

CHEM 3311 (Richardson) First Hour Exam – February 14, 2017

Your Name _____

Key

Student ID _____

- Recitation Time 8:00 Wednesday w/ Josh Kamps
 2:00 Wednesday w/ Josh Kamps
 10:00 Thursday w/ Brendan Griffiths
 11:00 Thursday w/ Brendan Griffiths
 12:00 Friday w/ Brendan Griffiths

Question	Score	Out of
1		
2		
3		
4		
5		
6		
7		
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.

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	selecnium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.60				
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	* 57-70 Lu 174.97	hafnium 71 Hf 178.49	tantalum 72 Ta 180.95	tungsten 73 W 183.84	rhenium 74 Re 186.21	osmium 75 Os 190.23	iridium 76 Ir 192.22	platinum 77 Pt 195.08	gold 78 Au 196.97	mercury 79 Hg 200.59	thallium 80 Tl 204.38	lead 81 Pb 207.2	bismuth 82 Bi 208.98	polonium 83 Po [209]	astatine 84 At [210]	radon 85 Rn [222]				
francium 87 Fr [223]	radium 88 Ra [226]	** 89-102 Lr [261]	rutherfordium 103 Rf [261]	bohrium 104 Db [262]	seaborgium 105 Sg [266]	hassium 106 Bh [264]	meitnerium 107 Hs [265]	darmstadtium 108 Mt [268]	roentgenium 109 Uu [269]	copernicium 110 Uu [271]	nihonium 111 Uu [272]	flerovium 112 Uu [277]									

* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	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
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]

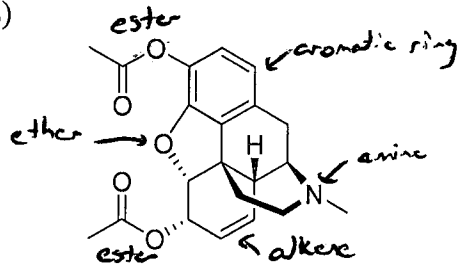
** Actinide series

pKa Values

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

Average: 81.4
 St. Dev: 12.5
 Max: 99
 Min: 44

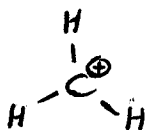
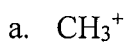
- 1) Heroin (a.k.a. diacetylmorphine), shown below, is an opiate typically used as a recreational drug for its euphoric effects. Which of the listed functional groups does heroin contain? Circle all that apply. (10 pts)



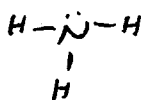
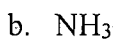
2 pts per circle
-2 pts per wrong circle

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

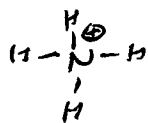
- 2) For each structure, draw a valid Lewis structure (including lone pairs and formal charges on each atom) and write **both** the electronic and the molecular geometry around the central atom. (20 pts)



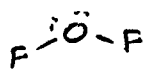
electronic: trigonal planar
molecular: " "



electronic: tetrahedral
molecular: trigonal pyramidal

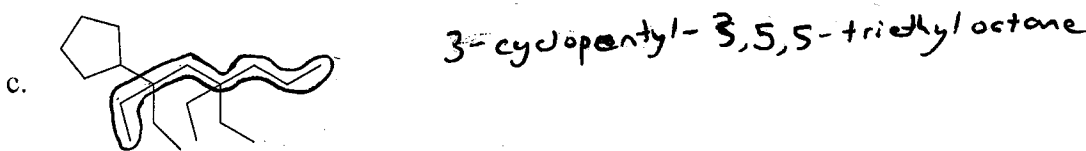
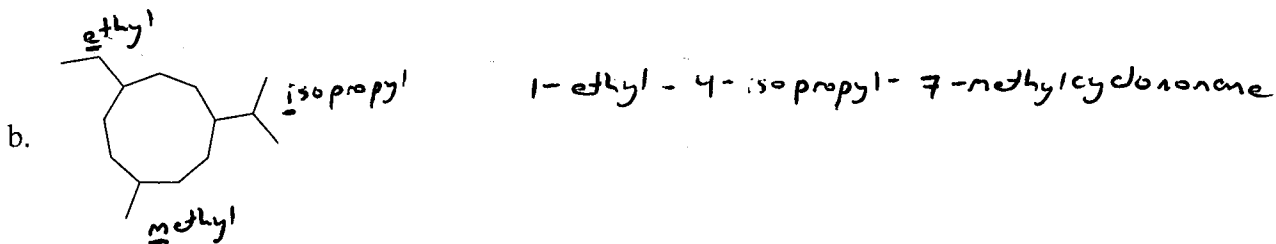
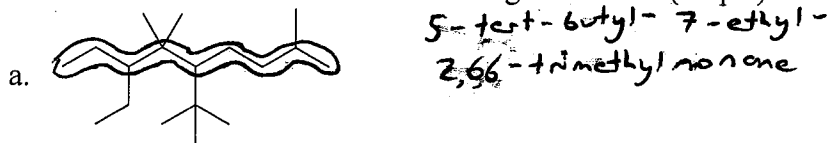


electronic: tetrahedral
molecular: " "

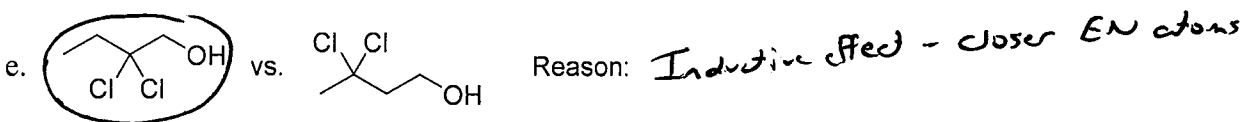
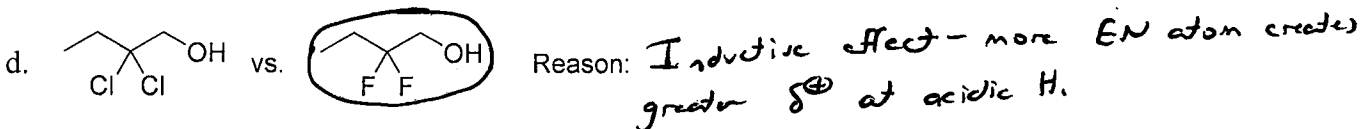
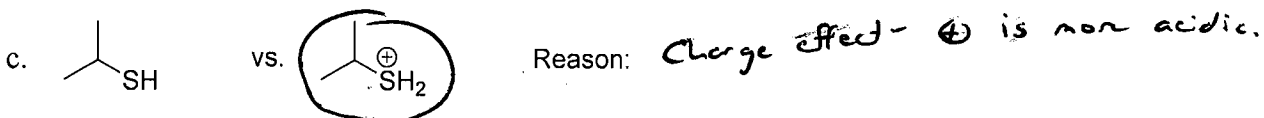
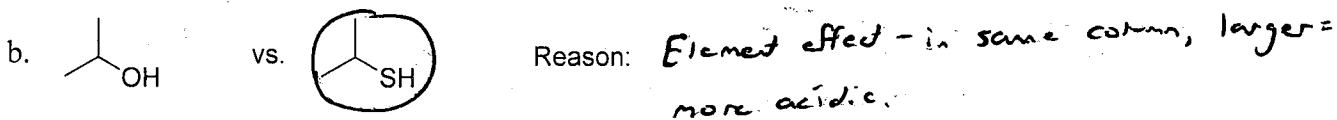
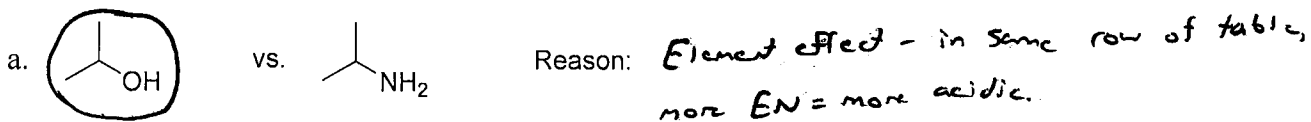


electronic: tetrahedral
molecular: bent

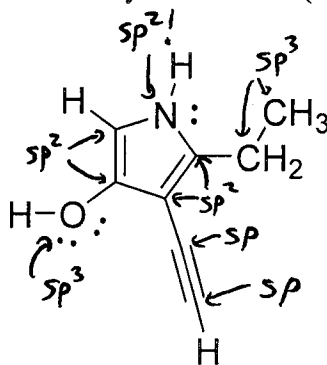
3) Provide names for each of the following structures. (15 pts)



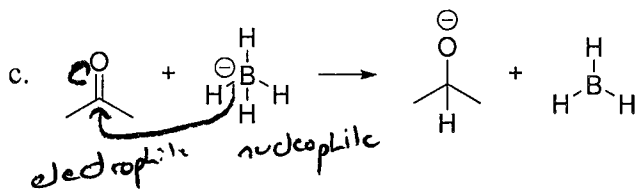
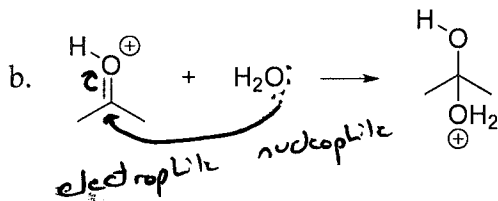
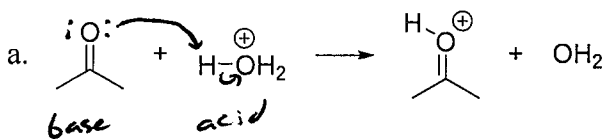
4) For each pair of compounds shown below, select the more acidic of the two compounds and explain your reasoning in under ten words per. (10 pts)



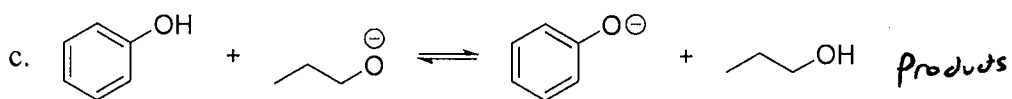
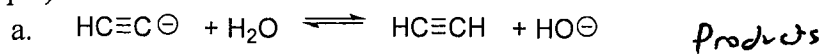
- 5) Give the hybridization for each non-hydrogen atom in this molecule. Note that the geometry around the nitrogen is actually trigonal planar and not tetrahedral as you may expect. What does this imply about the nitrogen atom's hybridization? (10 pts)



- 6) Complete each arrow-pushing mechanism and identify each reactant as a nucleophile, electrophile, acid, or base. (15 pts)



7) For each of the following reactions, does the equilibrium favor the reactants or products? (12 pts)



8) Draw a compound that matches the criteria listed. (8 pts)

a. An alkane with formula C_4H_8 with no primary carbons



b. An alkane with formula C_5H_{10} with exactly one quaternary carbon

