



CHE 322 Organic Chemistry II

Exam 1 Form 1

Thursday February 17, 2022

8:15 PM – 9:35 PM

1. Write your nine digit University ID number in the nine boxes provided and then bubble in each of the nine digits.
2. Print your name and sign your answer form using the spaces provided.
3. Questions 1 to 10 are multiple choice questions worth 5 points. Bubble your answers on the answer form. Questions 11-18 are short answer questions with points as indicated. Write out your answers in the indicated place on the answer form.

Effects of Substituents on Electrophilic Aromatic Substitution

Ortho-Para Directors

Strongly Activating

-NH₂ -NHR -NR₂

-OH -O⁻

Moderately Activating

-NHCOCH₃ -NHCOR

-OCH₃ -OR

Weakly Activating

-CH₃ -C₂H₅ -R -C₆H₅

Weakly Deactivating

-F -Cl -Br -I

Meta Directors

Moderately Deactivating

-C≡N

-SO₃H

-CO₂H -CO₂R

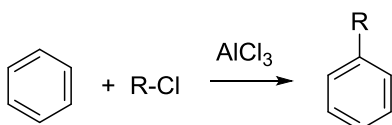
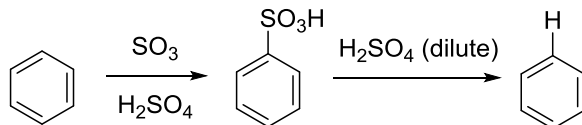
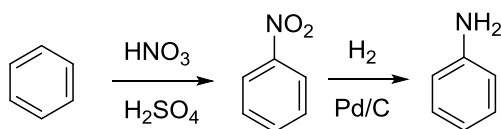
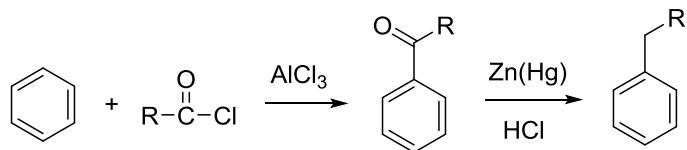
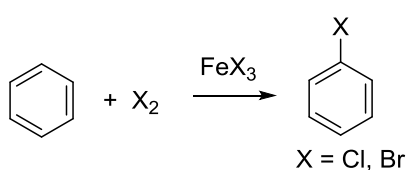
-CHO -COR

Strongly Deactivating

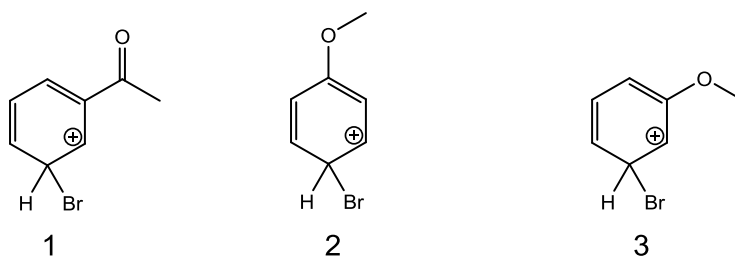
-NO₂

-NH₃⁺ -NR₃⁺

-CF₃ -CCl₃

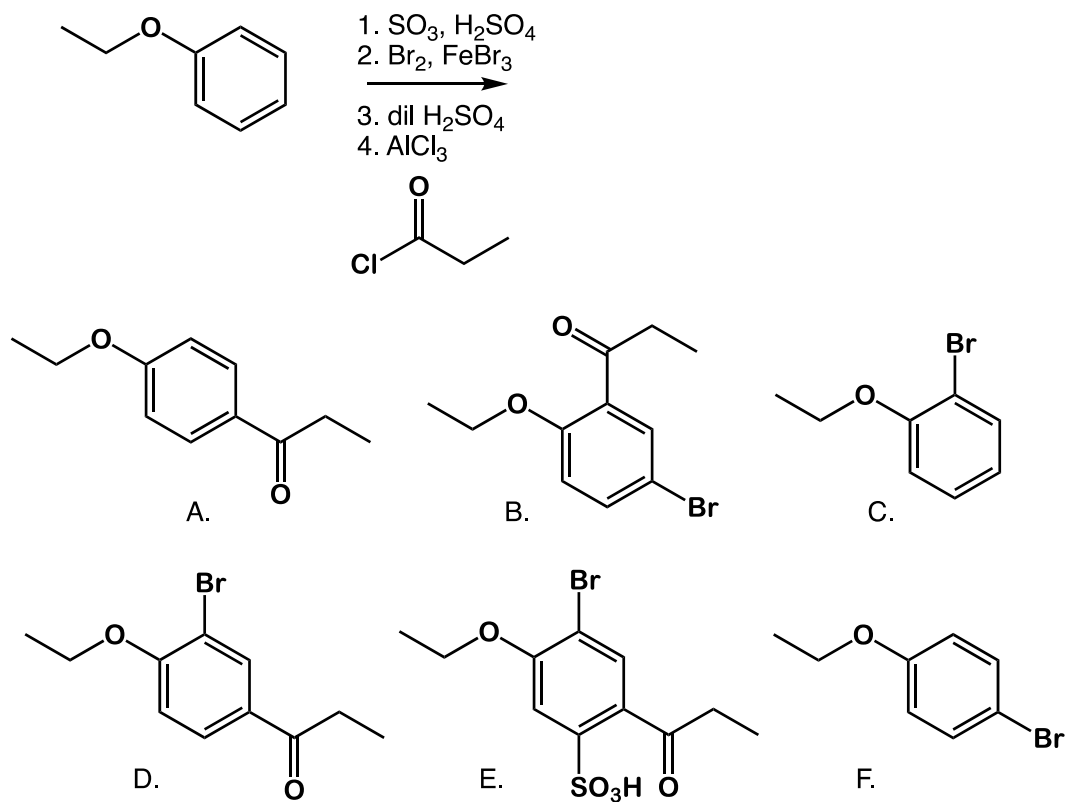


1. Choose the order that has the following pentadienyl cations correctly arranged with respect to increasing stability.

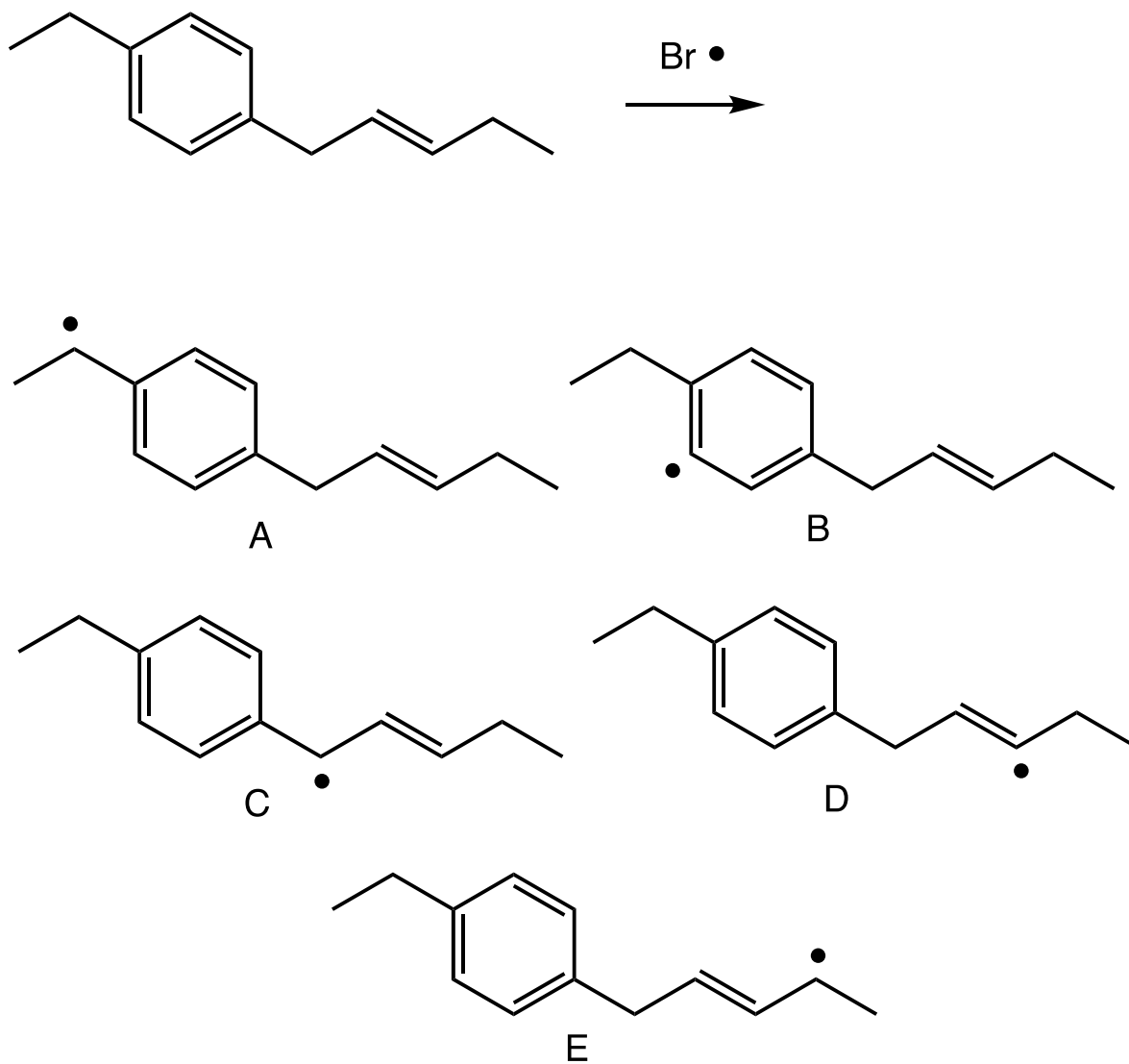


- A $\xrightarrow{\text{increasing stability}}$ 1 2 3 B $\xrightarrow{\text{increasing stability}}$ 1 3 2 C $\xrightarrow{\text{increasing stability}}$ 2 1 3 D $\xrightarrow{\text{increasing stability}}$ 2 3 1 E $\xrightarrow{\text{increasing stability}}$ 3 1 2 F $\xrightarrow{\text{increasing stability}}$ 3 2 1

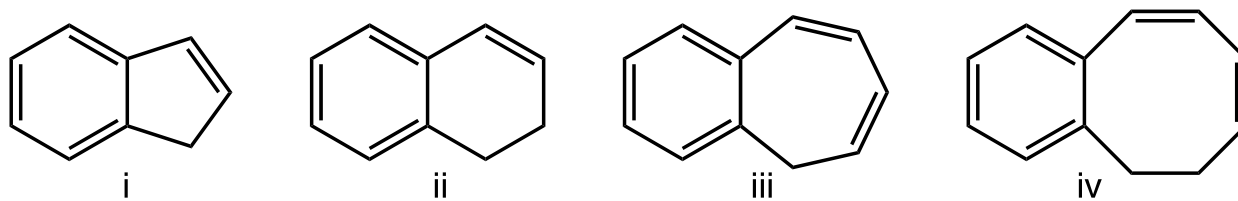
2. Choose the major product of the following reaction sequence.



3. Which is the most stable radical formed in the reaction with bromine radical?

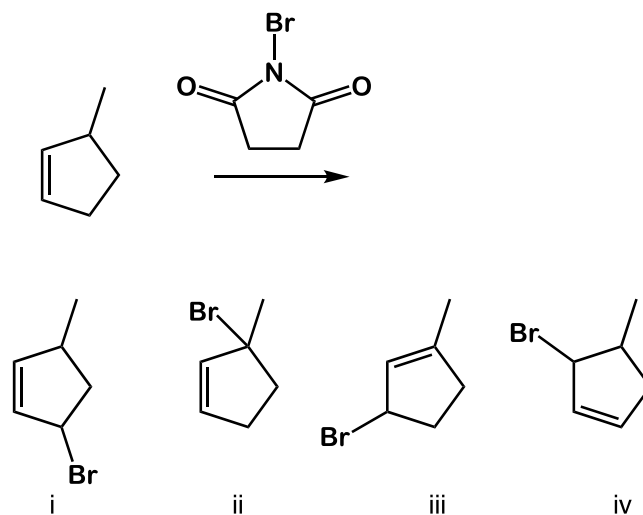


4. Which of the following compounds would you expect become aromatic when deprotonated by a base?



A. i B. ii C. iii D. iv E. i and ii F. ii and iii

5. Which two products would you expect from reaction with NBS?



A. i and ii

B. i and iii

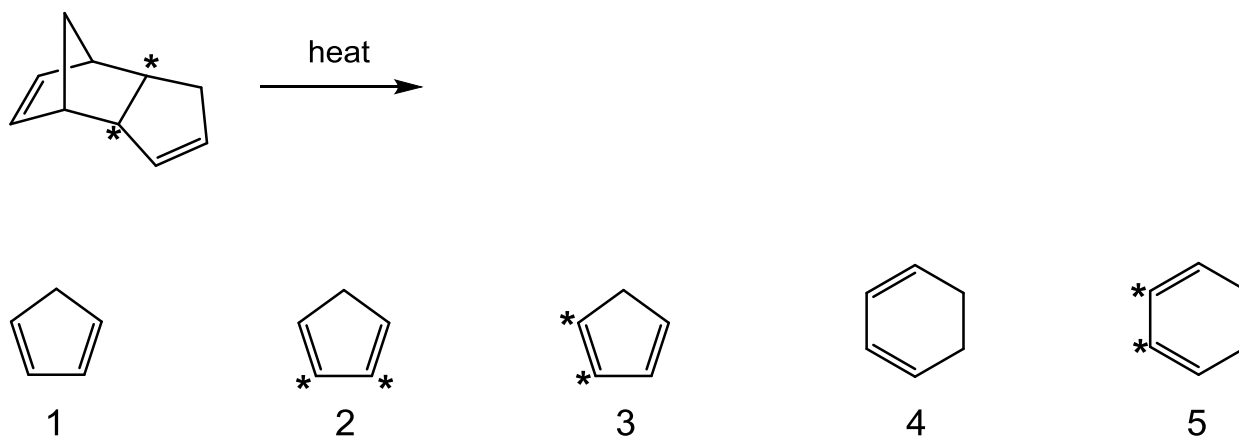
C. i and iv

D. ii and iii

E. ii and iv

F. iii and iv

6. What are the expected products of the following retro Diels-Alder reaction? An asterisk represents a carbon radiolabeled with the C-14 isotope.



A. 1 and 2

B. 1 and 3

C. 1 and 5

D. 2 and 4

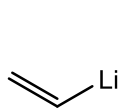
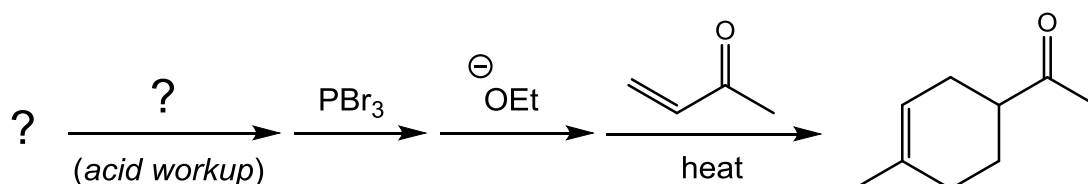
E. 3 and 4

F. 2 and 5

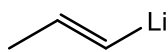
7. Molecular orbital theory can help explain why cyclopropenyl anion is especially unstable. Select the correct statement concerning the π molecular orbital system of cyclopropenyl anion.



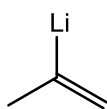
- A. The two highest energy electrons are paired in an antibonding molecular orbital.
 B. All the electrons are paired, but the bonding shell is not filled.
 C. The two highest energy electrons reside in a nonbonding molecular orbital.
 D. All the electrons are paired and completely fill every molecular orbital.
 E. The two highest energy electrons are unpaired, residing in degenerate antibonding molecular orbitals.
 F. The two highest energy electrons are unpaired, residing in degenerate bonding molecular orbitals.
8. Which two reactants would lead to the product shown of the following reaction sequence?



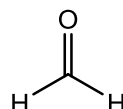
1



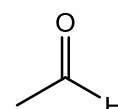
2



3



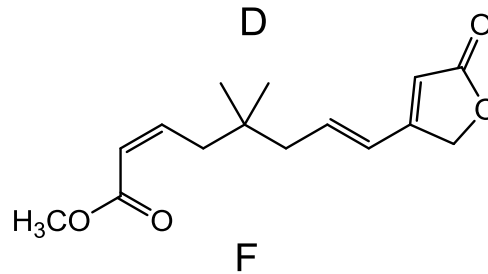
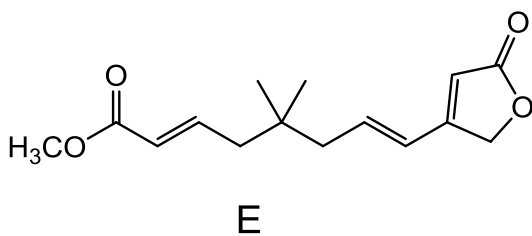
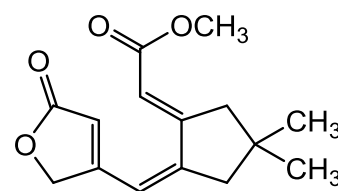
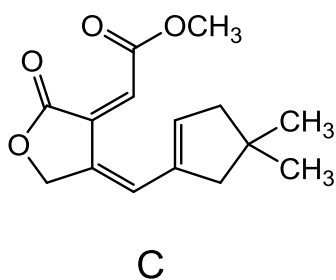
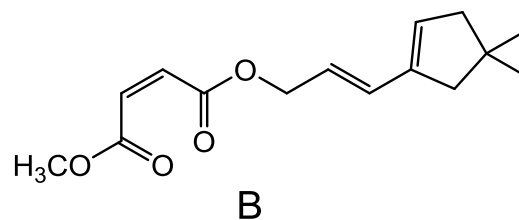
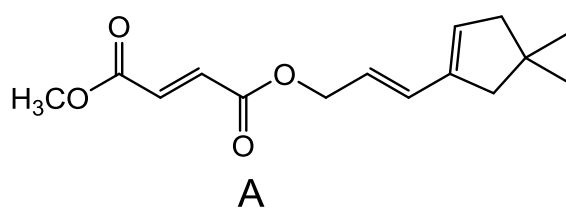
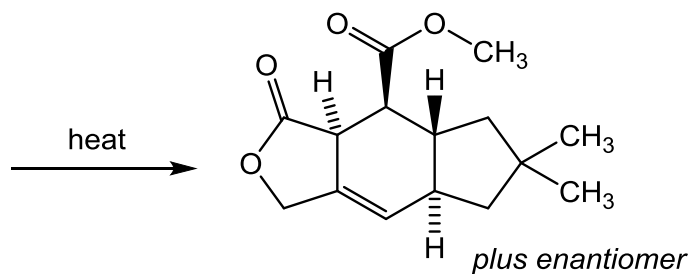
4



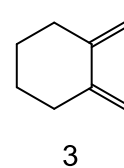
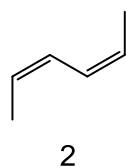
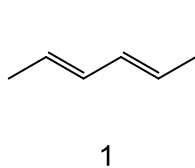
5

- A. 1 and 4 B. 1 and 5 C. 2 and 4 D. 2 and 5 E. 3 and 4 F. 3 and 5

9. Select the starting material that would give the product shown for the following intramolecular Diels-Alder reaction.

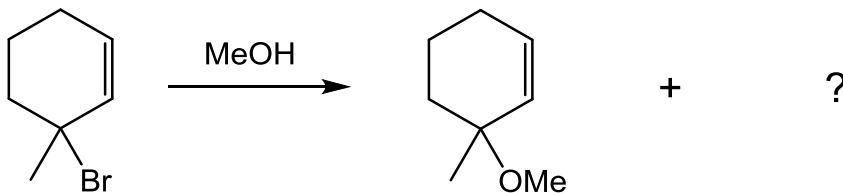


10. Choose the order that has the following dienes correctly arranged with respect to increasing reactivity in a Diels-Alder reaction.

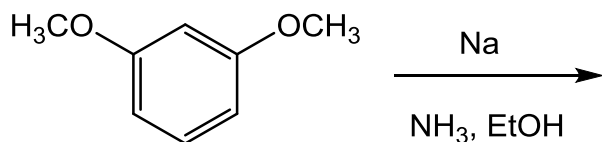


- A $\xrightarrow{\text{increasing reactivity}}$ 1 2 3
- B $\xrightarrow{\text{increasing reactivity}}$ 1 3 2
- C $\xrightarrow{\text{increasing reactivity}}$ 2 1 3
- D $\xrightarrow{\text{increasing reactivity}}$ 2 3 1
- E $\xrightarrow{\text{increasing reactivity}}$ 3 1 2
- F $\xrightarrow{\text{increasing reactivity}}$ 3 2 1

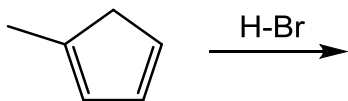
11. The following reaction gives two products. One of them is shown. Draw the other one. (5 points)



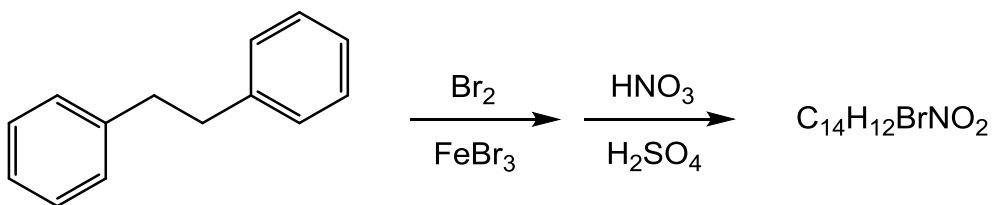
12. Draw the major product of the following reaction. (5 points)



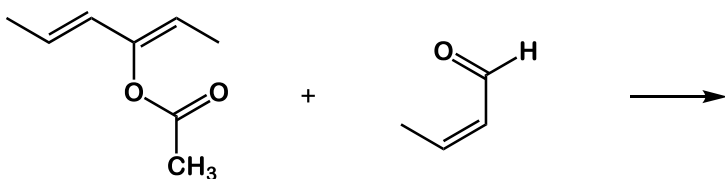
13. The following reaction produces the same single major product at any temperature. Draw that product. (5 points)



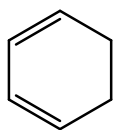
14. Draw the major product of the following reaction sequence. (5 points)



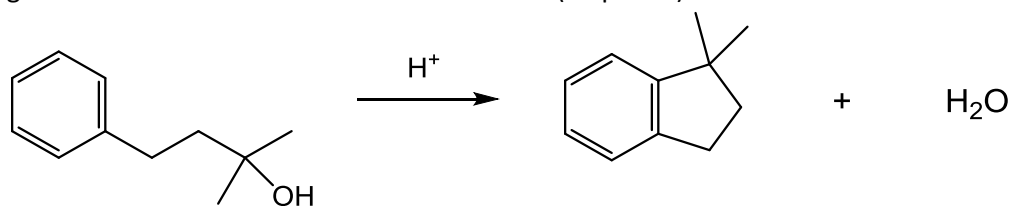
15. Draw the major product of the following Diels-Alder reaction. Use wedged and dashed bonds only where appropriate. The reaction produces a pair of enantiomers. Only draw one enantiomer. (5 points)



16. Draw the highest occupied molecular orbital (HOMO) of the following compound. Do this by adding the appropriate orbitals to the drawing provided on the answer sheet. (5 points)



17. Provide a curved arrow mechanism to illustrate all the bond breaking and bond making steps of the following reaction. Show all intermediate structures. (10 points)



18. Propose a synthesis of the following compound starting from benzene. You may use any reagents with four carbons or less. (10 points)

