

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

Your Name: _____

Student ID: _____

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

hydrogen 1 H 1.0079																			helium 2 He 4.0026																					
lithium 3 Li 6.941	beryllium 4 Be 9.0122																		boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180																
sodium 11 Na 22.990	magnesium 12 Mg 24.305																		aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948																
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80	rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29					
cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La [138.91]	cerium 58 Ce [140.12]	praseodymium 59 Pr [140.91]	neodymium 60 Nd [144.24]	promethium 61 Pm [144.91]	samarium 62 Sm [150.36]	europium 63 Eu [151.96]	gadolinium 64 Gd [157.25]	terbium 65 Tb [158.93]	dysprosium 66 Dy [162.50]	holmium 67 Ho [164.93]	erbium 68 Er [167.26]	thulium 69 Tm [168.93]	ytterbium 70 Yb [173.04]	francium 87 Fr [223]	radium 88 Ra [226]	actinium 89 Ac [227]	thorium 90 Th [232.04]	protactinium 91 Pa [231.04]	uranium 92 U [238.03]	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	unbibium 112 Uub [277]	ununquadium 114 Uuq [289]	tennessine 117 Ts [289]	oganesson 118 Og [289]

* Lanthanide series

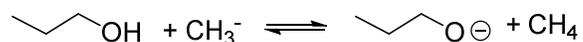
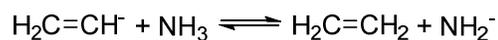
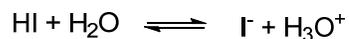
** Actinide series

pKa Values

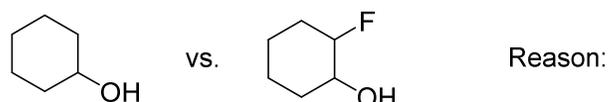
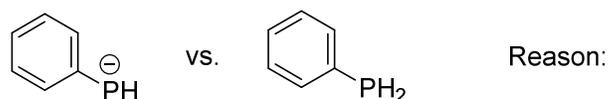
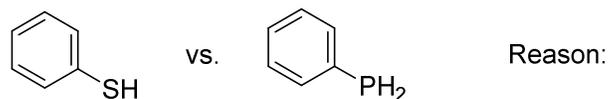
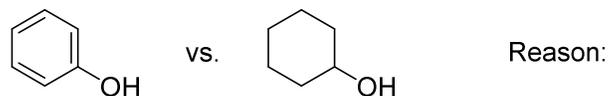
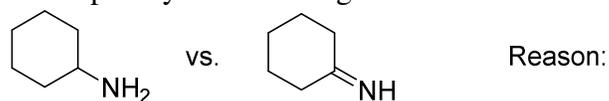
HI	-10	CH ₃ COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN ₃	4.7	RSH	10-12	H ₂	35
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	NH ₃	36
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH (R=alkyl)	16-18	H ₂ C=CH ₂	45
HF	3.2	HCN	9.4	O=C-CH (α H)	9-25	CH ₄	60

1) Acids and Bases (16 pts)

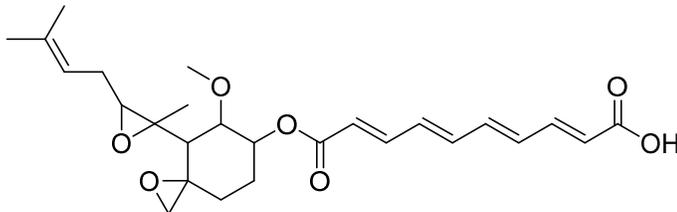
- a. For each of the following reactions, does the equilibrium favor the reactants or products? (2 pts each)



- 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)

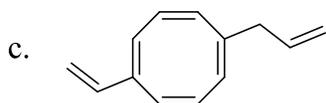
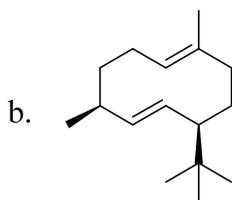


- 2) Fumagillin, shown below, is an antimicrobial agent. It is isolated from the microbial organism *Aspergillus fumigatus*, and is used to treat *Nosema* fungus infections in honeybees. Label all asymmetric carbons in fumagillin with an asterisk, and circle all alkenes with E/Z stereoisomerism. (10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

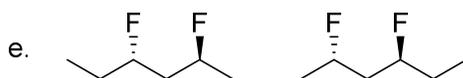
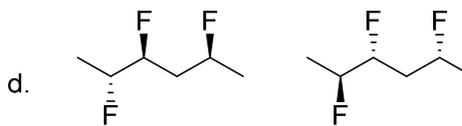
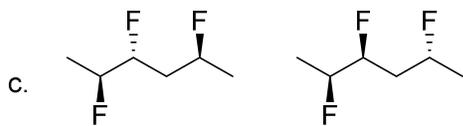
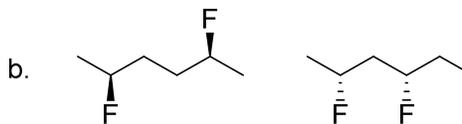
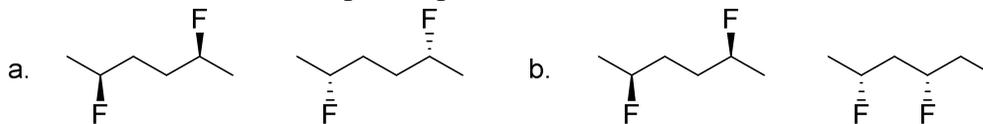


- 3) Show all the possible constitutional isomers of formula C_9H_{14} that could be hydrogenated to form cyclopropylcyclohexane. Do not repeat any structures. (12 pts)

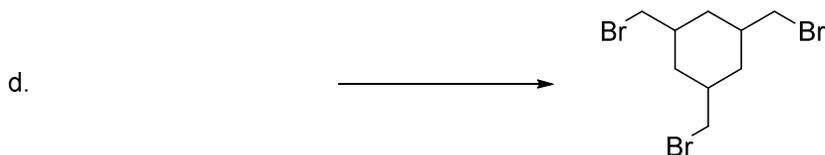
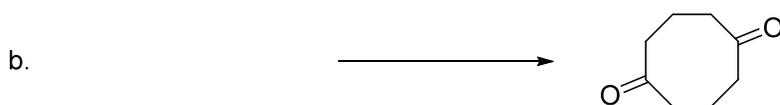
- 4) Give complete IUPAC names for the following compounds, including E/Z and R/S descriptors where necessary. (12 pts – 4 pts each)



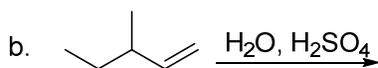
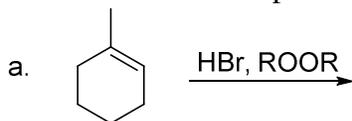
- 5) For each of the following pairs of molecules, are they identical, enantiomers, diastereomers, or constitutional isomers? (10 pts – 2 pts each)



- 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)



- 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)



- 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)

