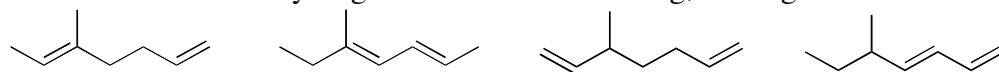


1. a. A common way to measure the relative stability of two unsaturated isomers is to compare their heat of hydrogenation (or combustion). In general, will the more stable isomer release more heat or less heat when it is hydrogenated (or burned)?

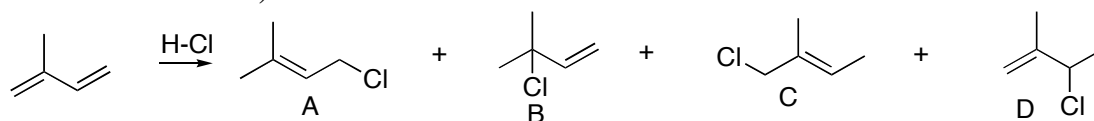
b. Rank the heats of hydrogenation for the following, 1 being most heat released.



2. Rank the rate of reaction of the following toward  $S_N1$  substitution ( $AgNO_3/CH_3CH_2OH$ ), 1 being most reactive and 4 being least reactive. (Think: what determines the rates for  $S_N1$  reactions?)

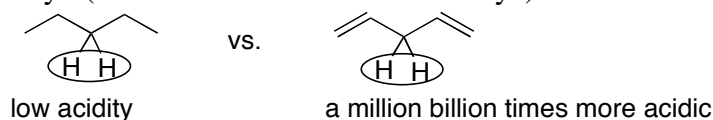


3. Products **A** and **B** combine to make up over 98% of the product mixture. Explain why products A/B dominate over products C/D. (Hint: what common intermediate leads to both products A/B, and what intermediate leads to both C/D? And what determines the rate of reaction for an HCl addition reaction to alkenes?)



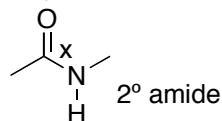
4. Draw the mechanism for formation of products A and B above.

5. 1,4-pentadiene is much more acidic than pentane (about a million billion times more!). Explain why. (Think: what determines acidity?)



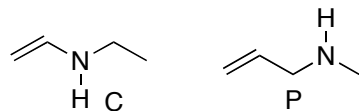
6. Proteins are made out of 2° amides. Try to explain the following two features crucial to protein structure and biological performance:

- 1) there is no rotation relative to bond "x" (even though it appears to be a single bond), and
- 2) the six atoms shown (ignoring the other H's) are perfectly flat.

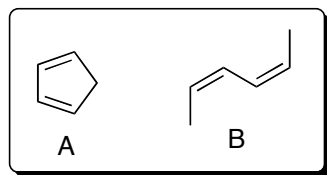


7a. Which is more stable, C or P?

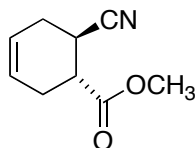
- b. What is the overall hybridization of the N atom in C?
- c. What is the hybridization of the N lone pair in C?
- d. What is the overall hybridization of the N atom in P?
- e. What is the hybridization of the N lone pair in P?
- f. Given that amines with  $sp^2$  or  $sp^3$  lone pairs are more basic than amines with p lone pairs, which is more basic?



8. Diels-Alder Reactivity: Explain why diene **A** is more than a million times more reactive than diene **B**.



9. Give the reactants (including stereochemistry) that would give the following D-A product.



10. Draw the major Diels-Alder product.

