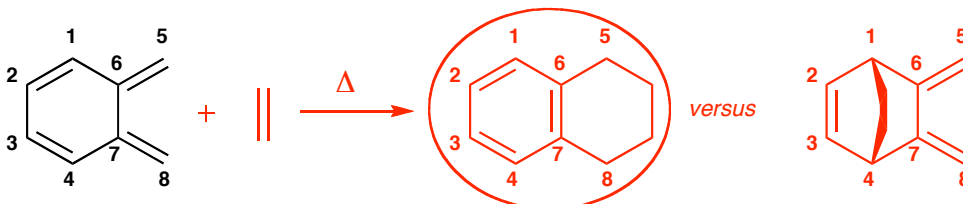


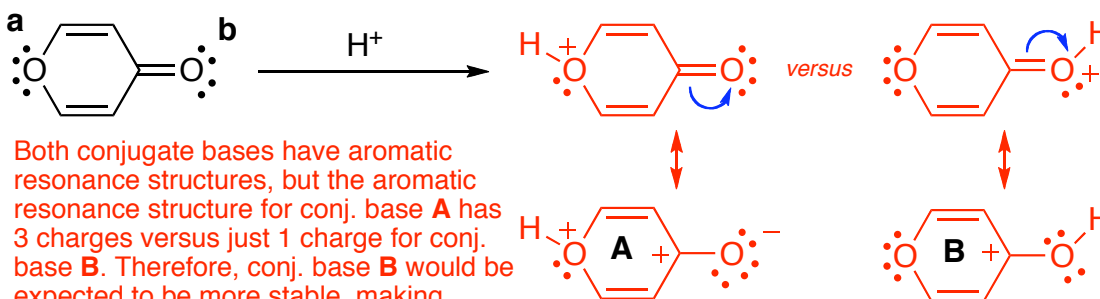
1. Use *both* text and structural illustrations to solve the problems below. (14 points)

- A. The compound shown has two sets of dienes, a diene at C<sub>1</sub>-C<sub>2</sub>-C<sub>3</sub>-C<sub>4</sub> and a diene at C<sub>5</sub>-C<sub>6</sub>-C<sub>7</sub>-C<sub>8</sub>. Therefore, two products are possible in Diels-Alder reactions with this compound. Show the two products that would form using ethylene (CH<sub>2</sub>=CH<sub>2</sub>) as the dienophile, indicate which is favored, and provide a rationale for your decision. Assume that enough heat is used to overcome any activation barrier.



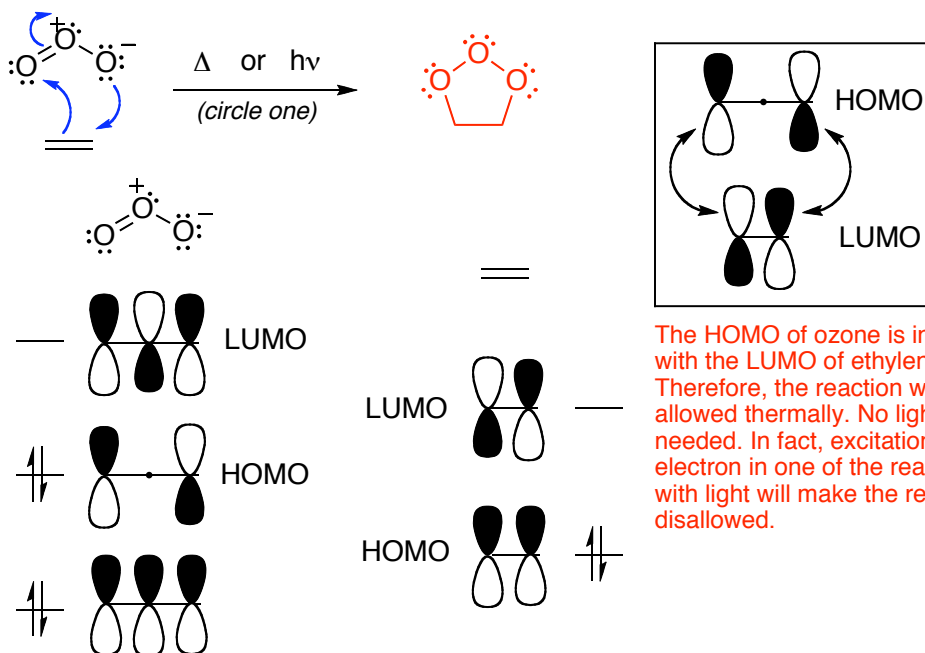
The C<sub>1</sub>-C<sub>4</sub> diene reacts to give an aromatic benzene ring while the C<sub>5</sub>-C<sub>8</sub> diene does not form an aromatic ring. The extra stability afforded by aromaticity favors the C<sub>1</sub>-C<sub>4</sub> diene product.

- B. Indicate whether O<sub>a</sub> or O<sub>b</sub> is more basic in the compound shown and provide a rationale for your decision. *Note: at the very least, draw both conjugate bases.*



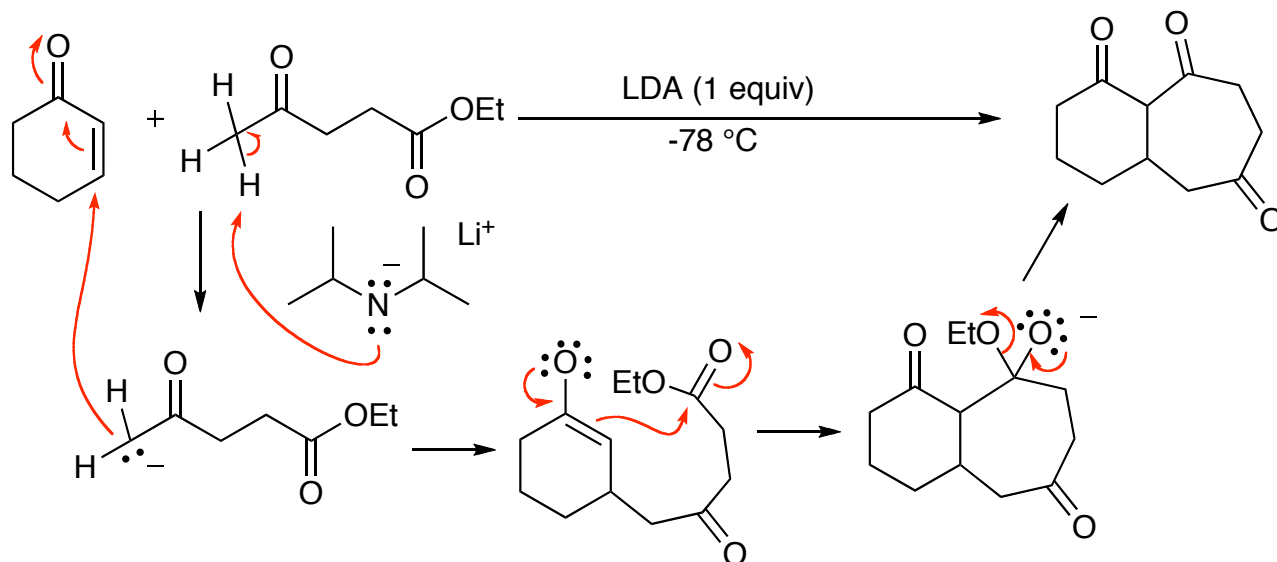
Both conjugate bases have aromatic resonance structures, but the aromatic resonance structure for conj. base **A** has 3 charges versus just 1 charge for conj. base **B**. Therefore, conj. base **B** would be expected to be more stable, making oxygen-**b** more basic in this compound.

2. Use MO theory to predict whether the cycloaddition reaction of ethylene and ozone is allowed using heat *or* light. Draw all the  $\pi$  MOs and provide a structure for the product. (10 pts)

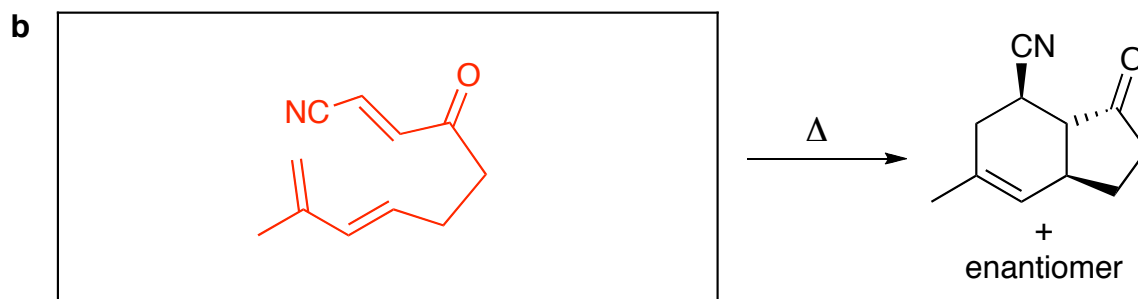
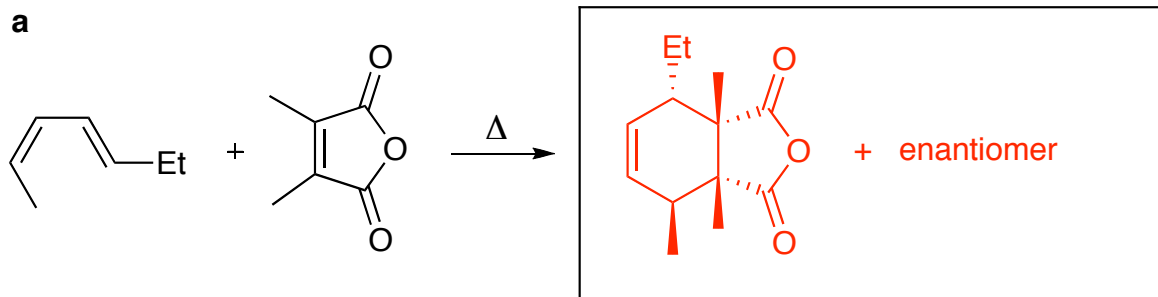


The HOMO of ozone is in phase with the LUMO of ethylene. Therefore, the reaction will be allowed thermally. No light is needed. In fact, excitation of an electron in one of the reactants with light will make the reaction disallowed.

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)



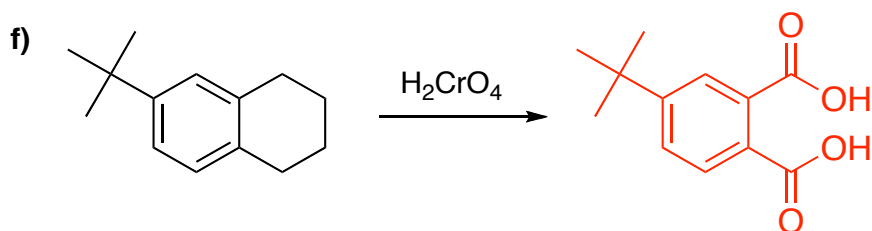
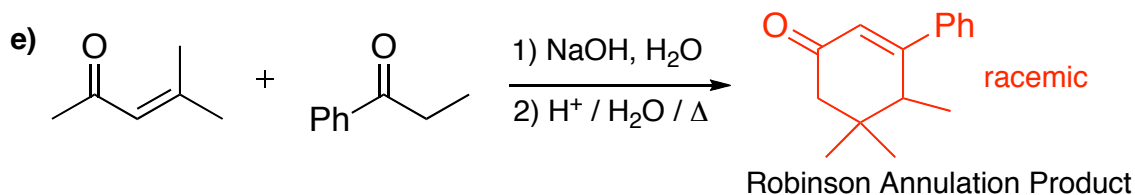
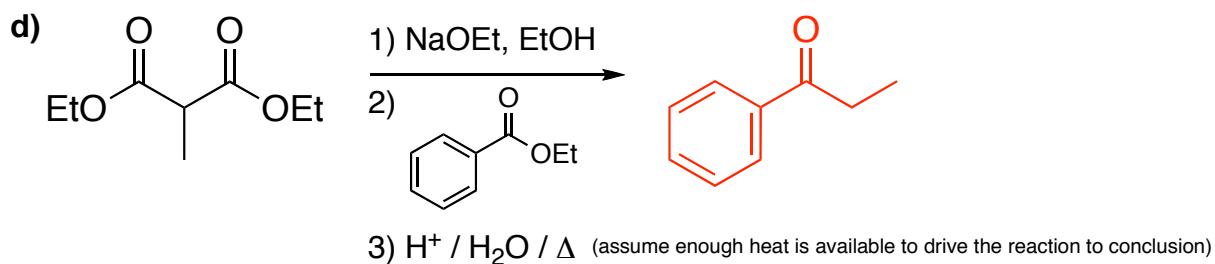
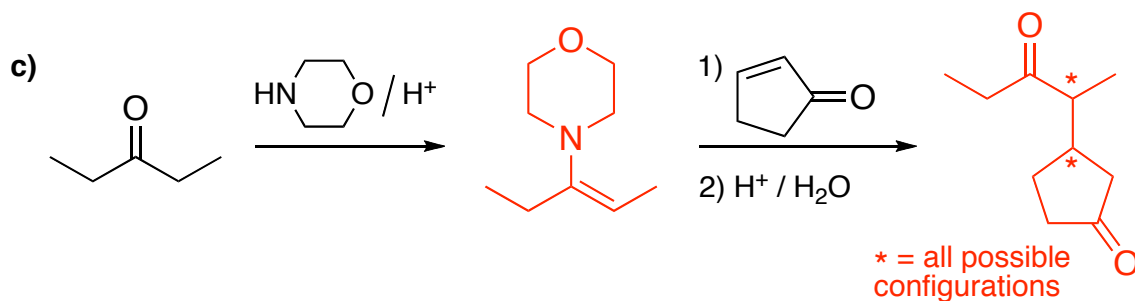
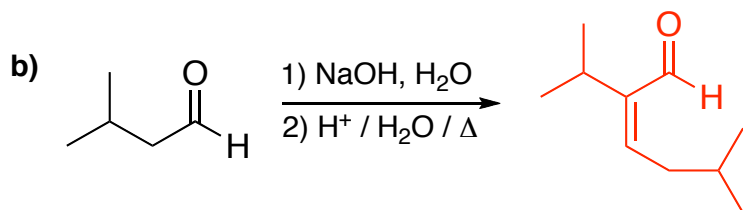
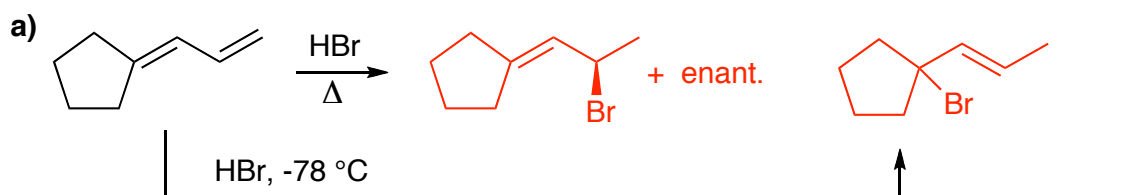
4. Complete the following Diels-Alder reactions by filling in the boxes. (8 points)



5. Explain how one could use UV-vis spectroscopy to monitor the progress of a typical Diels-Alder reaction. DO NOT use more than the space provided below. (4 points)

**The Diels-Alder reaction always transforms a diene into a single alkene in the cyclohexene ring, resulting in the loss of conjugation. Since conjugated compounds absorb higher wavelengths of light than nonconjugated alkenes, one could watch for the disappearance of the absorption peak from the diene.**

6. Provide the major product (circle it) of the following reactions. You may indicate new stereocenters formed in a 50:50 ratio with a "\*" rather than drawing all the possible stereoisomers. (30 points)



7. 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.**

