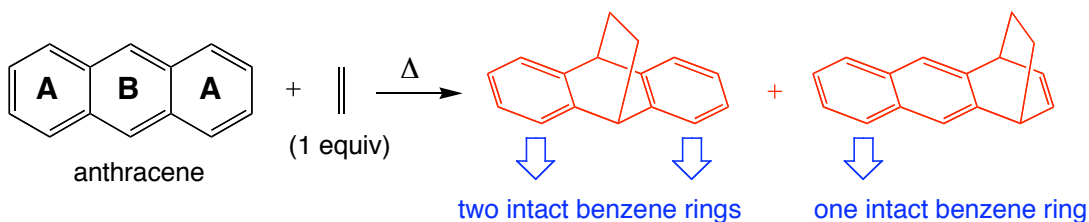


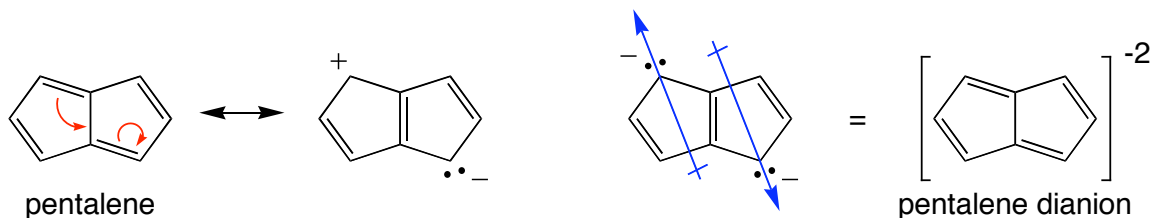
1. Show how the concept of aromaticity (or antiaromaticity) can be used to explain the following by providing short answers that use *both* text and structural illustrations. (10 points)

A. Anthracene is known to act as the diene in Diels-Alder reactions. Show the reaction for each ring, first **A** then **B**, by drawing the two products below. Then indicate and explain which product is favored.



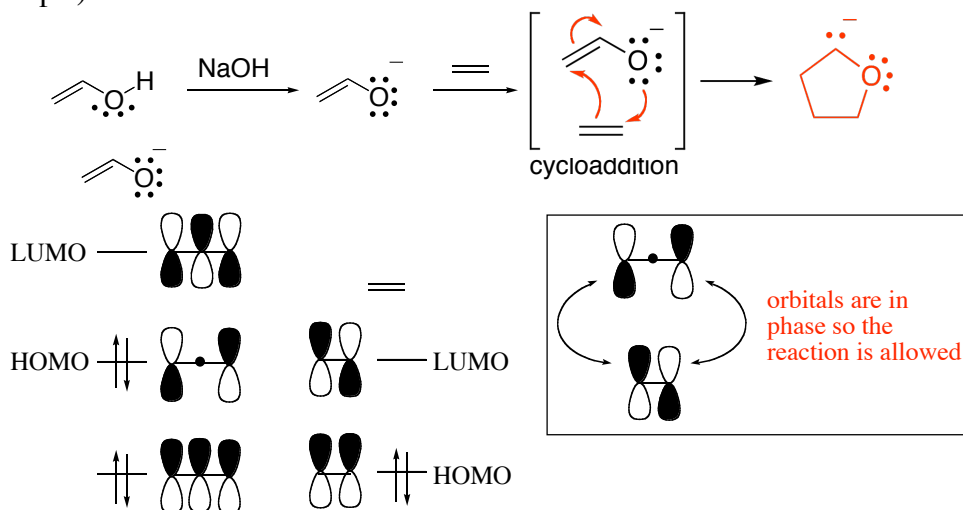
Attack at ring **B** yields a product with 2 intact benzene rings, while attack at **A** yields only 1 intact benzene ring. The reaction at **B** is favored because it results in a greater degree of aromaticity in the product than does the reaction at **A**.

B. Explain why the neutral molecule pentalene is polar but why its -2 dianion is nonpolar.

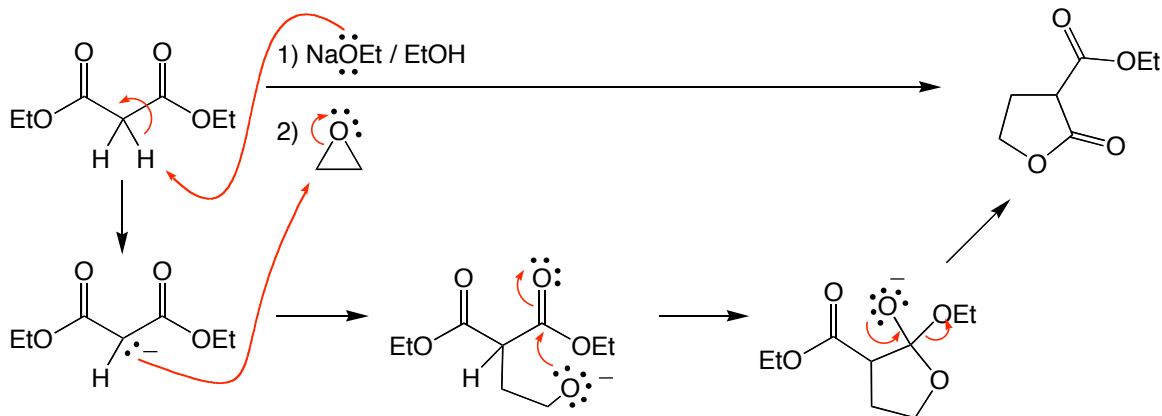


The uncharged resonance structure for pentalene is antiaromatic, while the charged resonance structure shown divides pentalene into an aromatic half and an antiaromatic half. Having at least some aromaticity (versus none) makes the latter situation a more stable situation, thus making pentalene polar. The dianion would have the structure shown because it places its two anions far away from each other and makes both rings aromatic. The dipoles that result cancel each other as shown, making it a nonpolar compound.

2. Use MO theory to predict whether the cycloaddition reaction shown would be allowed or forbidden. Show mechanism arrows for the cycloaddition step & provide a structure for the hypothetical product. (10 pts)

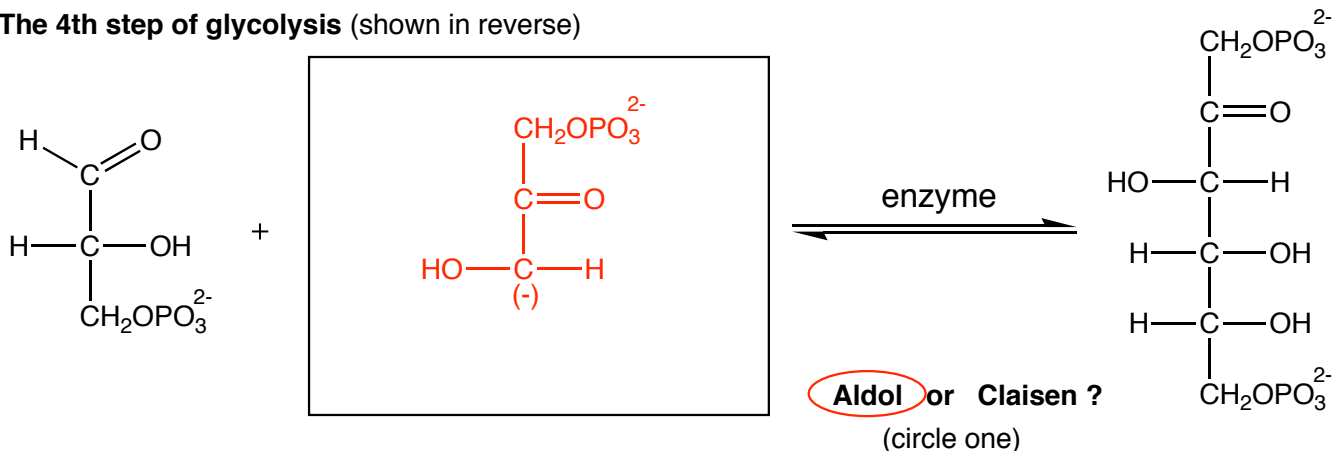


3. Provide a mechanism for the sequence of reactions shown below. Be sure to show all charges and lone pairs of electrons in your structures, and provide the structures of all intermediates. (10 pts)

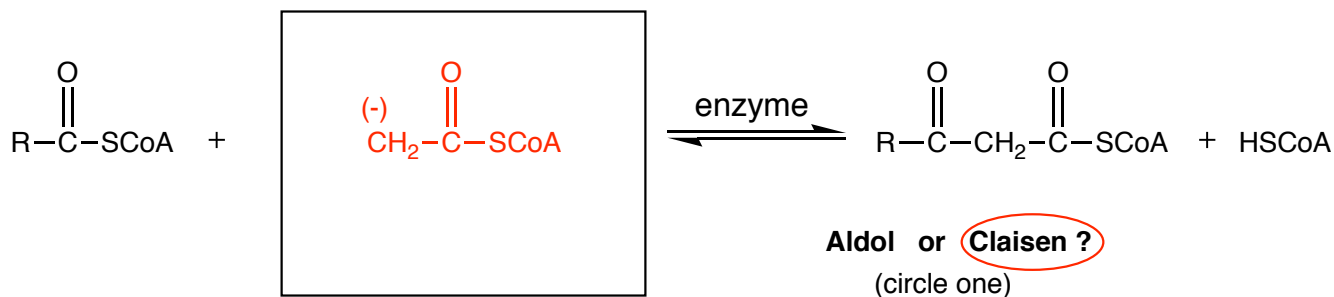


4. The reactions below occur in metabolism and illustrate how Mother Nature is the world's most efficient organic chemist. For each one, decide whether the reaction is analogous to an Aldol or Claisen and provide the missing piece in the boxes shown. Ignore the fact that the alcohol groups aren't protected; *Mother Nature doesn't need to use protecting groups.* (10 pts)

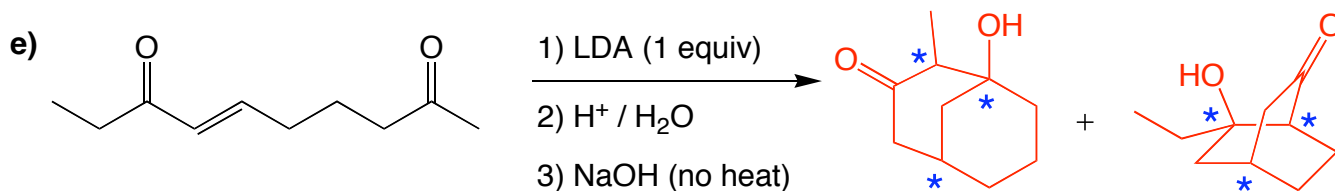
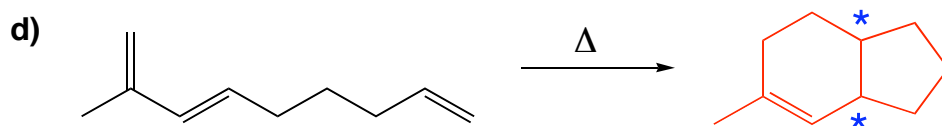
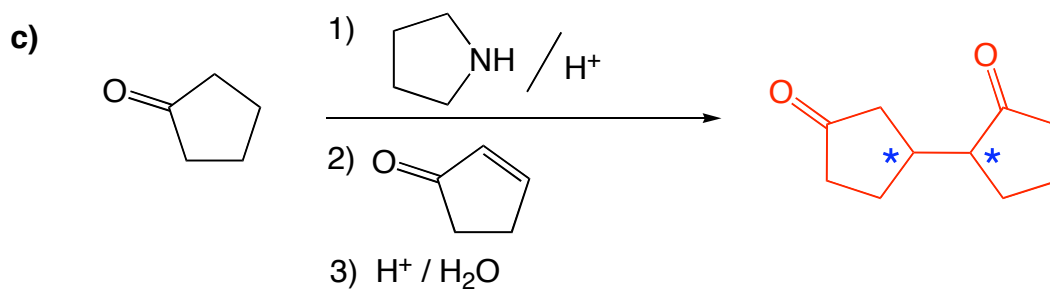
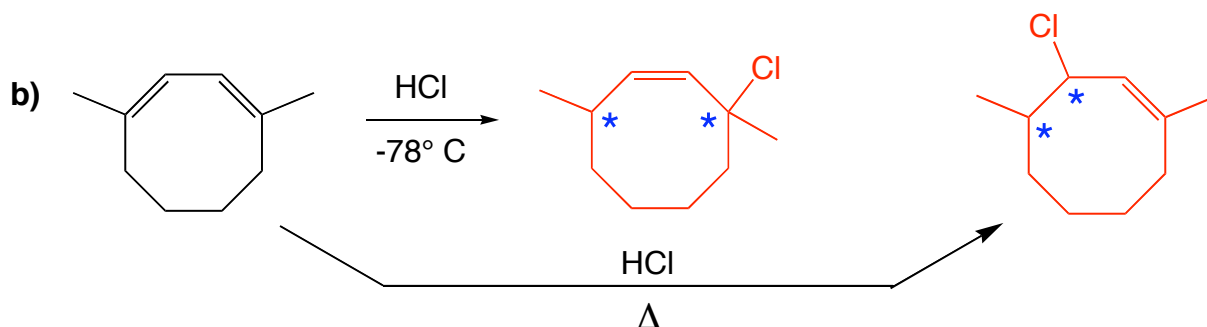
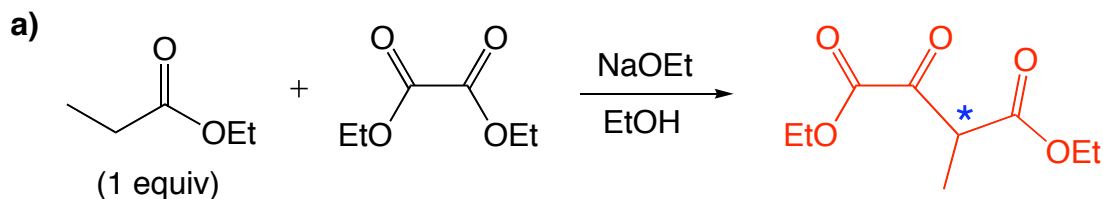
The 4th step of glycolysis (shown in reverse)



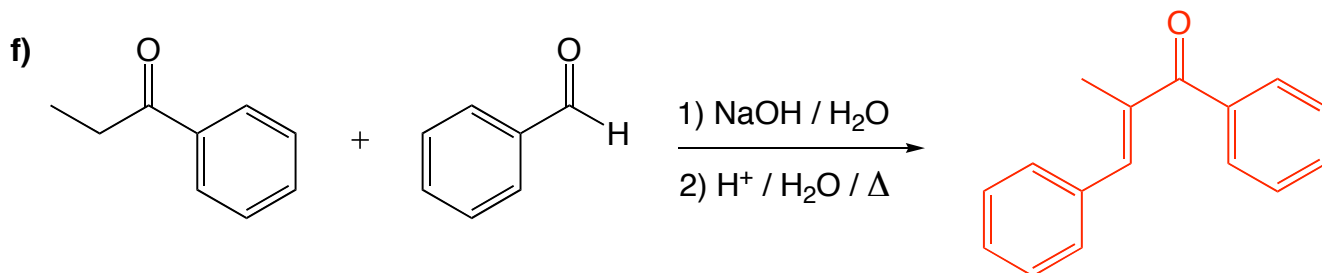
The 4th step of β -oxidation (breakdown of fatty acids...shown in reverse)



5. Provide the major product of the following reactions (circle your answer). You may indicate new stereocenters formed with a "*" rather than drawing all the possible stereoisomers. (36 points)



Two main products are possible.
You need only draw one of them



6. Provide syntheses for the following transformations. For full credit, be sure to draw all intermediary products along the way. (24 points) **Note: these are but one possible set of answers.**

