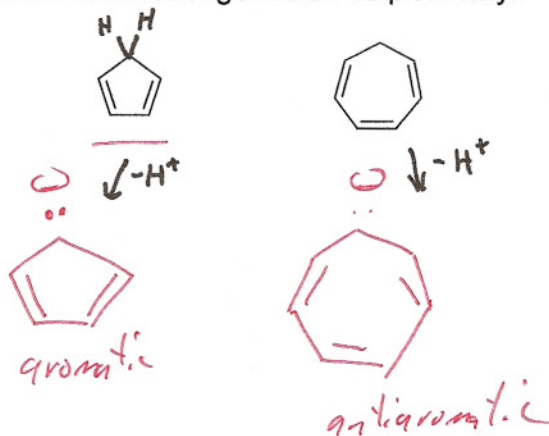
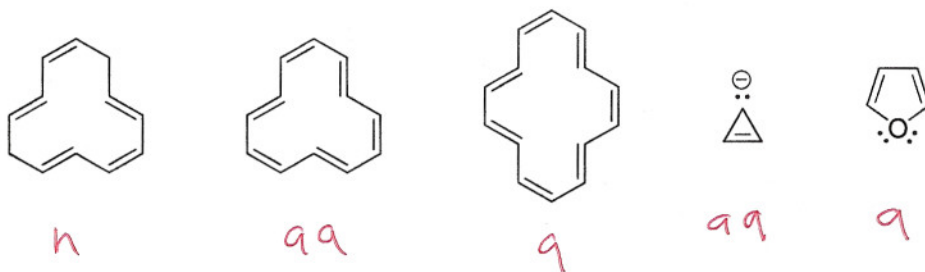


1. Which of the molecules below is the stronger acid? Explain why.



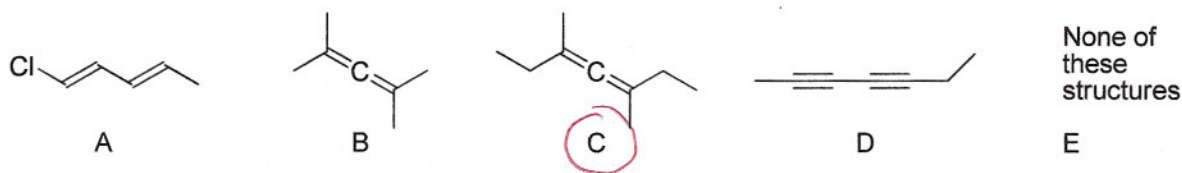
8  
6

2. Label each of the following molecules as being aromatic, antiaromatic, or neither:



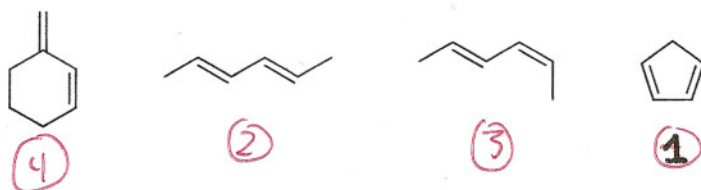
8/10  
10

3. Multiple choice: which molecule below is capable of being chiral? Circle the one correct answer.



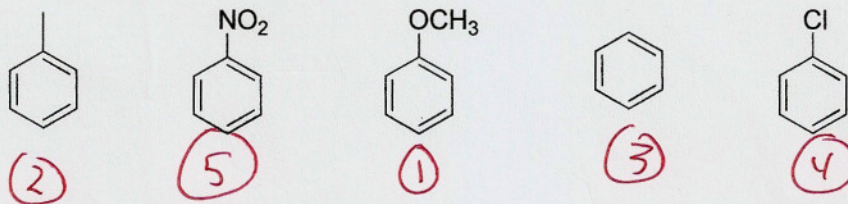
4  
4

4. Number the following dienes in order of Diels-Alder reactivity (1 = most reactive diene, 4 = least reactive):



4  
4

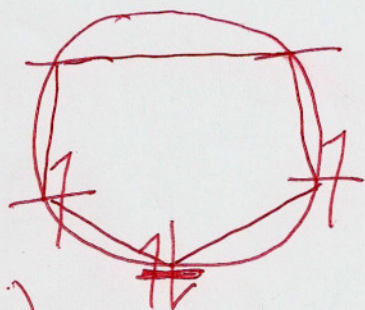
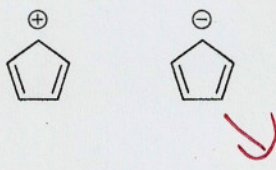
5. Rank the following compounds in order of reactivity to electrophilic aromatic substitution (1 = most reactive, 5 = least reactive):



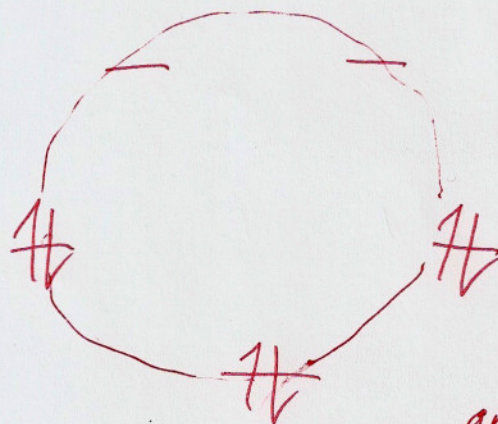
10

10  
8  
3

6. Give Molecular Orbital (MO) diagrams (hint: you can use a Frost circle) for the cyclopentadienyl cation and anion. Using them, show which is aromatic and which is antiaromatic. Also using the MO diagrams, explain why the aromatic electron configuration is more stable than the antiaromatic.



HOMO  
 half-full  
 ("diradical")  
 antiaromatic  
 less stable



HOMO  
 full-  
 aromatic  
 more stable

8

7. Give the major product(s) for the following reactions:

3 each

- If stereo is issue, that's -1/3

- wrong regioselectivity -1

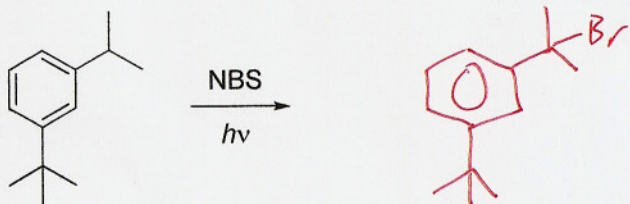
- minor product included with

markovnikov = 1/3 major = 1

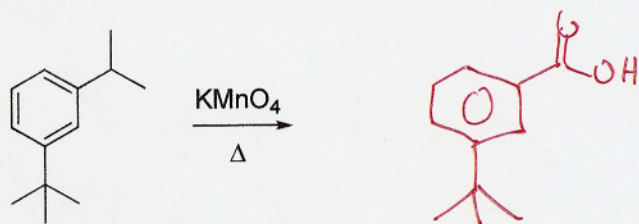
a)



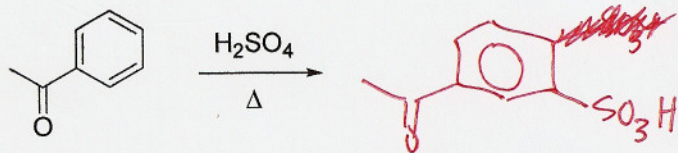
b)



c)



d)

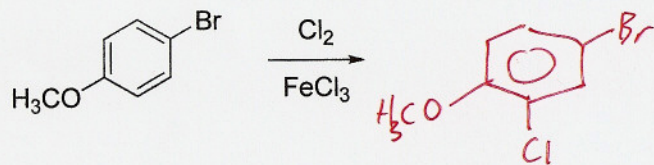


Wrong

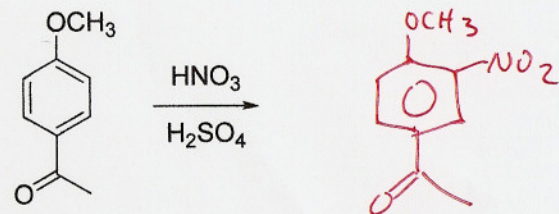
regiochem

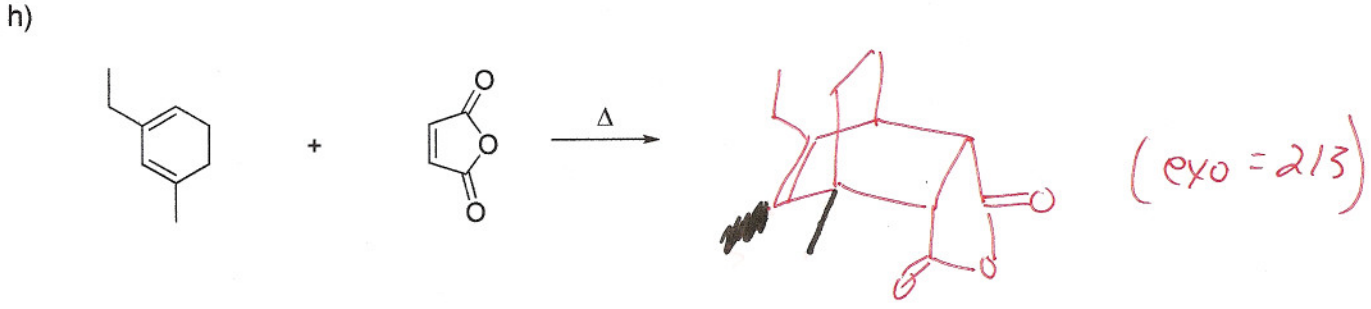
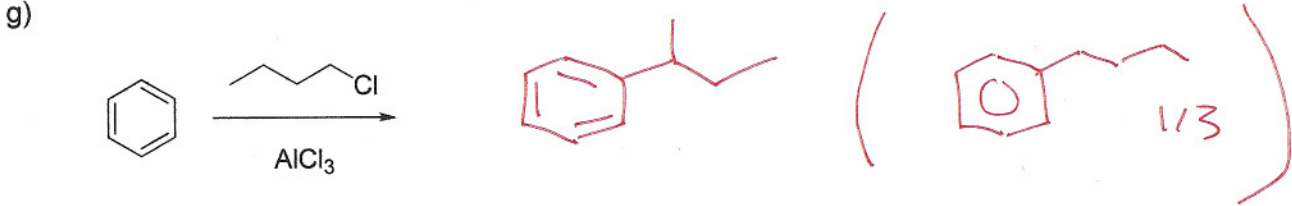
give 2/3

e)

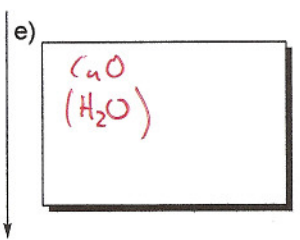
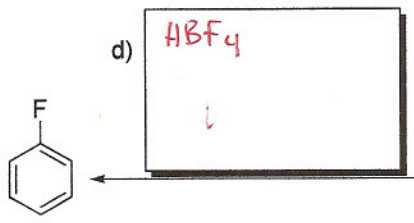
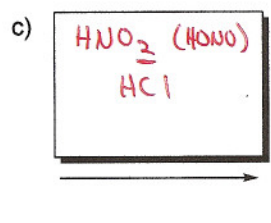
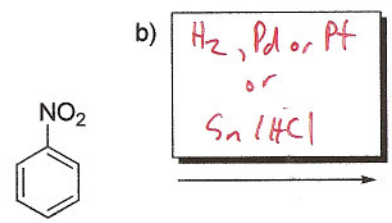
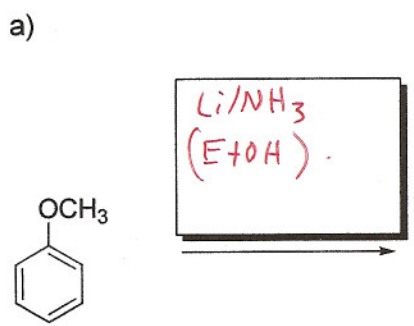


f)



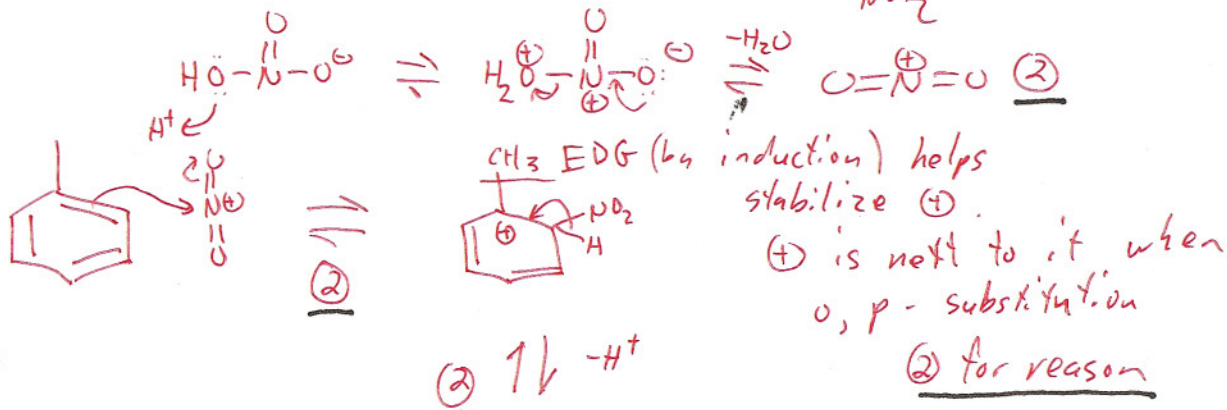
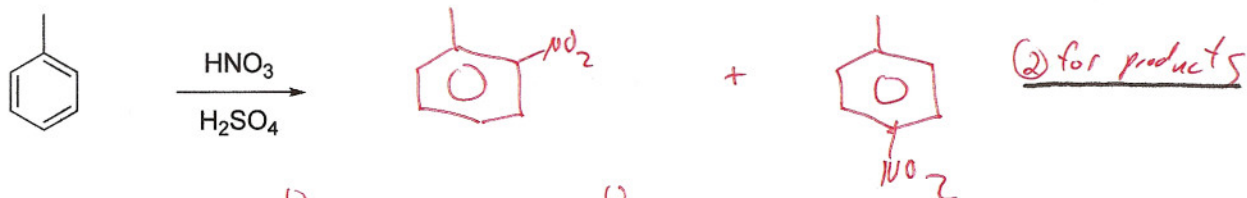


8. Provide reagents for all the following transformations:



15  
+10

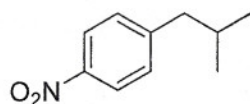
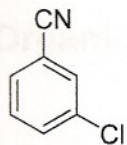
9. Provide the major product or products for the nitration of toluene, as well as a mechanism for the formation for one such product. The mechanism should include the generation of the electrophile as well as the addition of the electrophile to the aromatic ring. Use the mechanism to explain the predicted regioselectivity (*o*-/*p*- or *m*- substitution) for the reaction.



10 total

or similar for *p*-

10. Provide a synthesis for one of the following compounds from benzene. Retrosynthetic analysis may also be provided for partial credit. **If you show work on both, CLEARLY INDICATE WHICH SYNTHESIS YOU WANT GRADED.** Otherwise, the one first worked on will be graded.



10

