

CHEM 3311 (Richardson) First Exam – Sep. 23, 2019

Your Name: Key

Student ID: _____

Recitation (check one)

- 10:00 Mon (Jonathan Thurston)
- 11:00 Mon (Andrew Chomas)
- 1:00 Mon (Shea O'Sullivan)
- 2:00 Mon (Shea O'Sullivan)
- 3:00 Mon (Dominique Blackmun)
- 8:00 Tue (John Flood)
- 9:00 Tue (Chance Brandt)
- 10:00 Tue (John Flood)
- 12:00 Tue (Jonathan Thurston)
- 2:00 Tue (Andrew Chomas)
- 3:00 Tue (Justin Olson)
- 4:00 Tue (Justin Olson)

Question	Score	Out of
1		16
2		14
3		12
4		14
5		18
6		10
7		16
Total		106

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.

Periodic Table of the Elements

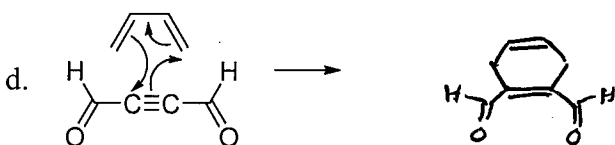
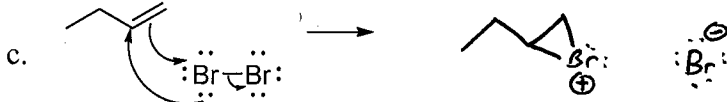
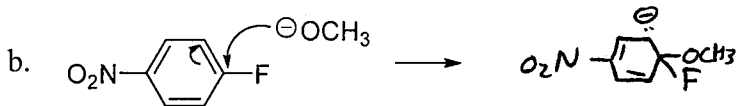
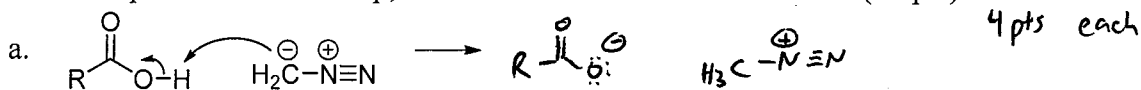
The periodic table shows elements from Hydrogen (1) to Oganesson (118). It includes the Lanthanide series (57-71) and Actinide series (89-103). A legend box indicates: Atomic Number, Symbol, Name, Atomic Mass.

pKa Values

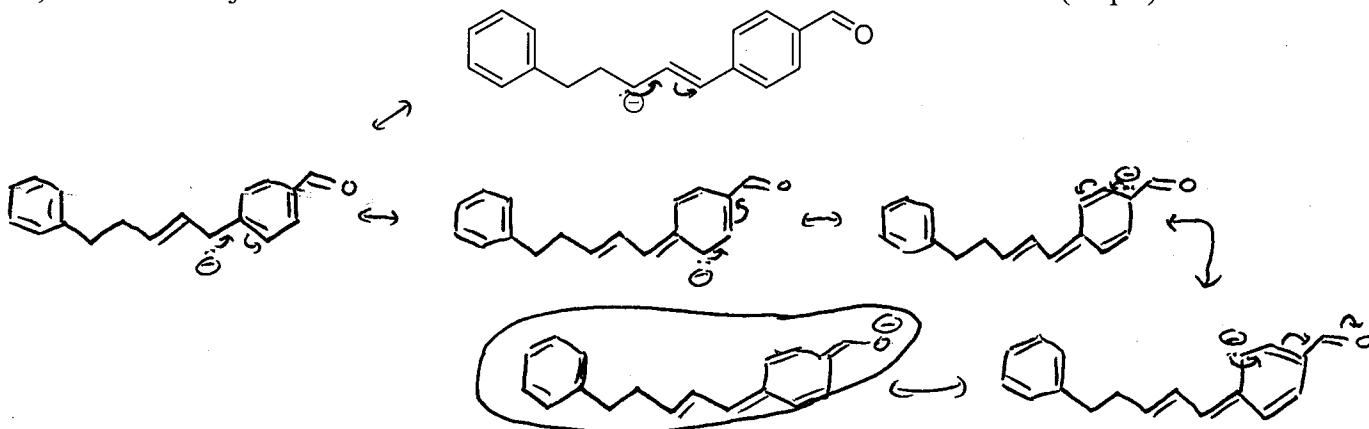
HI	-10	CH ₃ COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN ₃	4.7	RSH	10-12	H ₂	35
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	NH ₃	36
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH	16-18	H ₂ C=CH ₂	45
HF	3.2	HCN	9.4	O=C-CH	9-25	CH ₄	60

Average: 76.4
 Curve: 0
 St. Dev: 16.5
 Max: 106
 Min: 18

1) Draw the product of each step, based on the curved arrows shown. (16 pts)

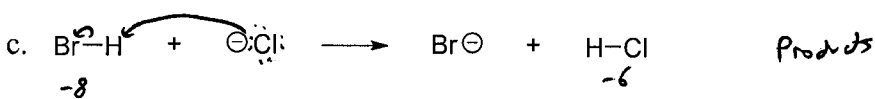
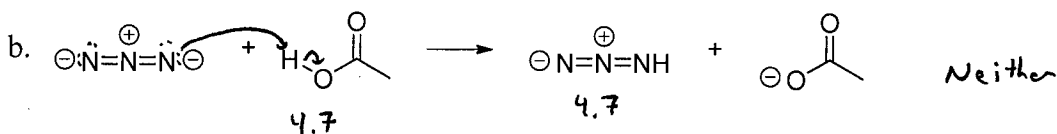
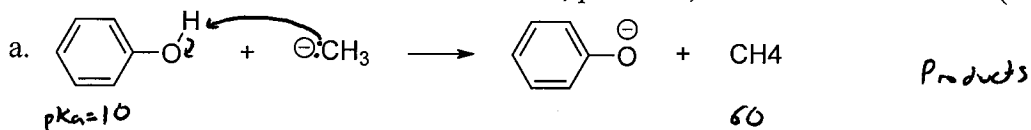


2) Show all major resonance forms for this molecule and circle the most stable. (14 pts)



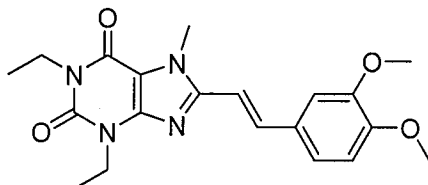
2 pts per form, 4 pts for circle

- 3) For each of the following acid-base reactions, draw curved arrows to indicate electron movement and determine whether reactants, products, or neither are favored. (12 pts)



- 4) Istradefylline, shown below, is a new drug approved in 2019 as a treatment for Parkinson's disease. (14 pts total)

- a. Which of the listed functional groups does istradefylline contain? Circle all that apply. (10 pts)



2 pts each (~~1~~ pts for each wrong circle)

Alcohol	Aldehyde	<u>Alkene</u>	<u>Amide</u>	<u>Amine</u>
<u>Aromatic ring</u>	Carboxylic acid	Ester	<u>Ether</u>	Ketone

- b. How many sp^2 -hybridized carbon atoms does istradefylline have? (2 pts)

13

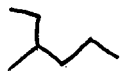
- c. How many sp^3 -hybridized carbon atoms does istradefylline have? (2 pts)

7

5) The following compounds were given names that are almost correct, but have something wrong with them. Complete these steps for each one: (18 pts total)

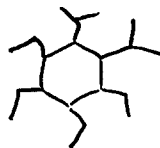
- Draw the skeletal structure (2 pts per problem)
- Write the correct IUPAC name (4 pts per problem)

a. 2-ethylpentane



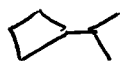
3-methylhexane

b. 3,4,5,6-tetraethyl-1,2-diisopropylcyclohexane



1,2,3,4-tetraethyl-5,6-diisopropylcyclohexane

c. 2-cyclobutylpropane



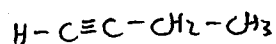
isopropylcyclobutane

6) Draw a molecule that satisfies the given criteria. (16 pts)

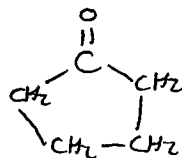
- a. An alkane with formula C_5H_{10} with no primary, tertiary or quaternary carbons



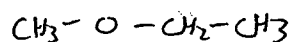
- b. An alkyne with formula C_4H_6 with a single methylene unit



- c. A ketone with formula C_5H_8O with only a single trigonal planar carbon

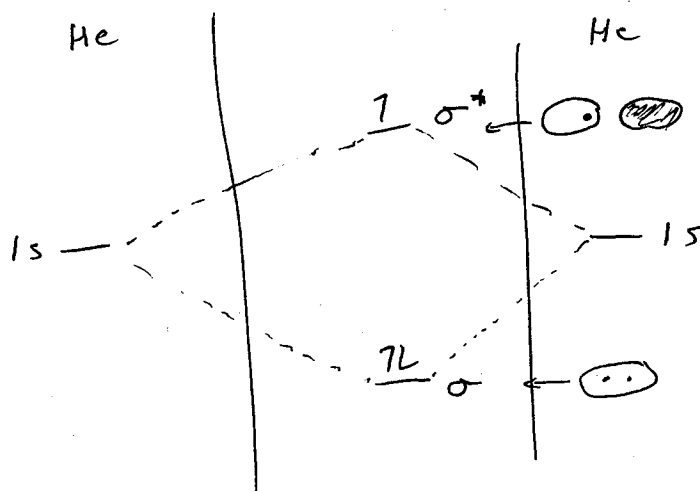


- d. An ether with formula C_3H_8O .



7) Although He_2 cannot exist, the He_2^+ ion can. (16 pts total)

- a. Draw an MO diagram for an He_2^+ ion, being sure to name each orbital and fill in electrons correctly. (10 pts)



- b. What is the bond order between the two helium atoms in this molecule? (2 pts)

$$(2-1)/2 = 1/2$$

- c. Draw the shape of each MO next to its position in the MO diagram. (4 pts)