

CHEM 3311 (Richardson) Final Exam – May 5, 2016

Your Name _____ *Key*

Student ID _____

- Recitation Time
- 3:00 Monday w/ Blaine McCarthy
 - 11:00 Tuesday w/ Thomas Carey
 - 1:00 Wednesday w/ Garrett Cairo
 - 8:00 Thursday w/ Blaine McCarthy
 - 3:00 Thursday w/ Garrett Cairo

Question	Score	Out of
1		30
2		30
3		30
4		20
5		30
6		30
7		30
8		10 e.c.
Total		200

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.

1 H 1.0079																	2 He 4.0026						
3 Li 6.941	4 Be 9.0122																	5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305																	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80						
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc 98	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.90	54 Xe 131.29						
55 Cs 132.91	56 Ba 137.33	57-70 * * * * *	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.39	82 Pb 207.2	83 Bi 208.98	84 Po [209]	85 At [210]	86 Rn [222]					
87 Fr [223]	88 Ra [226]	89-102 * * * * *	103 Lr [261]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 Uun [271]	111 Uuu [271]	112 Uub [271]											

* Lanthanide series

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 158.93	67 Ho 162.50	68 Er 167.26	69 Tm 168.93	70 Yb 173.05
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** Actinide series

89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]
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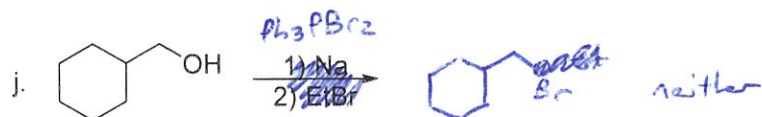
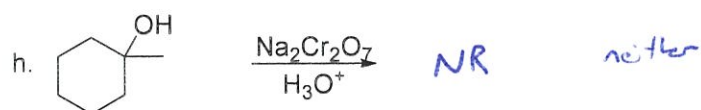
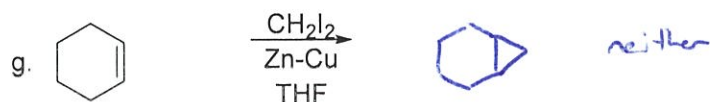
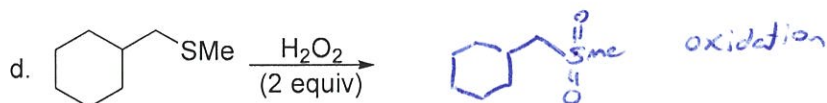
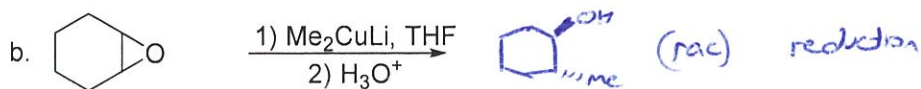
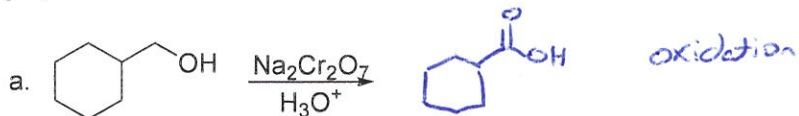
pKa Values

HI	-10	HF	3.2	HCN	9.4	HC≡CH	26
HBr	-8	CH ₃ COOH	4.7	PhOH	10	H ₂	35
HCl	-6	HN ₃	4.7	RSH	10-12	NH ₃	36
H ₃ O ⁺	-1.7	H ₂ S	7.0	H ₂ O	15.7	H ₂ C=CH ₂	45
ROH ₂ ⁺	-2	NH ₄ ⁺	9.3	ROH	15-19	CH ₄	60

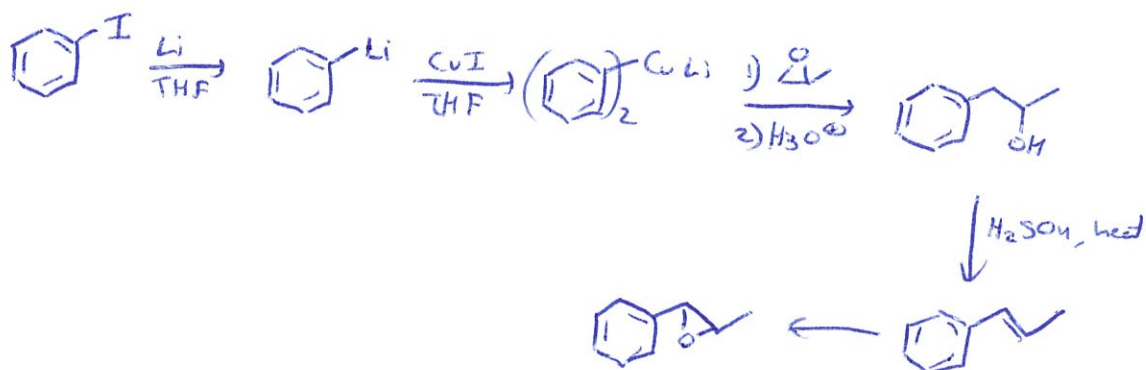
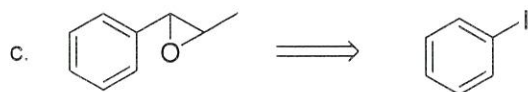
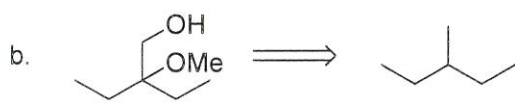
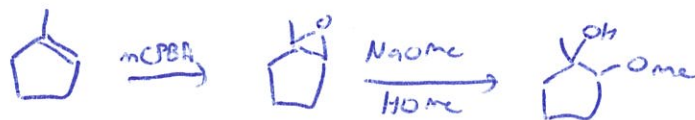
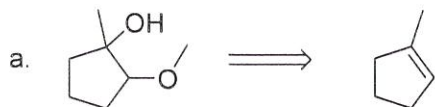
Average: 122.5
St. Dev: 37.3
Max: 198
Min: 23

(Add 40-point curve to your score)

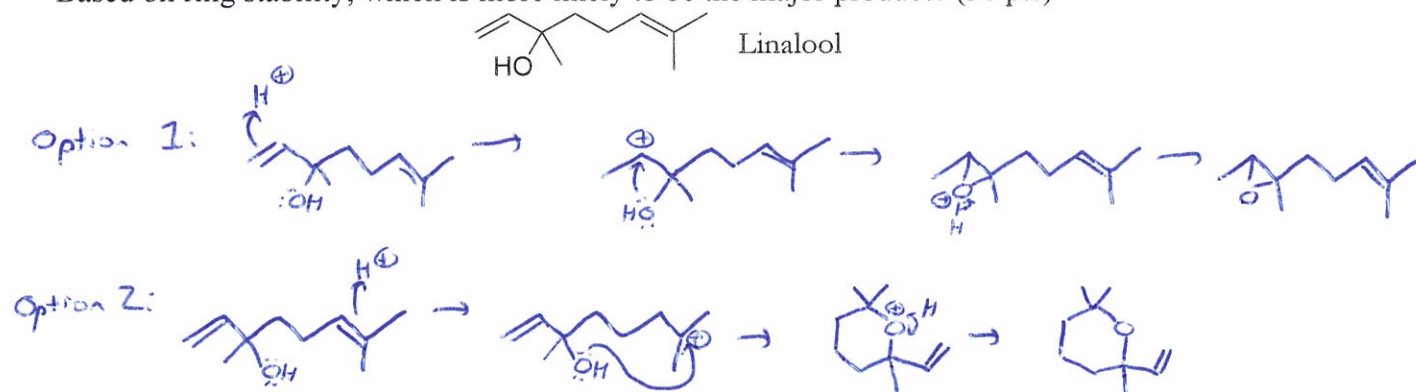
- 1) **Predict the product** of the following reactions, and **choose the appropriate descriptor** (reduction, oxidation, or neither) for what happens to the organic molecule during each reaction. If no reaction occurs, then write NR. Show stereochemistry where necessary – if a racemic mixture is formed, you can show only one product and write “racemic” or “rac”. (30 pts)



2) Find a way to synthesize the desired product from the given starting material. If more than one step is necessary, show the product of each step. Do not show mechanisms. (30 pts)

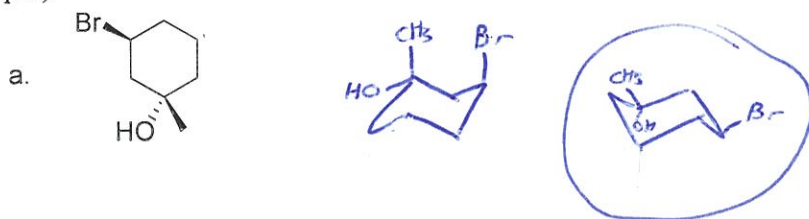


- 3) While rummaging around in your lab you come across a bottle of linalool, which is shown below. Having nothing better to do, you react it with dilute sulfuric acid and find that you have created a cyclic molecule with the same formula as linalool. Show two possibilities for the structure of this cyclic molecule, and give the mechanism for each of them forming. Based on ring stability, which is more likely to be the major product? (30 pts)

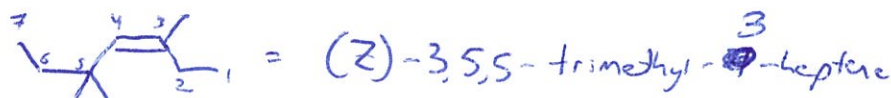
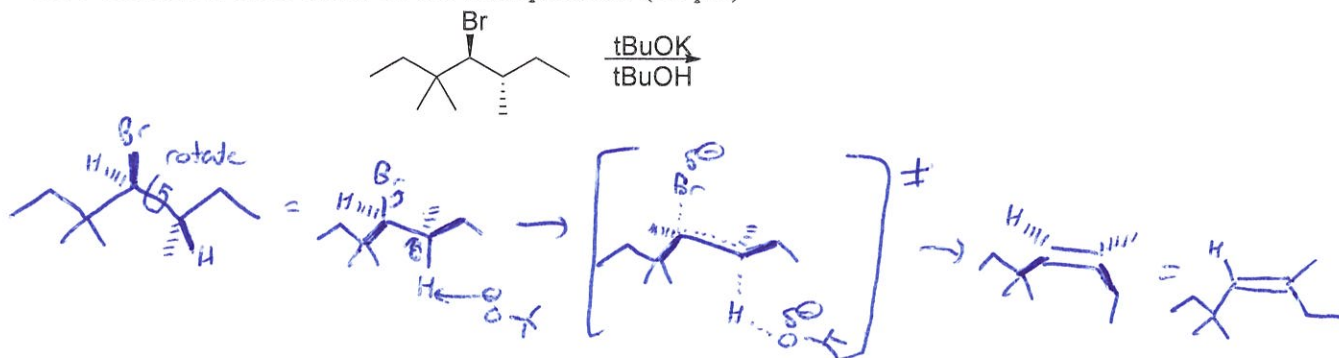


Option 2 is more likely, since 6-membered ring is more stable.

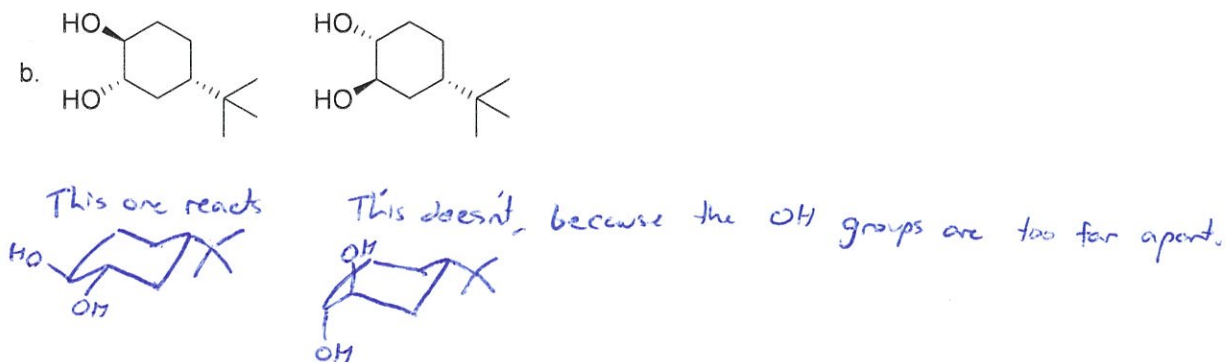
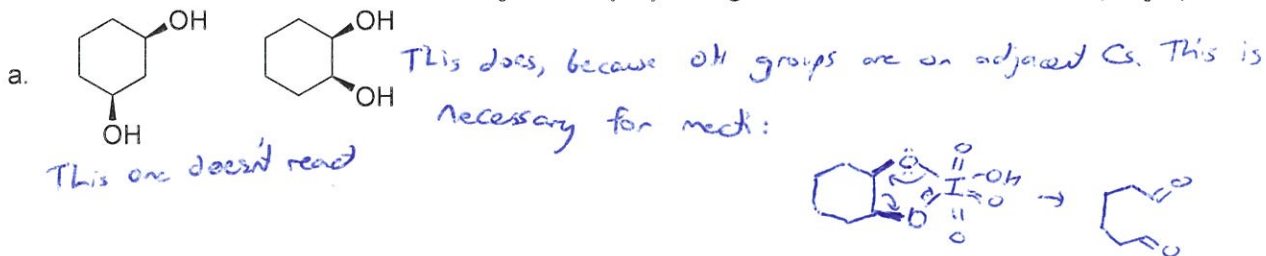
- 4) Draw the following molecules in **both** chair conformations, and circle the most stable. (20 pts)



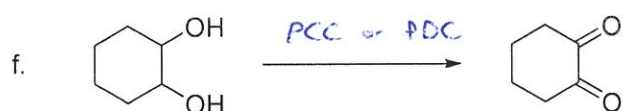
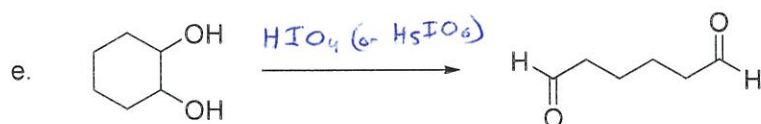
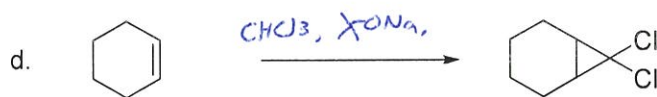
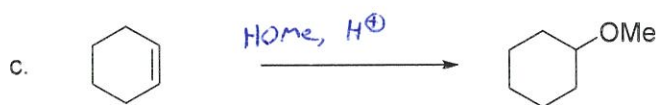
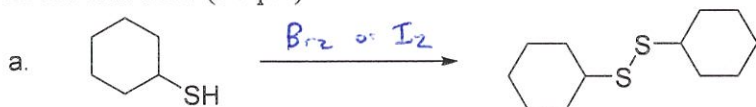
- 5) Show the transition state for this reaction, and draw the product with correct stereochemistry. Give the full IUPAC name of the final product. (30 pts)



- 6) In each of the following pairs of molecules, one reacts with periodic acid and the other does not. Determine which is which, and explain why by using structures or mechanisms. (30 pts)



- 7) Each of these reactions can be done in a single step. On each arrow, show the reagents needed to accomplish each one. In each case, the target product should be the major product of the reaction. (30 pts)



- 8) Extra credit! Write an arrow-pushing mechanism for this reaction, assuming only a single bromine atom is added to the molecule. Clearly label each section of the mechanism, and show at least two examples of termination. (10 pts e.c.)

