

CHEM 3331 (Richardson) Midterm Exam 1 – Sep. 20, 2022

Your Name: _____

Student ID: _____

Recitation (fill in one circle):

- 134 (Wed 12:20 w/ Will)
- 135 (Wed 1:25 w/ Will)
- 136 (Wed 2:30 w/ Will)
- 137 (Wed 3:35 w/ Will)
- 142 (Thu 10:10 w/ Ethan)
- 143 (Thu 11:15 w/ Ethan)
- 144 (Thu 12:20 w/ Ethan)
- 147 (Thu 3:35 w/ Hongxuan)

Question	Score	Out of
1		15
2		10
3		30
4		15
5		10
6		20
7		10 e.c.
Total		100

This is a closed-book exam. The use of notes, 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.

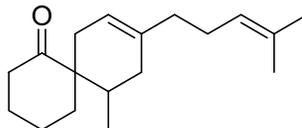
Periodic Table of the Elements

The periodic table shows elements from Hydrogen (1) to Oganesson (118). It includes the Lanthanide series (57-71) and Actinide series (89-103). A legend box indicates: Atomic Number, Symbol, Name, Atomic Mass.

pKa Values

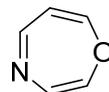
HI	-10	CH ₃ COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN ₃	4.7	RSH	10-12	H ₂	35
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	NH ₃	36
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH	16-18	H ₂ C=CH ₂	45
HF	3.2	HCN	9.4	O=C-CH	9-25	CH ₄	60

- 1) The molecule below was recently synthesized in one step via a Diels-Alder reaction, as a precursor to several *spiro* bicyclic compounds isolated from sea plants. (15 pts total)

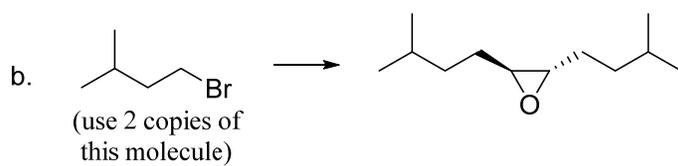
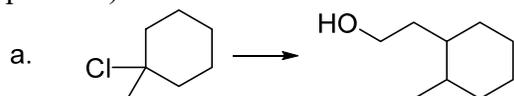


- Draw a star inside the ring which was formed during the Diels-Alder reaction. (3 pts)
- Draw the two disconnect lines ($\text{---}\text{---}$) across the bonds that were formed during this reaction. (2 pts)
- Draw the two molecules that reacted to form this product. (5 pts)
- If they came together with a different orientation, these molecules could have reacted to form another product with slightly different connectivity. Draw this product (you do not need to show stereochemistry). (5 pts)

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



- 3) Find a way to synthesize the desired product from the given starting material. If more than one step is necessary, show the product of each step. Do not show mechanisms. (30 pts - 10 pts each)



4) Most alkyl bromides are water-insoluble liquids. But when 7-bromo-1,3,5-cycloheptatriene was first isolated, its high melting point of 203 °C and its water solubility led its discoverers to comment that it behaves more like a salt. (15 pts total)

a. Draw this structure, based on its name. (2 pts)

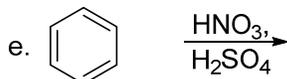
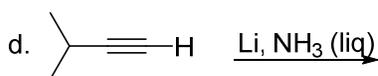
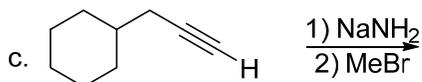
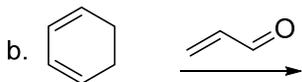
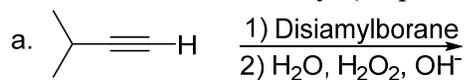
b. Draw the mechanism for bromine detaching from the molecule to create two ions. (3 pts)

c. One of these ions is unusually stable. Explain why in under thirty words. (5 pts)

d. Explain why this molecule behaves like a salt, in under thirty words. (5 pts)

5) Draw out the mechanism for the bromination of benzene with Br₂ and FeBr₃. (10 pts)

6) Predict the major product of the following reactions. If no reaction occurs, then write NR. Do not show stereochemistry. (20 pts; 4 pts each)



7) Extra credit! This reaction forms a molecule with a carbonyl in it. Based on what you know of alkyne and alkene reactions, draw the product of this reaction and the mechanism for how it forms. (10 pts extra credit)

