CHEM 3311 (Richardson) Second Exam – Oct. 23, 2018

Your Name: Key

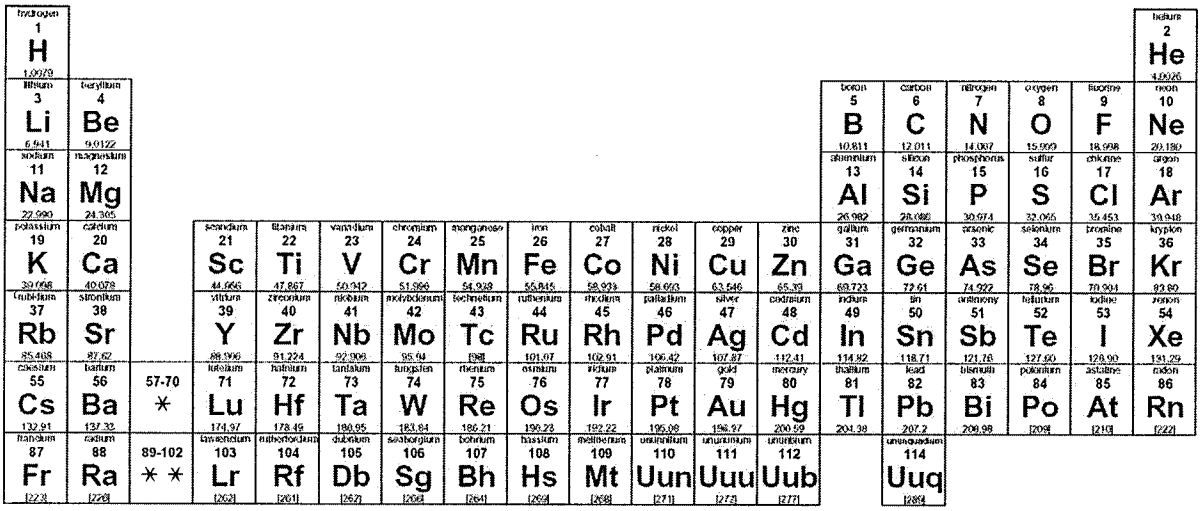
Student ID: _____

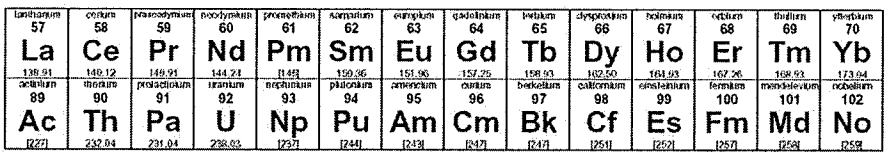
Recitation (check one)

O 11:00 Mon (Matthew Farmer)
O 2:00 Mon (Shaofeng Huang)
O 9:00 Tue (Lacey Wayment)
O 12:00 Tue (Josh Kamps)
O 3:00 Tue (Lauren Bodkin)
O 10:00 Mon (Shafer Soars)
O 1:00 Mon (Lacey Wayment)
O 3:00 Mon (Shaofeng Huang)
O 10:00 Tue (Josh Kamps)
O 2:00 Tue (Lauren Bodkin)
O 4:00 Tue (Matthew Farmer)

Question	Score	Out of
1		16
2		10
3		12
4		12
5		10
6		20
7		20
8		10 e.c.
Total		

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.



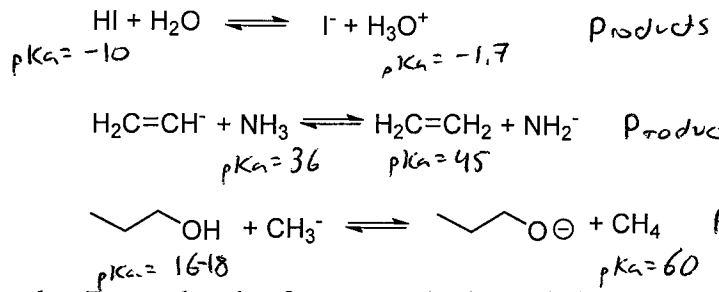


pKa Values

HI	-10	CH_3COOH	4.7	ArOH	10	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 (R=alkyl)	16-18	$H_2C{=}CH_2$	45
HF	3.2	HCN	9.4	O=C-CH (α H)	9-25	CH_4	60

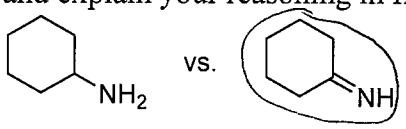
Avg 74.5
St. Dev 23.4
max 110
min 17

1) Acids and Bases (16 pts)
   a. For each of the following reactions, does the equilibrium favor the reactants or products? (2 pts each)

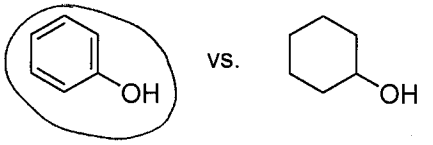


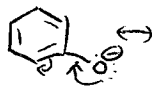
   b. For each pair of compounds shown below, select the more acidic of the two compounds and explain your reasoning in fifteen words or fewer. (2 pts each)

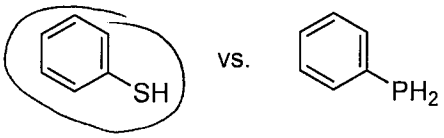
1 pt per circle, 1 per reason



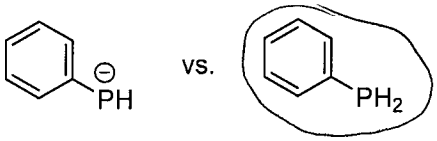
Reason: Orbital effect - sp^2 N is more acidic than sp^3.



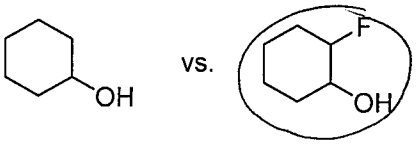
Reason: Resonance effect - more resonance forms for  etc.



Reason: Atom effect - S & P in same row of table, so more EN = more acidic.

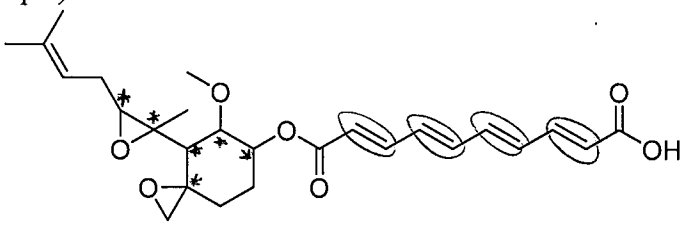


Reason: Charge effect - more ⊖ = less acidic.



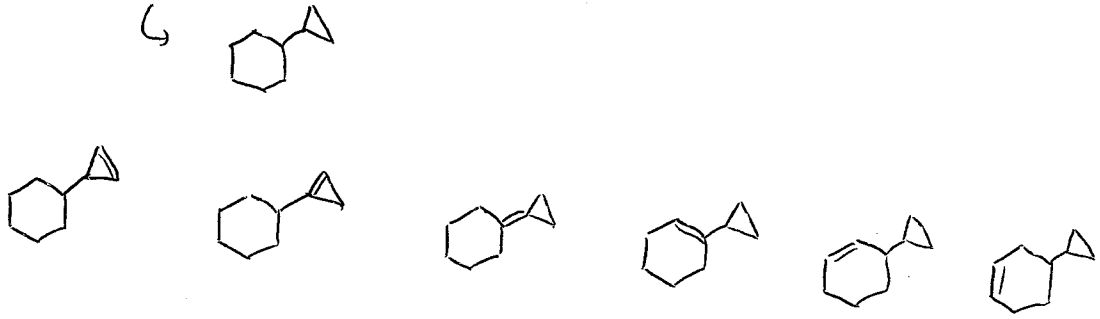
Reason: Dipole/induction effect - F stabilizes ⊖ through induction.

2) Fumagillin, shown below, is an antimicrobial agent. It is isolated from the microbial organism Aspergillus fumigatus, and is used to treat Nosema fungus infections in honeybees. Label all asymmetric carbons in fumagillin with an asterisk, and circle all alkenes with E/Z stereoisomerism. (10 pts)



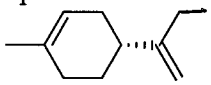
1 pt for each correct marking
-1 for each superfluous/wrong one

3) Show all the possible constitutional isomers of formula C_9H_{14} that could be hydrogenated to form cyclopropylcyclohexane. Do not repeat any structures. (12 pts)

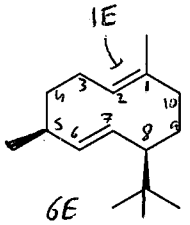


2 pts each
−1 for each duplicate/incorrect

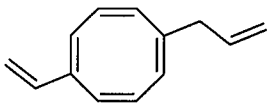
4) Give complete IUPAC names for the following compounds, including E/Z and R/S descriptors where necessary. (12 pts – 4 pts each)

a. 

(R)-4-(1-ethylethenyl)-1-methylcyclohexene

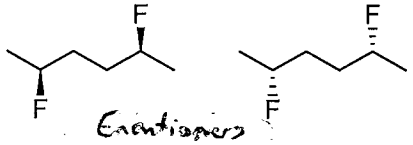
b. 

(1E,5S,6E,8R)-
8-tert-butyl-1,5-dimethyl-1,6-cyclodecadiene

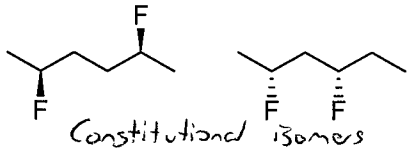
c. 

1-allyl-5-vinyl-1,3,5,7-cyclooctatetraene

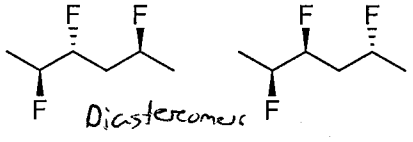
5) For each of the following pairs of molecules, are they identical, enantiomers, diastereomers, or constitutional isomers? (10 pts – 2 pts each)

a. 

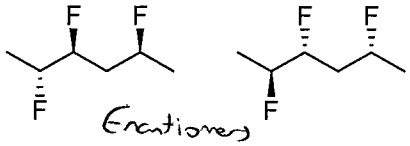
Enantiomers

b. 

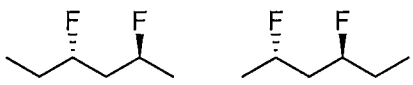
Constitutional isomers

c. 

Diastereomers

d. 

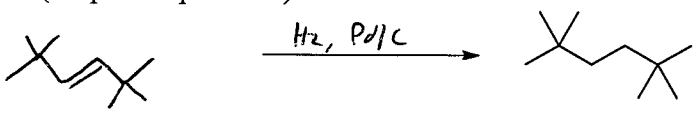
Enantiomers

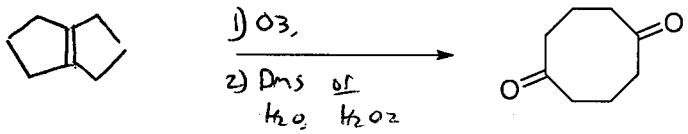
e. 

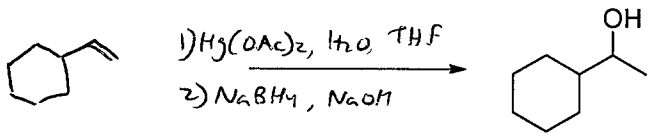
Identical

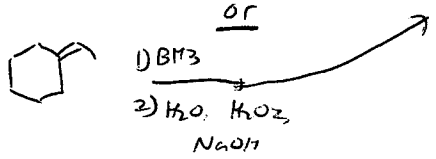
6) Using any reactions that have been covered so far in class, show how you would create the products shown, starting with any hydrocarbon (consisting of C and H only) that has the same number of carbon atoms as the product (or as one repeat unit in the product, if it's a polymer). Write your starting material before the arrow, and the other reagents above or below the arrow. Make sure that each reaction gives the desired structure as the only major product. (20 pts - 4 pts each)

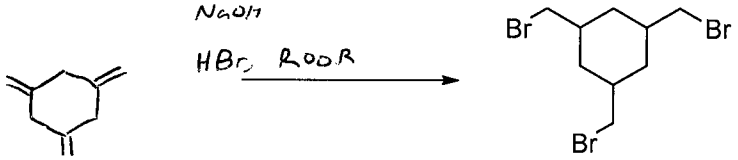
2 pts for starting material
2 pts for reagents

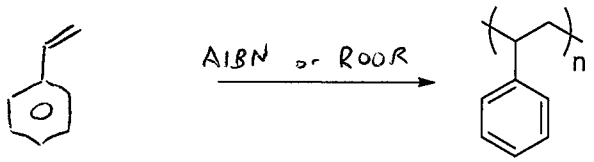
a. 

b. 

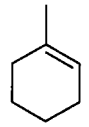
c. 

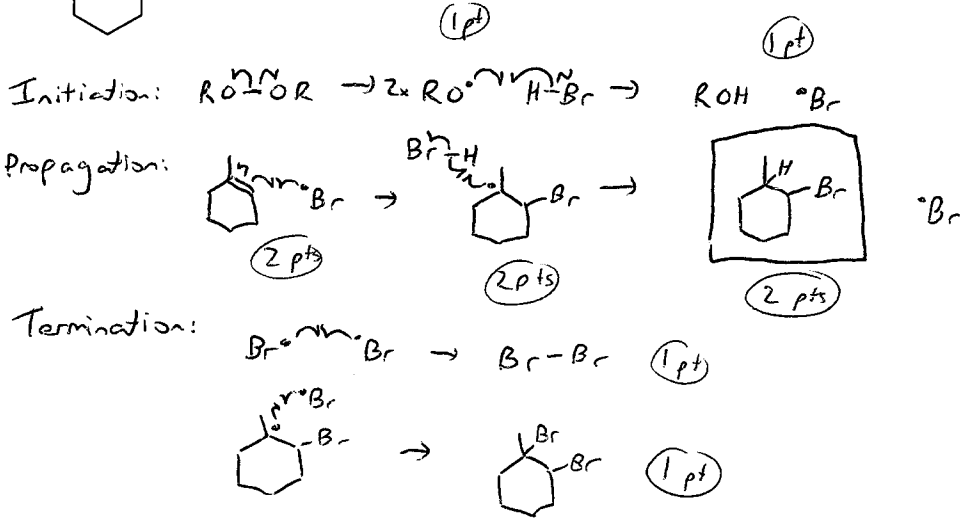


d. 

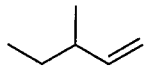
e. 

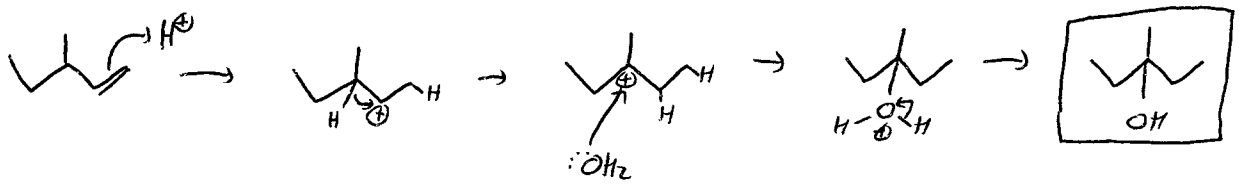
7) Show a mechanism for each reaction, and draw a box around the major product. For radical reactions, clearly differentiate the initiation, propagation, and termination steps (you only need to show 2 examples of termination.) (20 pts - 10 pts each)

a.  HBr, ROOR



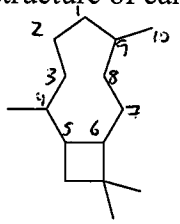
Wrong amon type: -4
No initiation/propagation/termination labeled: -1 ea

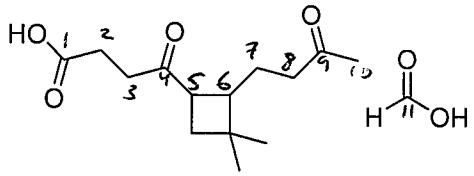
b.  H_2O, H_2SO_4



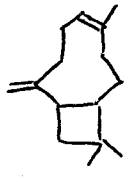
2 pts per step,
2 pts for box

8) Extra credit! In your lab, you have found a mysterious bottle labeled "Caryophyllene." In an attempt to discover its structure, you perform some reactions on it and observe the following results. What is the structure of caryophyllene? (10 pts extra credit)

Caryophyllene $\xrightarrow[\text{Pd/C}]{H_2}$ 

Caryophyllene $\xrightarrow[2)\ H_2O,\ H_2O_2]{1)\ O_3}$ 

Double bonds between 1 & 9, 4 & 11.

Caryophyllene: 

Sigma-bond skeleton 4 pts
each correct alkene 3 pts
-2 for each extra alkene/other mistake