

CHE 322 Organic Chemistry II

Exam 1 Form 1

Thursday February 15, 2024

8:30 PM – 9:50 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 11-17 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

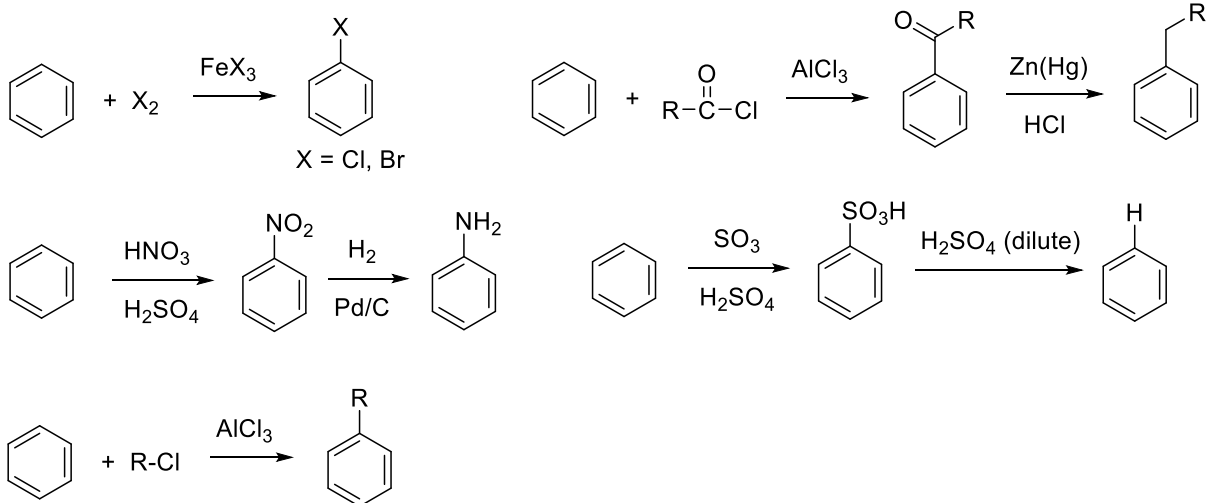
Meta Directors

Moderately Deactivating

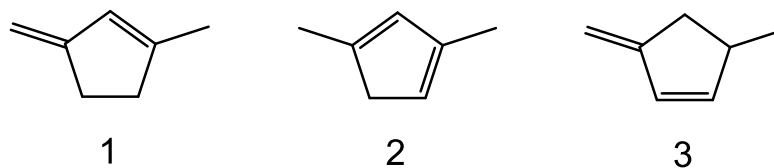
-C≡N
-SO₃H
-CO₂H -CO₂R
-CHO -COR

Strongly Deactivating

-NO₂
-NH₃⁺ -NR₃⁺
-CF₃ -CCl₃

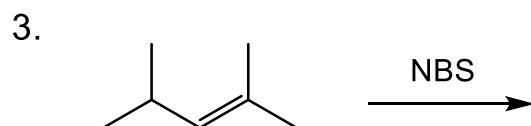
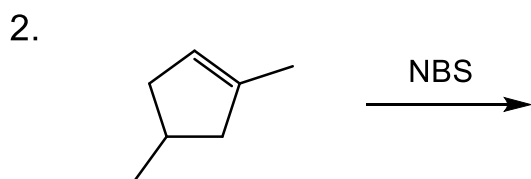
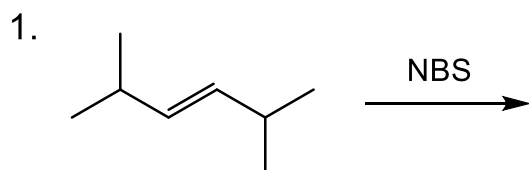


1. Which dienes lead to the same product(s) when treated with HBr?



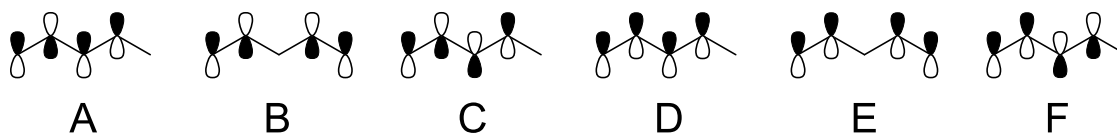
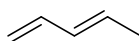
- A. 1 and 2 B. 1 and 3 C. 2 and 3 D. all three lead to the same product(s).
E. Each produces a different product or set of products.

2. Which reaction(s) leads to only one product?

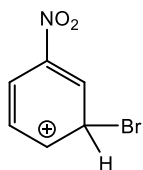


- A. 1 only B. 2 only C. 3 only D. 1 and 2 E. 1 and 3 F. 2 and 3

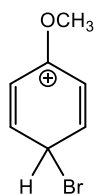
3. Choose the orbital diagram that represents the highest occupied molecular orbital (HOMO) of 1,3-pentadiene.



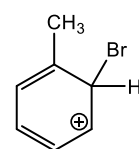
4. Choose the order that has the following pentadienyl cations correctly arranged with respect to increasing stability.



1



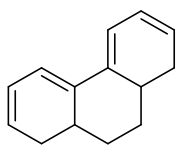
2



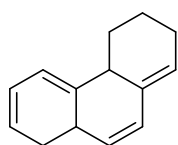
3

- 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

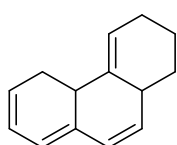
5. Which compound is expected to have the longest wavelength absorption in the UV spectrum?



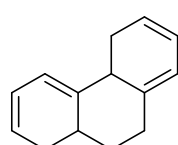
A



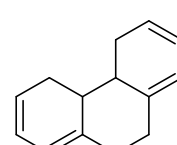
B



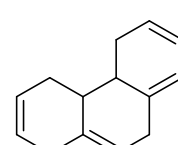
C



D



E

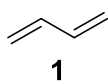


F

6. What are the expected energies of the occupied orbitals of cyclobutadiene based on Hückel theory?

A. $\alpha + \beta$ onlyB. $\alpha + 2\beta$ onlyC. $\alpha + \beta$ and $\alpha - \beta$ D. $\alpha + 2\beta$ and $\alpha + \beta$ E. $\alpha + 2\beta$ and α F. $\alpha + 2\beta$ and $\alpha - 2\beta$

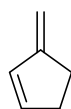
7. Which diene/dienophile combination will react fastest in a Diels-Alder reaction?



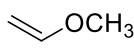
1



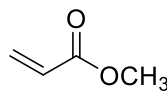
2



3



4



5

A. 1 + 4

B. 1 + 5

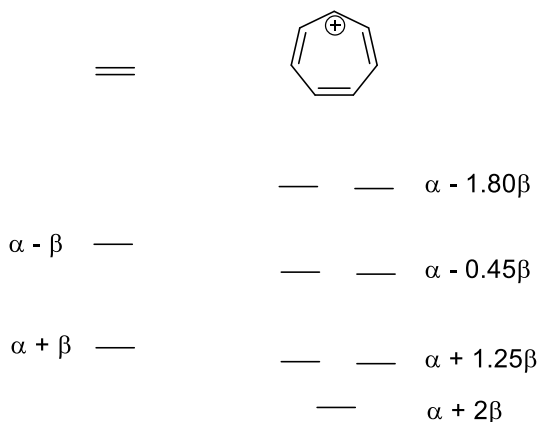
C. 2 + 4

D. 2 + 5

E. 3 + 4

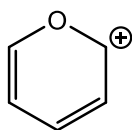
F. 3 + 5

8. Shown are the Hückel π -molecular orbital energies for ethene and the cycloheptatrienyl cation. Determine the delocalization energy for the cycloheptatrienyl cation based on comparison to three ethene molecules. (Orbital energies are rounded so that you should not need or use a calculator.)

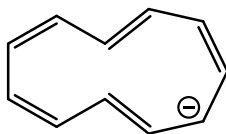


- A. 0.5β B. 1.0β C. 1.25β D. 1.5β E. 2.0β F. 3.0β

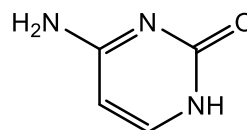
9. Which compound(s) is(are) aromatic?



1



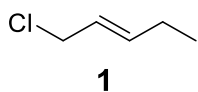
2



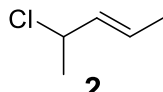
3

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

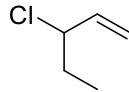
10. Choose the correct statement regarding the three compounds shown.



1



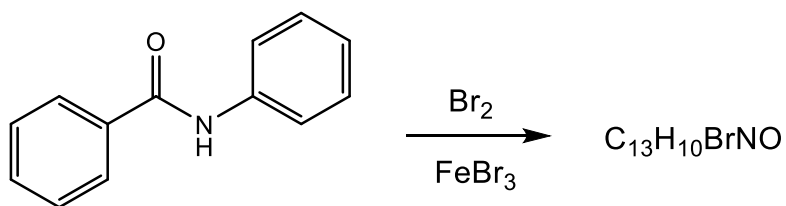
2



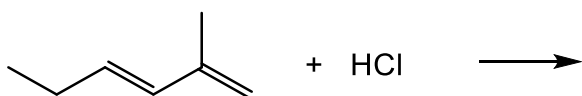
3

- A. **1** will react fastest in an S_N1 reaction and **2** will react fastest in S_N2 .
 B. **1** will react fastest in an S_N1 reaction and **3** will react fastest in S_N2 .
 C. **2** will react fastest in an S_N1 reaction and **1** will react fastest in S_N2 .
 D. **2** will react fastest in an S_N1 reaction and **3** will react fastest in S_N2 .
 E. **3** will react fastest in an S_N1 reaction and **1** will react fastest in S_N2 .
 F. **3** will react fastest in an S_N1 reaction and **2** will react fastest in S_N2 .

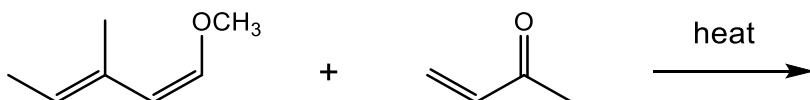
11. Draw the major product of the following reaction. 5 pts



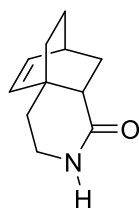
12. Draw the thermodynamic product of the following addition reaction. 5 pts



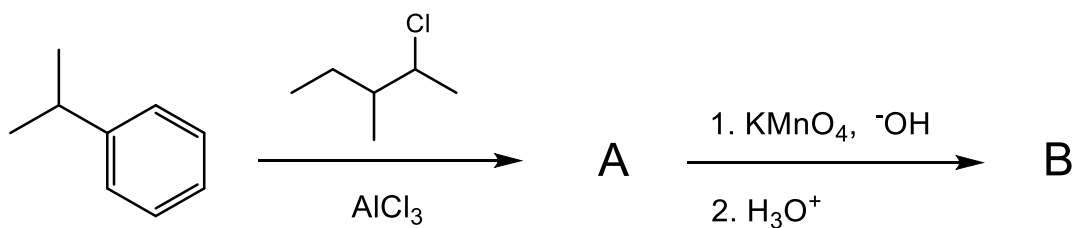
13. Draw the major product of the following Diels-Alder reaction. The reaction will produce a racemic mixture, but you only need to draw one enantiomer. Used wedged and dashed bonds where appropriate. 5 pts



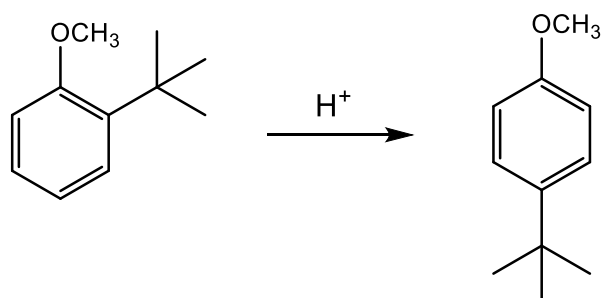
14. Draw the reactant that would give the product shown in an intramolecular Diels-Alder reaction. 5 pts



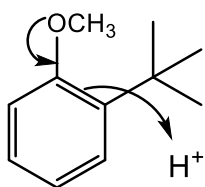
15. Determine and draw the structures of compounds **A** and **B**. 10 pts



16. Provide a curved arrow mechanism to illustrate all the bond breaking and bond making steps of the following reaction. Show all intermediate structures. 10 pts



The first set of arrows is already provided for you below.



17. Propose a synthesis of the following compound starting from benzene. You may use any other reagents that contain four carbon atoms or less. 10 pts

