CHEM 3331 (Richardson) Midterm Exam 1 – Sep. 24, 2024

Your Name: _____

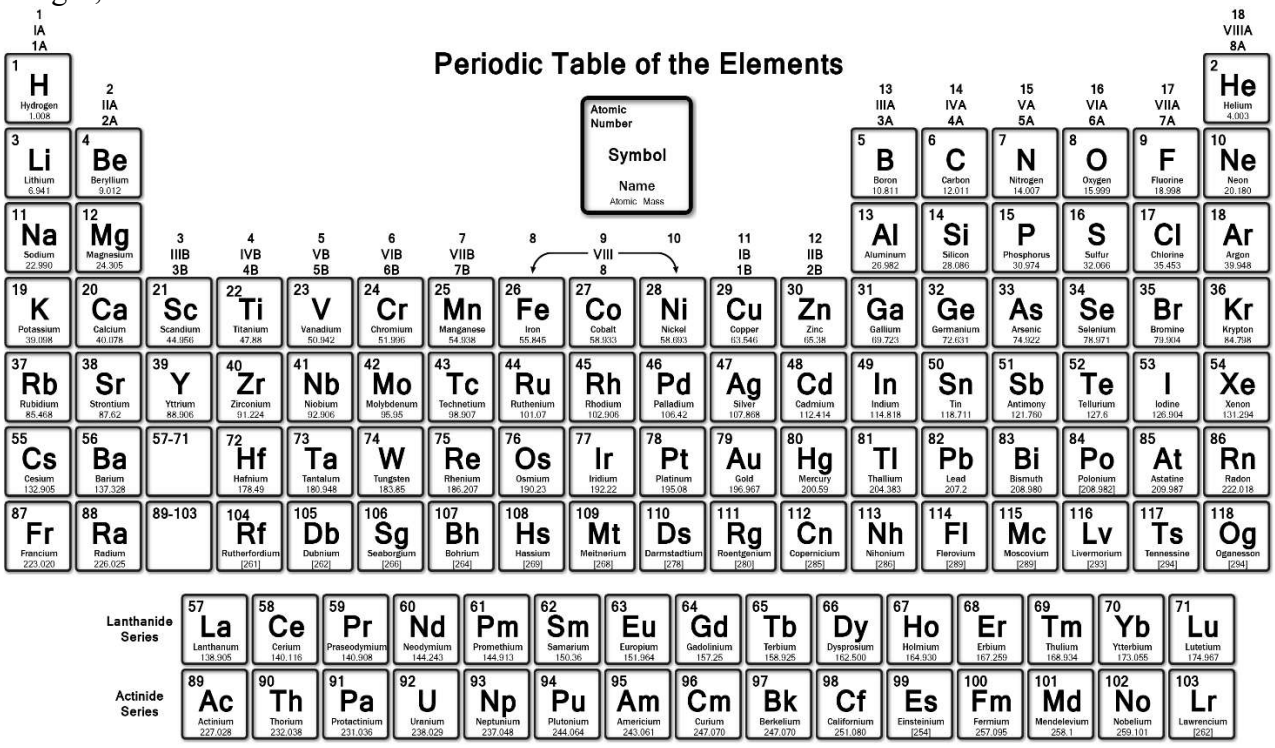
Student ID: _____

Recitation TA (fill in one circle):

O 134 (Phil Pham)
O 135 (Phil Pham)
O 136 (Max Abreu)
O 137 (Max Abreu)
O 141 (Phil Pham)
O 142 (Phil Pham)
O 143 (Zhehao Yuan)
O 144 (Tania Shahvali)
O 147 (Tania Shahvali)

Question	Score	Out of
1		10
2		20
3		15
4		25
5		30
6		10 e.c.
Total		100

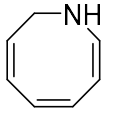
This is a closed-book exam, except for one double-sided sheet of 8.5 x 11" paper. The use of calculators or cell phones will not be allowed during the exam. You may use models sets brought in a clear bag. Use the backs of the pages for scratch work. If your final answer is not clearly specified, you will lose points. For mechanisms, show all intermediates including correct formal charges, but do not show transition states.

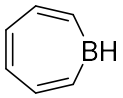


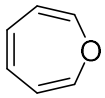
pKa Values

HI	-10	CH_3COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN_3	4.7	RSH	10-12	H_2	35
HCl	-6	H_2S	7.0	H_2O	15.7	NH_3	36
H_3O^+	-1.7	NH_4^+	9.3	ROH	16-18	$H_2C{=}CH_2$	45
HF	3.2	HCN	9.4	O=C-CH	9-25	CH_4	60

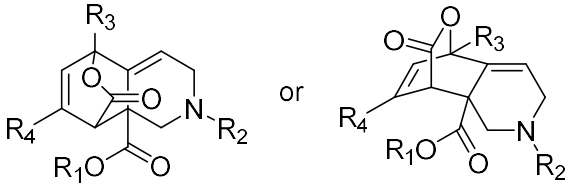
1) Describe each of the structures below as aromatic, nonaromatic, or antiaromatic. Assume each structure is planar. (10 pts)







2) The molecule below is an intermediate in the synthesis of lissodendoric acid A. It was recently synthesized via a Diels-Alder reaction. (20 pts total)



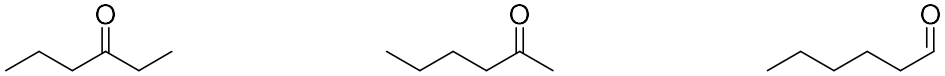
a. On either depiction of the molecule, draw a star inside the ring which was formed by a Diels-Alder reaction. (1 pts).

b. Draw the two disconnect lines (⟜) across the bonds that were formed during this reaction. (4 pts)

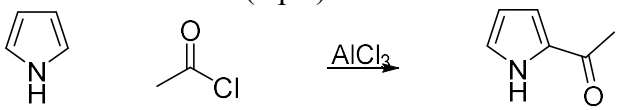
c. Draw the precursor molecules that reacted to form this product. (10 pts)

d. The dienophile precursor above should look pretty unstable to you. In 20 words or less, what is it about this compound that makes it unstable? (Hint: what is the hybridization of each atom, and how well does that work with the existing ring size?) (5 pts)

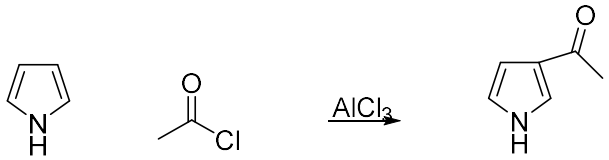
3) Which of the compounds shown below could be synthesized as the only major product from the hydration of an alkyne? Explain why each would or would not work, and give the precursor molecules for the ones that would work. (15 pts)



4) Although we've shown EAS reaction occurring only on benzene derivatives, it's also possible to apply the same logic to other aromatic rings. (25 pts)
   a. Show the mechanism for this reaction, including the formation of the electrophile and all resonance forms for the intermediate. (8 pts)



   b. Show the mechanism for this reaction, including the formation of the electrophile and all resonance forms for the intermediate. (8 pts)

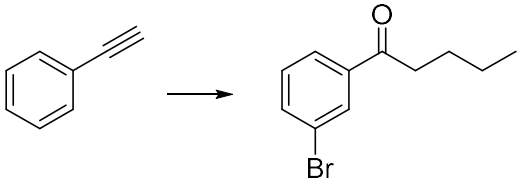


   c. Which of the reactions shown above would be faster, and why? (6 pts)

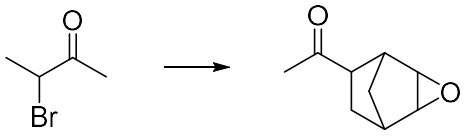
   d. Would the reaction you chose for part (c) be faster or slower than the same reaction occurring on an unsubstituted benzene ring? (3 pts)

5) Find a way to synthesize the desired product from the given starting material plus any other organic molecules needed. If more than one step is necessary, show the product of each step. Do not show mechanisms. (30 pts - 15 pts each)

a.



b.



6) Extra credit! The molecule shown below is named borazole, but its nickname is "inorganic benzene". It's surprisingly unreactive, and doesn't readily act as an electrophile (using the empty orbitals on boron) or as a nucleophile (using the lone pairs on nitrogen). In 20 words or less, explain why it's so stable. (10 pts extra credit)