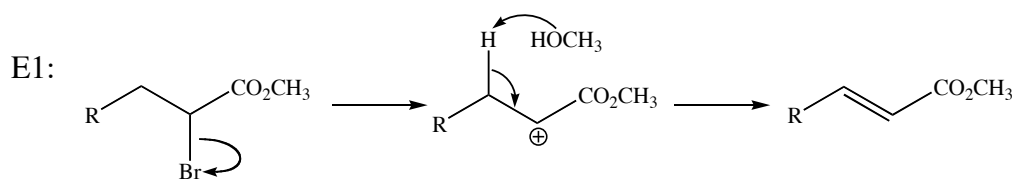
22. We consider S_N2 before S_N1 because S_N2 is energetically less expensive (lower energy of activation). An S_N2 reaction requires a moderate nucleophile (NH_3 is a pretty good one), moderate leaving group (Br is moderate) and the carbon undergoing substitution cannot be tertiary (it is secondary). Since the S_N2 requirements are met, we predict S_N2 to be feasible.



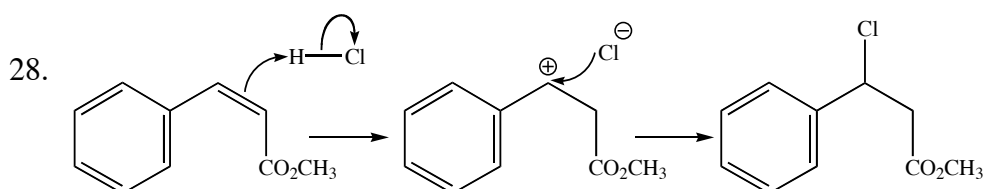
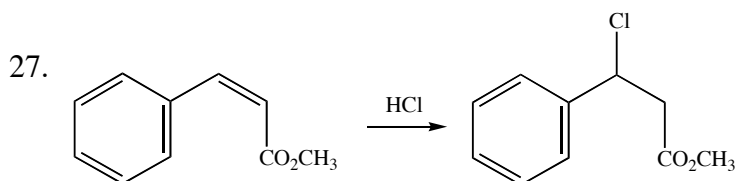
The stereochemistry of this product is **R and S** because the carbocation intermediate can accept methanol from either face.

24. The major product is the more stable alkene (the E isomer in this case).

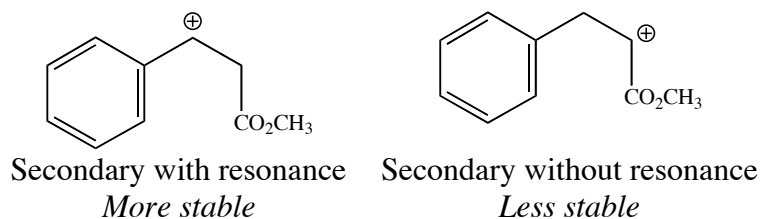




26. The most probable mechanism is **E2** (CH_3O^- is a strong base, Br is a moderate leaving group, and the molecule has the necessary β -hydrogens.)



29. The major product is derived from the more stable carbocation.



Carbonyl groups are actually electron withdrawing due to the inductive effect of the carbonyl oxygen atom.