CHEM 3331 (Richardson) First Midterm Exam – Feb. 13, 2018

Your Name: Key

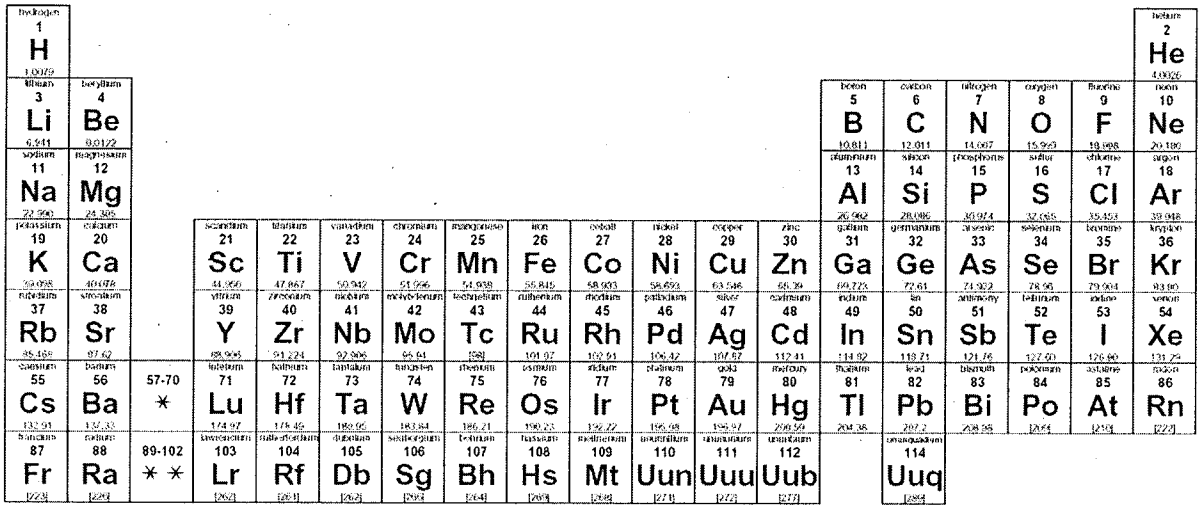
Student ID: _____

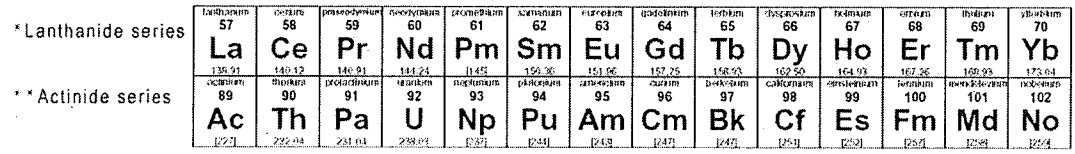
Recitation (check one)

O 12:00 Wed (Patrick Li)
O 4:00 Wed (Michael Ortiz)
O 11:00 Thu (Josh Kamps)
O 3:00 Thu (Rachel Weintraub)
O 8:00 Wed (Rachel Weintraub)
O 2:00 Wed (Patrick Li)
O 9:00 Thu (Josh Kamps)
O 1:00 Thu (Aaron Hinds)
O 5:00 Thu (Rachel Weintraub)

Question	Score	Out of
1		15
2		15
3		15
4		10
5		30
6		15
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 ziplock 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.



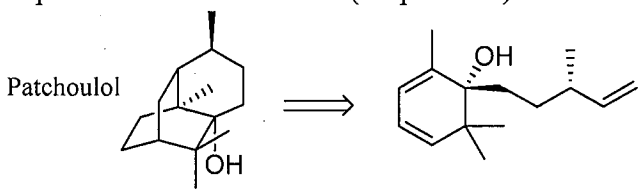


pKa Values

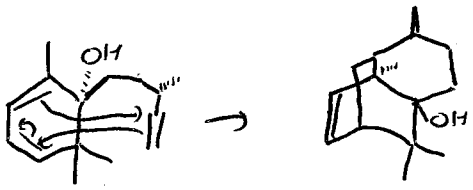
HI	-10	CH_3COOH	4.7	ArOH	10	H_2	35
HBr	-8	HN_3	4.7	RSH	10-12	NH_3	36
HCl	-6	H_2S	7.0	H_2O	15.7	$H_2C{=}CH_2$	45
H_3O^+	-1.7	NH_4^+	9.3	ROH (R=alkyl)	16-18	CH_4	60
HF	3.2	HCN	9.4	HC≡CH	26		

Average: 76
St Dev: 20.4
Max: 108
Min: 3

1) Patchouli oil, or patchoulol, is responsible for the smell of many types of incense and also hippies. In addition, it is used as a precursor to the chemotherapy drug Taxol. Patchoulol can be synthesized from the precursor shown below. (15 pts total)



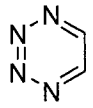
a. There are two steps in this synthesis: one generates a new ring, and the other changes a functional group. Show the mechanism for the ring formation step. You don't have to show the 3d shape perfectly – just focus on correct connectivity. (10 pts)



b. What reagents are needed for the second step, to finish converting the precursor to patchoulol? (5 pts)

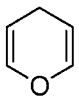
H_2 & Pd/C

2) Describe each of the structures below as aromatic, nonaromatic, or antiaromatic. Assume each structure is planar. In addition, list the hybridization of each heteroatom. (15 pts total)



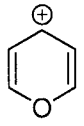
Aromatic

Each N is sp^2



Nonaromatic

O is sp^3



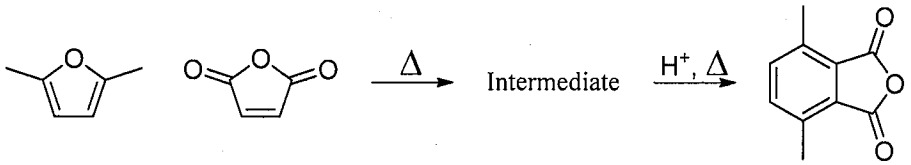
Aromatic

O is sp^2

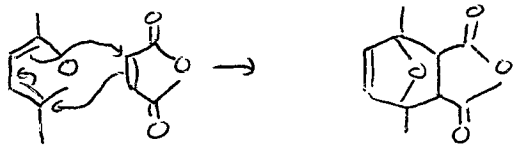
3pts per structure

1 pt per heteroatom

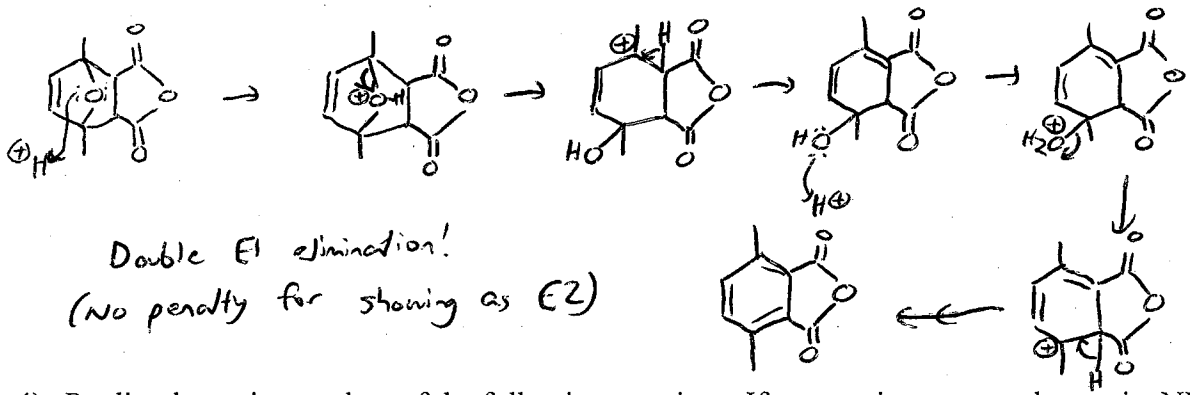
3) The reagents shown below react to form an intermediate, which, in the presence of acid, continues on to form the final product shown below. (15 pts total)



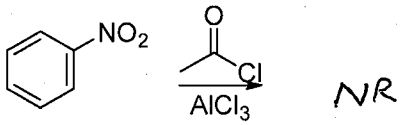
a. Show the structure of the intermediate, and the mechanism for its formation. (5 pts)

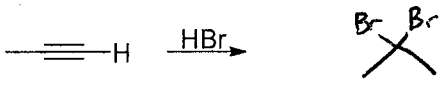


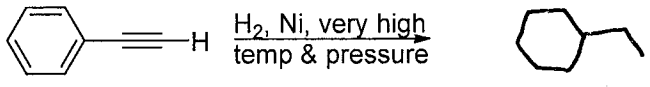
b. Show the mechanism for the formation of the final product. (10 pts)

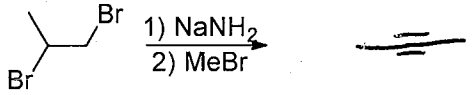


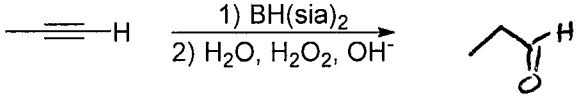
4) Predict the major product of the following reactions. If no reaction occurs, then write NR. Show stereochemistry where necessary – if a racemic mixture is formed, you can show only one product and write "racemic" or "rac". (10 pts; 2 pts each)

a. 

b. 

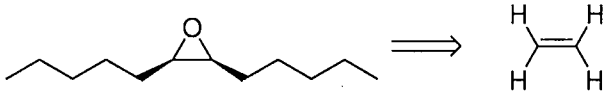
c. 

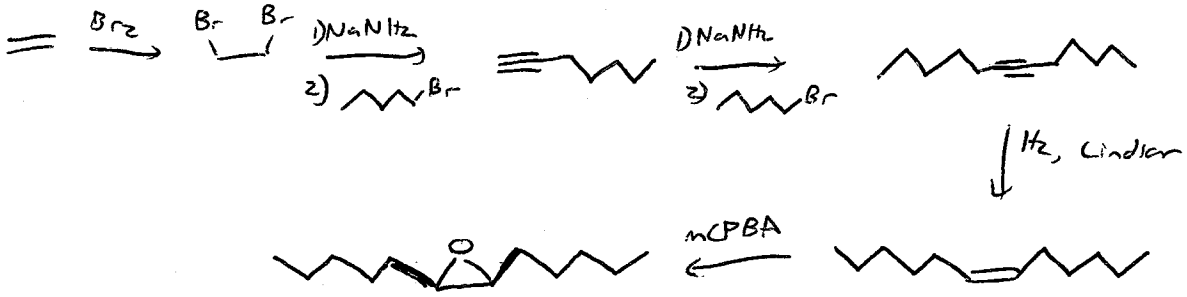
d. 

e. 

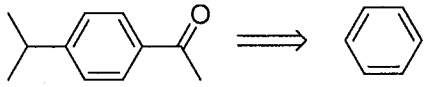
5) Find a way to synthesize the desired product from the given starting material(s) and any other reagents containing at most 5 carbon atoms. If more than one step is necessary, show the product of each step. Do not show mechanisms. (30 pts; 10 pts each)

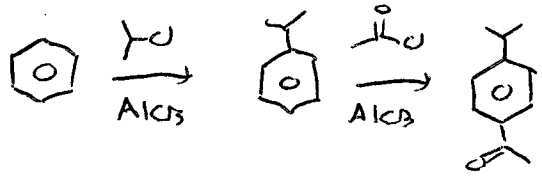
a.



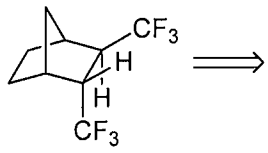


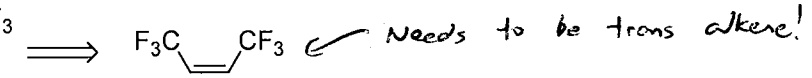
b.



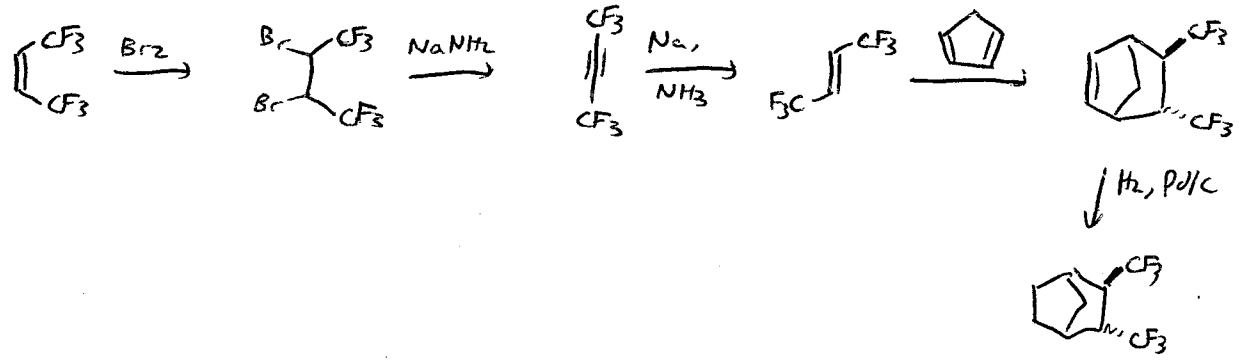


c.

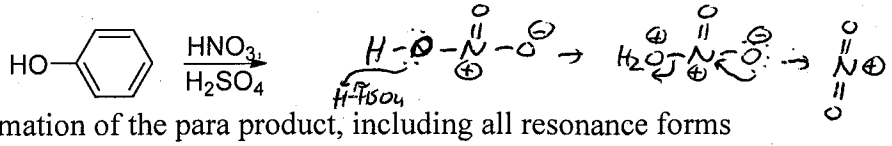




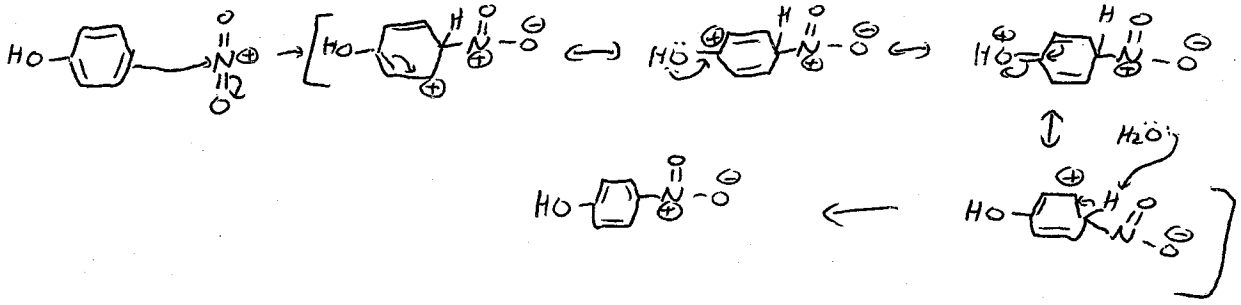
Needs to be trans alkene!



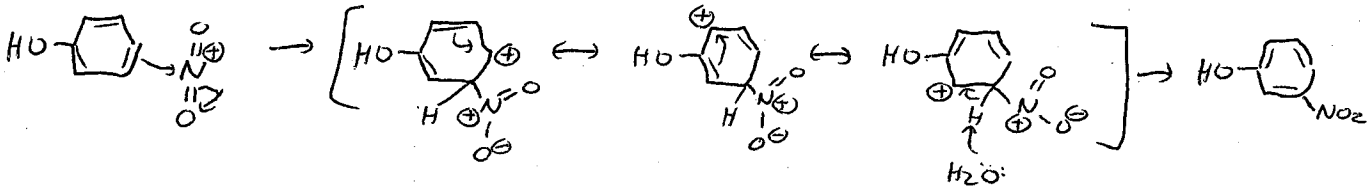
6) The reaction shown below could hypothetically produce three isomers – the ortho, meta, and para products. (15 pts)



a. Show the mechanism for the formation of the para product, including all resonance forms for the intermediate. (5 pts)



b. Show the mechanism for the formation of the meta product, including all resonance forms for the intermediate. (5 pts)



c. In twenty words or less, explain which of these outcomes is favored and why. (5 pts)

Para is favored b/c it creates best resonance form, w/ ⊕ on oxygen.

7) Extra credit! Calicene, shown below, has a surprisingly high dipole moment for a hydrocarbon. Explain why this is true in thirty words or less, and show the dominant resonance form for this molecule. (10 pts e.c.)

(Both rings are aromatic, so it is a very favorable resonance form)