

# CHEM 3331 (Richardson) Midterm Exam 2 – Oct. 22, 2024

Your Name: Key

Student ID: \_\_\_\_\_

Recitation TA (fill in one circle):

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

Question	Score	Out of
1		30
2		20
3		20
4		30
5		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.

**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

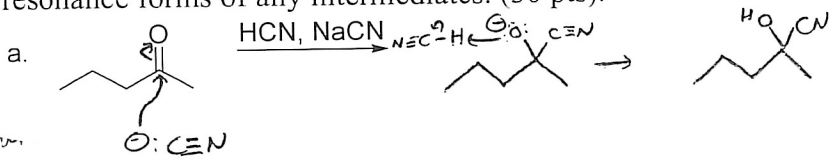
HI	-10	CH <sub>3</sub> COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN <sub>3</sub>	4.7	RSH	10-12	H <sub>2</sub>	35
HCl	-6	H <sub>2</sub> S	7.0	H <sub>2</sub> O	15.7	NH <sub>3</sub>	36
H <sub>3</sub> O <sup>+</sup>	-1.7	NH <sub>4</sub> <sup>+</sup>	9.3	ROH	16-18	H <sub>2</sub> C=CH <sub>2</sub>	45
HF	3.2	HCN	9.4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

Avg: 78.0  
 (no curve)  
 St. Dev: 23.9  
 Max: 110

-1 Arrow starts wrong place -5 ⊖ on N

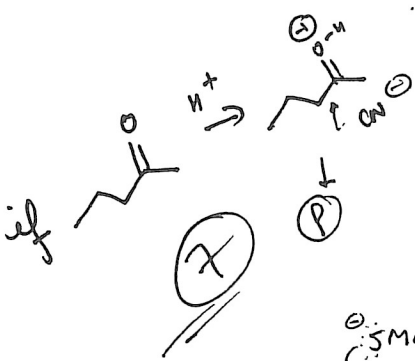
-3 Prot. 1st.

1) Show the products of these reactions and the mechanism for their formation. Show all major resonance forms of any intermediates. (30 pts).



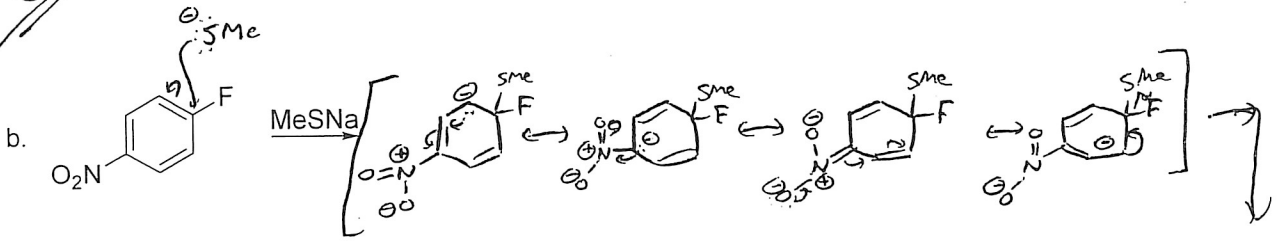
→ 3 if the final product correct

→ no. of top carbons in the right product minus reactants (-2)

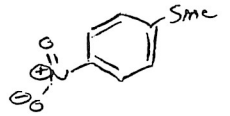


if just H<sup>+</sup> instead of HCN (-2)

→ Right product one carbon missing (-1.5)



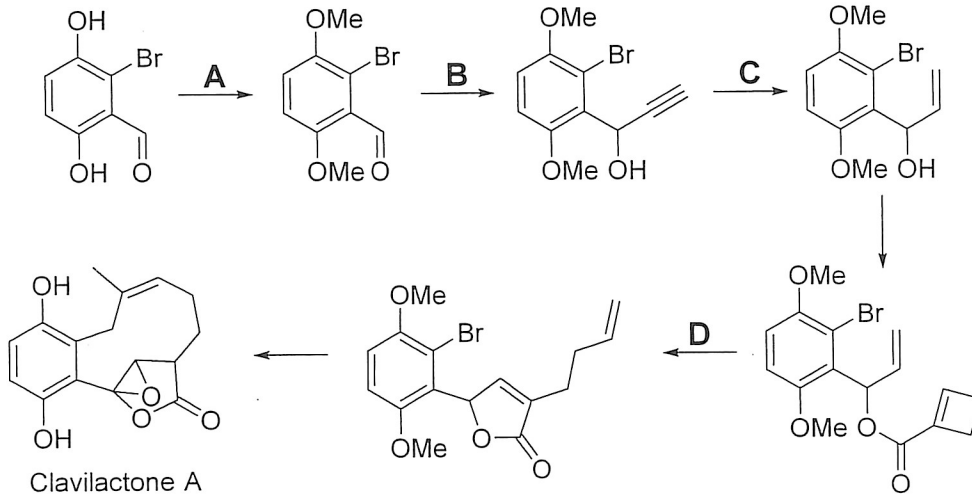
2 per form, 1 for arrows



*[Handwritten signature]*

*[Handwritten mark]*

2) Clavilactone A is a compound with interesting antifungal and antibacterial properties. It was synthesized by the following route. List the reagents that would be needed for each lettered step. (20 pts)



A: (Williamson ether synthesis!)  
 1) NaH, 2) MeBr or MeI, etc.  
 -2 if just Base or other base

B: 1)  $\text{HC}\equiv\text{C}^- \text{Na}^+$ , 2)  $\text{H}_3\text{O}^+$

5 each

C:  $\text{H}_2$  & Lindlar

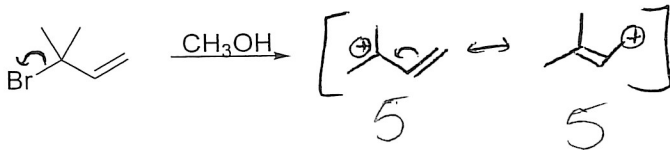
D: Grubbs catalyst (42)

(full credit for  $\text{Na}/\text{NH}_3$ , although this would react w/ ring as well. But we didn't cover that rxn.)

Opts if  $\text{H}_2$  Pd/C, -2 if Pd/C w/ Lindlar

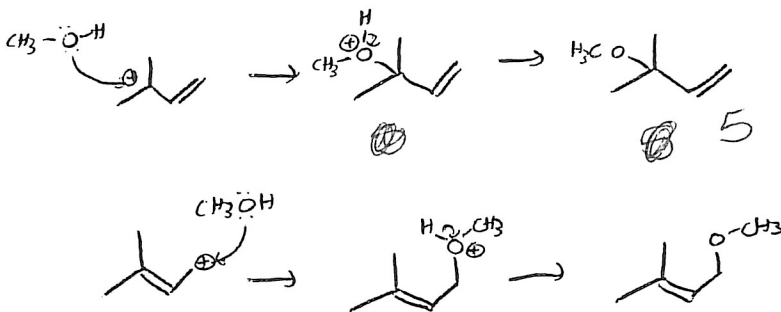
3) When 3-bromo-3-methyl-1-butene is dissolved in methanol, a reactive intermediate is formed which results in two products. (20 pts)

a. Give the two major resonance contributors to the structure of this intermediate. (10 pts)



if they gave Prod but showed res off to side (+2) per res structure

b. Draw the structures of the two major products for this reaction. (10 pts)



Missing double bond (-2)

Missing Carbon (-1)

⊖ (-2)

atom connectivity

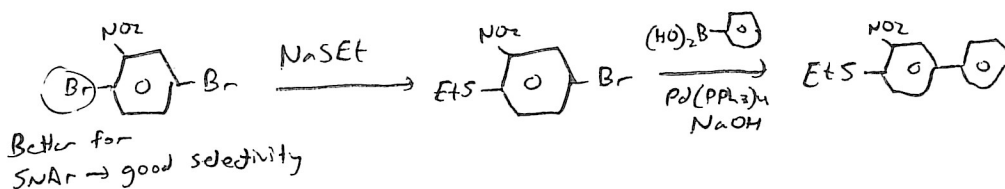
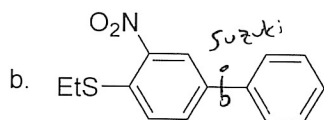
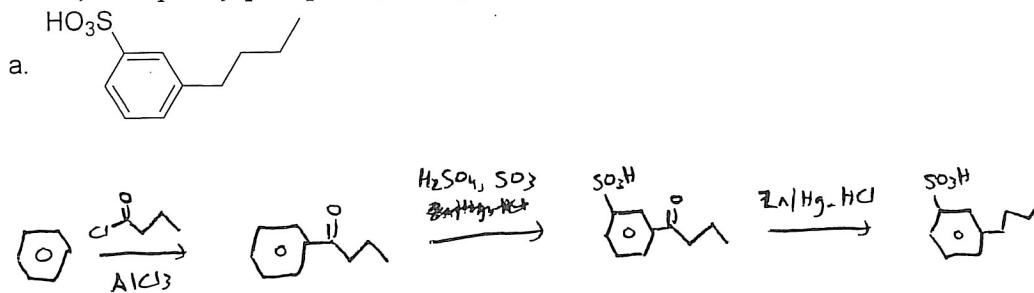
(-1)

or incorrect group

if just added Me groups (-3)

& protonated OMe (-2) 5

4) Find a way to synthesize the desired product from any reagents containing at most six carbon atoms, or triphenylphosphine, or any transition metal catalyst. (30 pts)



5) Extra credit! Show the mechanism and final products for this reaction. (10 pts e.c.)

