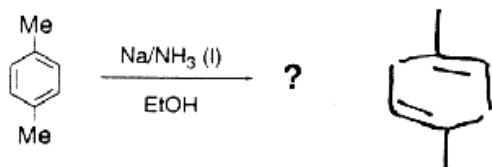
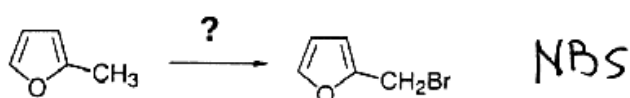


1. (30 points) Provide the missing reagents or products for the following reactions. Carefully show the stereochemistry of each product (if relevant) using wedges and dashes.

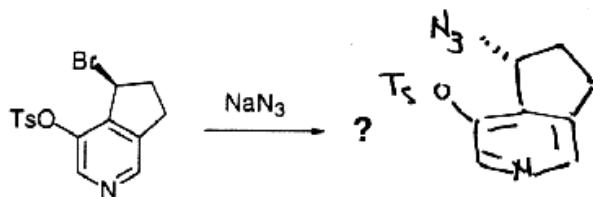
a.



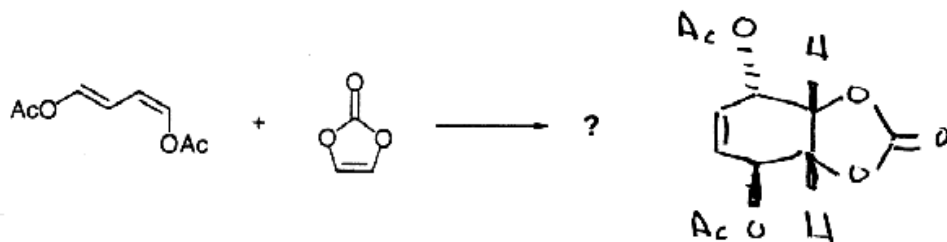
b.



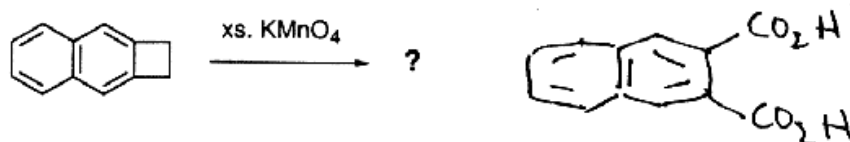
c.



d.

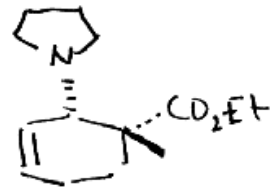
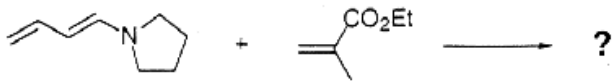


e.

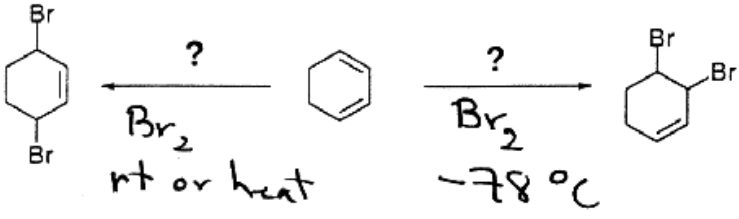


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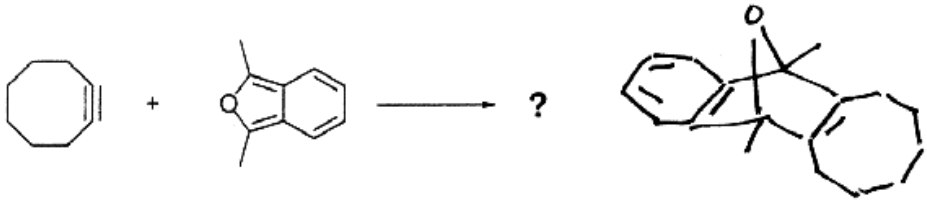
f.



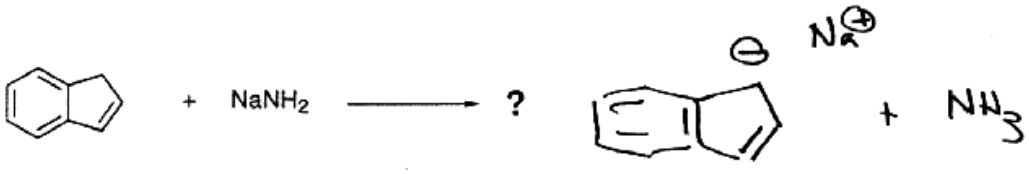
g.



h.

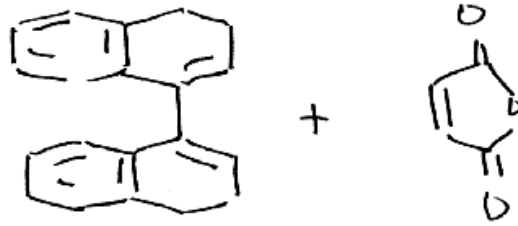
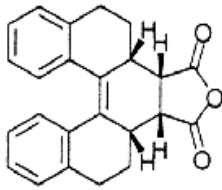


i.

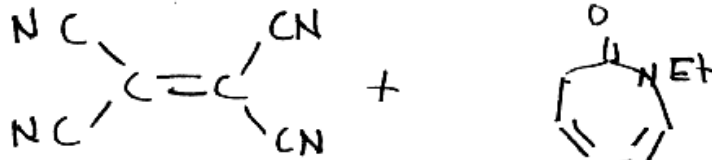
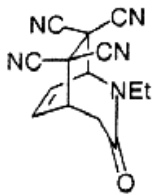


2. (15 points) Draw the diene and dienophile that would react to generate the products provided below.

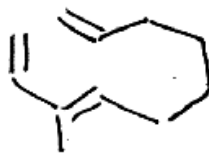
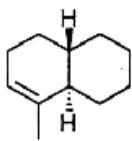
A.



B.

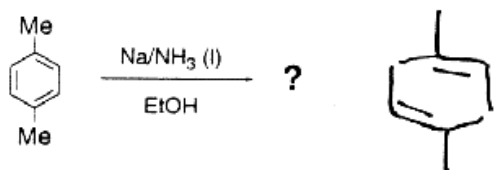


C.

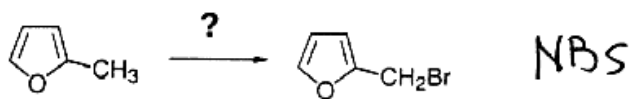


1. (30 points) Provide the missing reagents or products for the following reactions. Carefully show the stereochemistry of each product (if relevant) using wedges and dashes.

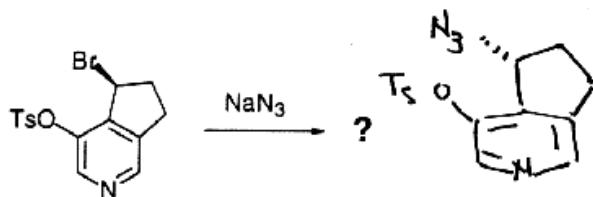
a.



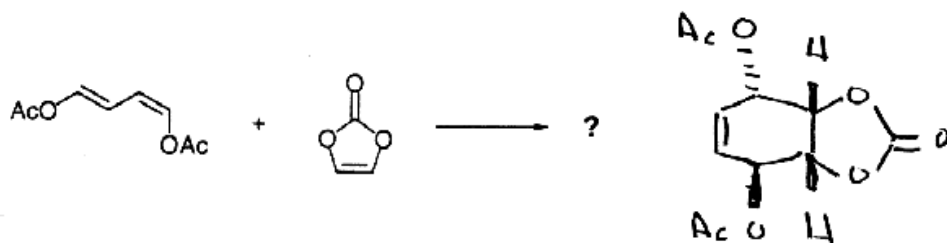
b.



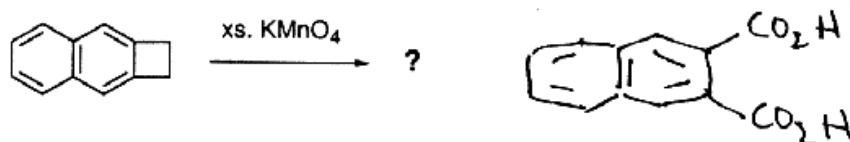
c.



d.

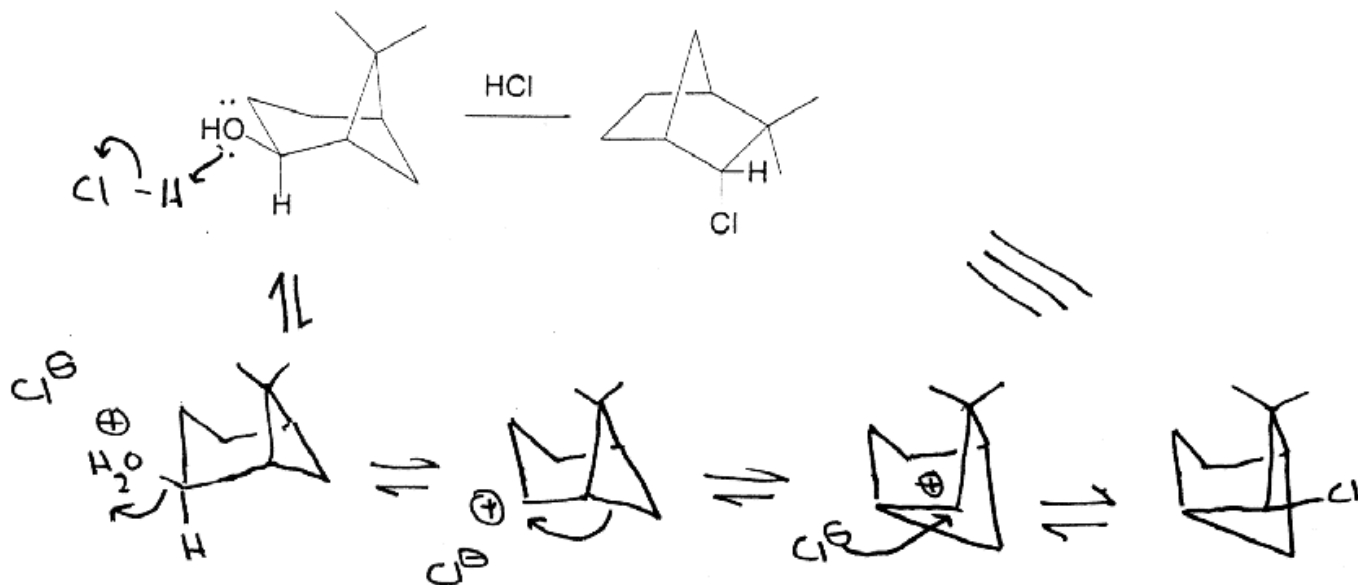


e.

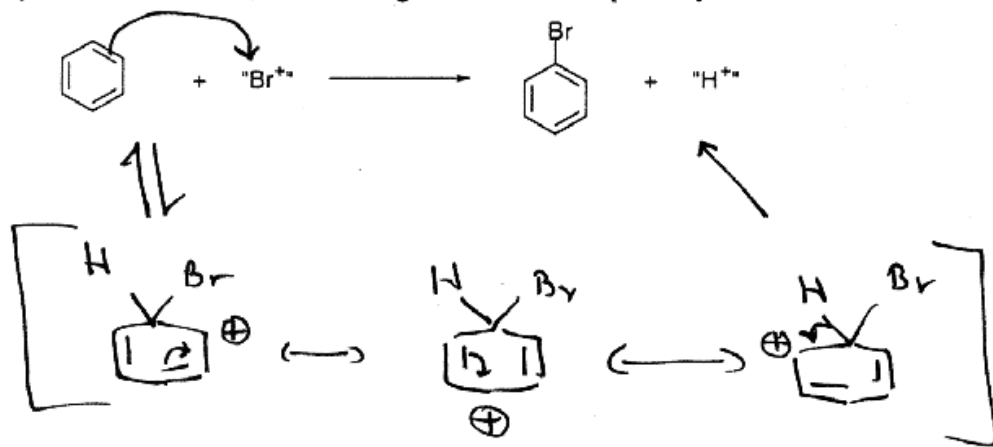


3. (20 points) Using the arrow formalism, write out a detailed, stepwise mechanism for the following transformations.

A.



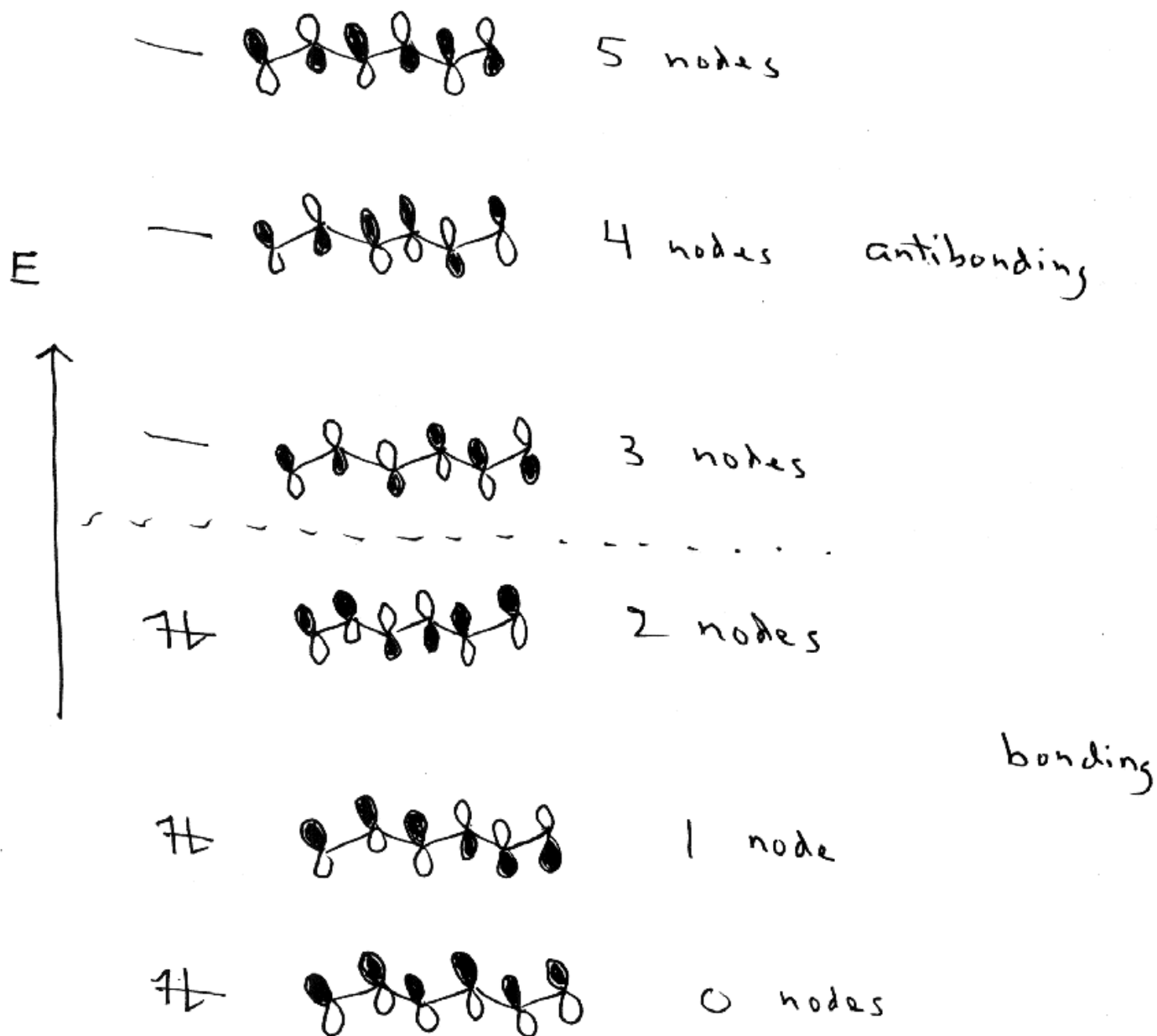
B. In addition to writing the mechanism for the following reaction, draw resonance structures for the key intermediate encountered along the mechanistic pathway.



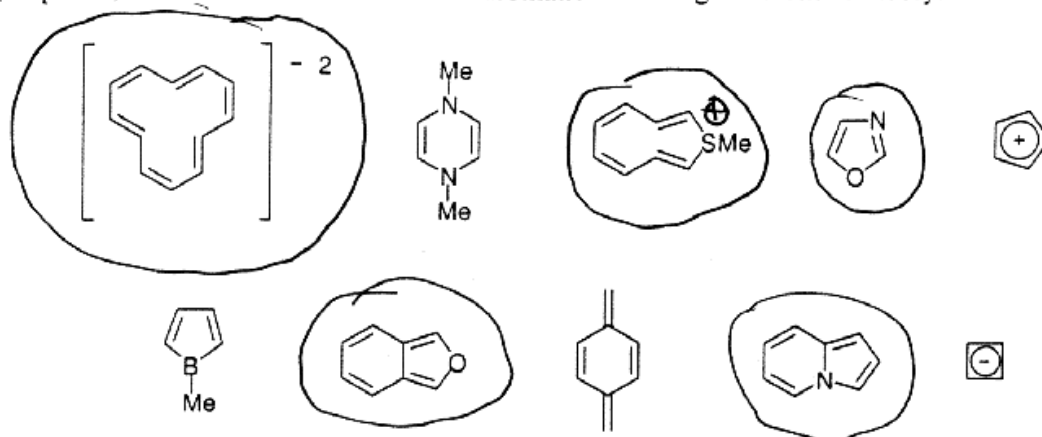
4. (25 points) Draw the  $\pi$  molecular orbitals for the 1,3,5-hexatriene system and arrange them in order of increasing energy. Indicate how many nodes are associated with each molecular orbital. Label the molecular orbitals as bonding, nonbonding, or antibonding as appropriate for their energy levels. Finally, on this diagram show the electron distribution for 1,3,5-hexatriene.



1,3,5-hexatriene

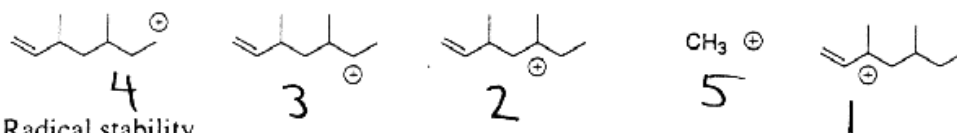


5. (20 points) Circle the molecules that are aromatic according to Hückel's theory.

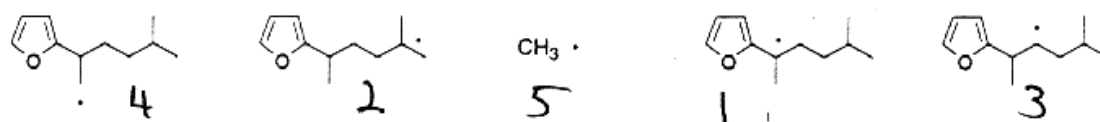


6. (30 points) Rank the following [1→5, 1 = greatest or most] according to the indicated criteria.

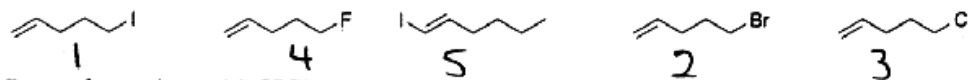
a. Cation stability



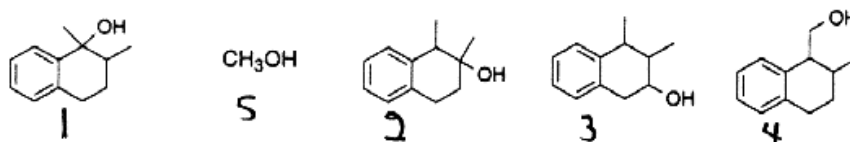
b. Radical stability



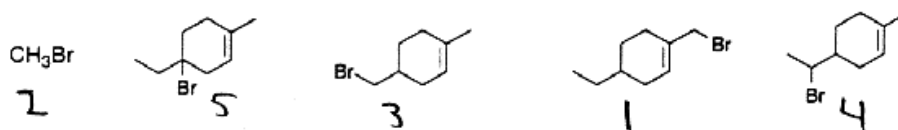
c. Rate of reaction with NaCN



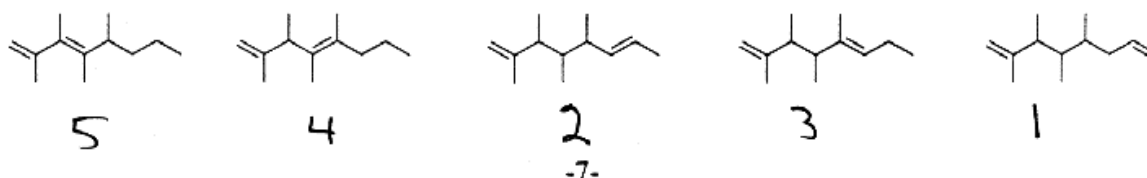
d. Rate of reaction with HCl



e. Rate of reaction with  $\text{NaN}_3$ .

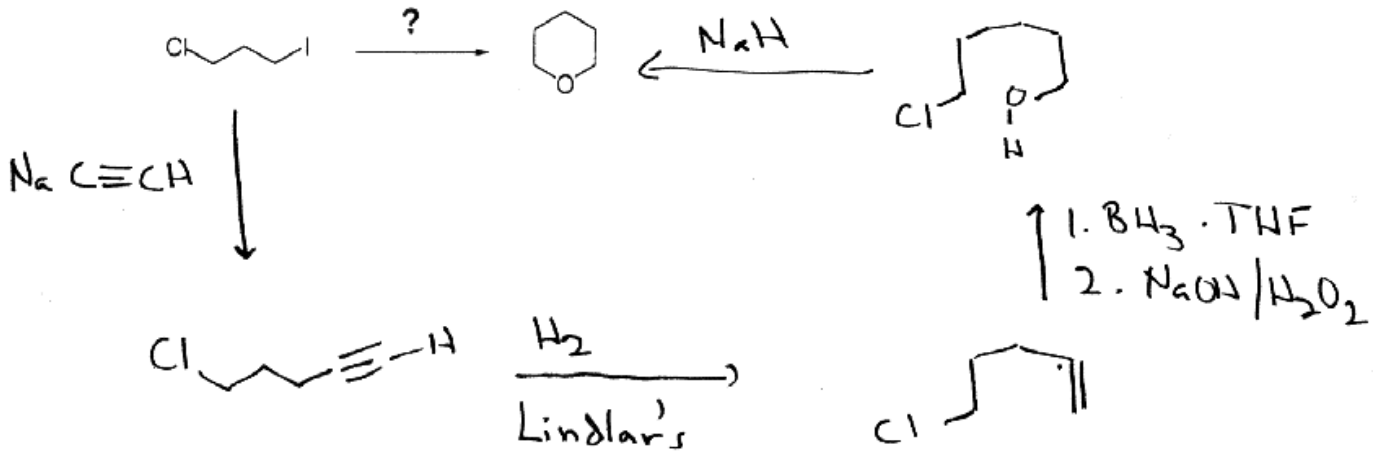


f. Heat of combustion.

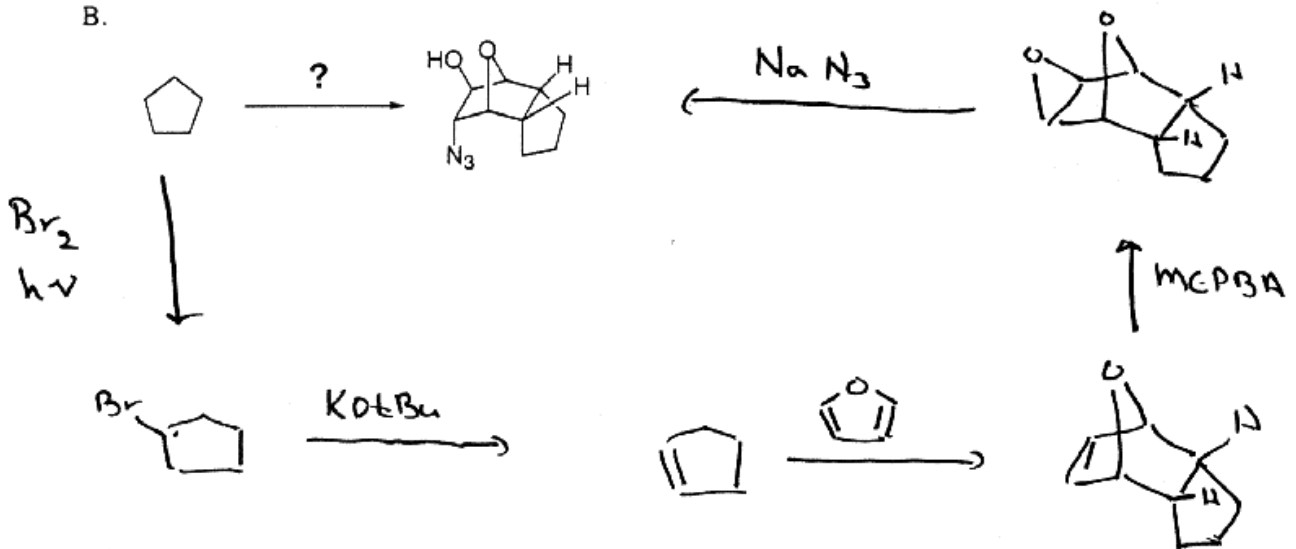


7. (30 points) Propose a synthesis of the target compounds starting with the substrate provided and any other chemical reagents. Several steps are required in each case. You do not have to show mechanisms for each of the individual steps, but do show the products formed from each of the reactions you perform.

A.

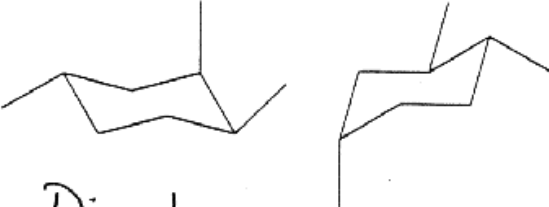
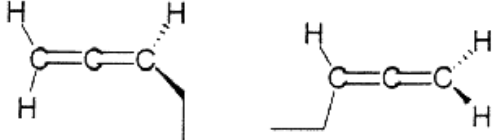
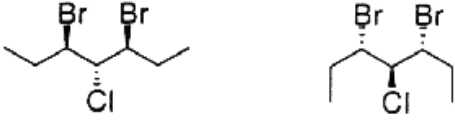
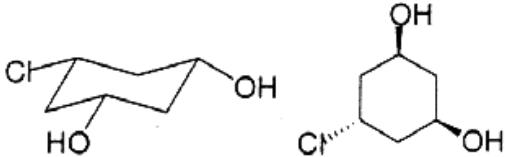
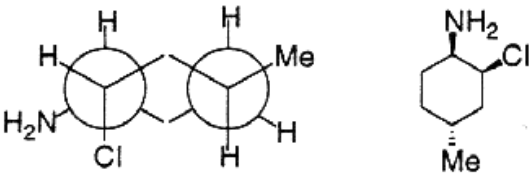
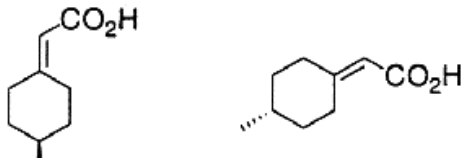


B.





8. (30 points) Label each of the following pairs of structures as the same, isolable enantiomers, diastereomers, or structural isomers, and indicate whether each compound is chiral or achiral using the check boxes.

 <p><i>Diastereomers</i></p> <p><input checked="" type="checkbox"/> Chiral      <input checked="" type="checkbox"/> Chiral  <input type="checkbox"/> Achiral      <input type="checkbox"/> Achiral</p>	 <p><i>Same</i></p> <p><input type="checkbox"/> Chiral      <input type="checkbox"/> Chiral  <input checked="" type="checkbox"/> Achiral      <input checked="" type="checkbox"/> Achiral</p>
 <p><i>Same</i></p> <p><input type="checkbox"/> Chiral      <input type="checkbox"/> Chiral  <input checked="" type="checkbox"/> Achiral      <input checked="" type="checkbox"/> Achiral</p>	 <p><i>Diastereomers</i></p> <p><input type="checkbox"/> Chiral      <input type="checkbox"/> Chiral  <input checked="" type="checkbox"/> Achiral      <input checked="" type="checkbox"/> Achiral</p>
 <p><i>Same</i></p> <p><input checked="" type="checkbox"/> Chiral      <input checked="" type="checkbox"/> Chiral  <input type="checkbox"/> Achiral      <input type="checkbox"/> Achiral</p>	 <p><i>Enantiomers</i></p> <p><input checked="" type="checkbox"/> Chiral      <input checked="" type="checkbox"/> Chiral  <input type="checkbox"/> Achiral      <input type="checkbox"/> Achiral</p>