

CHEM 3311-200 (Ellison/Richardson) 3rd Exam – April 16, 2013

Your Name _____

KEY

Student ID No. _____

Recitation Day/Time _____

Recitation TA (circle one) Katelyn Chando,
Setareh Azarnoush

Question	Score	Out of
1		12
2		10
3		12
4		12
5		16
6		16
7		12
8		10
Total		100

This is a closed-book exam. The use of notes, calculators, scratch paper, 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. Please put all your final answers on the test in pen, not pencil. 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 1.00794																	Helium 2 He 4.00260	
Lithium 3 Li 6.941	Beryllium 4 Be 9.0122																	Neon 10 Ne 20.1797
Sodium 11 Na 22.98976928	Magnesium 12 Mg 24.304																	Argon 18 Ar 39.948
Potassium 19 K 39.0983	Calcium 20 Ca 40.078	Scandium 21 Sc 44.955912	Titanium 22 Ti 47.867	Vanadium 23 V 50.9415	Chromium 24 Cr 51.9961	Manganese 25 Mn 54.938044	Iron 26 Fe 55.845	Cobalt 27 Co 58.933195	Nickel 28 Ni 58.6934	Copper 29 Cu 63.546	Zinc 30 Zn 65.38	Gallium 31 Ga 69.723	Germanium 32 Ge 72.6305	Arsenic 33 As 74.9216	Selenium 34 Se 78.96	Bromine 35 Br 79.904	Krypton 36 Kr 83.80	
Rubidium 37 Rb 85.4678	Strontium 38 Sr 87.62	Yttrium 39 Y 88.90584	Zirconium 40 Zr 91.224	Niobium 41 Nb 92.90638	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 107.8682	Cadmium 48 Cd 112.411	Indium 49 In 114.818	Tin 50 Sn 118.710	Antimony 51 Sb 121.757	Tellurium 52 Te 127.60	Iodine 53 I 126.905	Xenon 54 Xe 131.29	
Cesium 55 Cs 132.90545196	Barium 56 Ba 137.327	* 57-70	Lanthanum 57 Lu 174.973	Hafnium 72 Hf 178.49	Tantalum 73 Ta 180.94788	Tungsten 74 W 183.84	Rhenium 75 Re 186.207	Osmium 76 Os 190.23	Iridium 77 Ir 192.222	Platinum 78 Pt 195.084	Gold 79 Au 196.966569	Mercury 80 Hg 200.59	Thallium 81 Tl 204.3833	Lead 82 Pb 207.2	Bismuth 83 Bi 208.9804	Po 84 Po [209]	Astatine 85 At [210]	Rn 86 Rn [222]
Francium 87 Fr [223]	Radium 88 Ra [226]	** 88-102	Lr [261]	Rf [261]	Db [262]	Sg [263]	Bh [264]	Hs [265]	Mt [266]	Uun [271]	Uuu [272]	Uub [273]	Uuq [274]					

* Lanthanide series

Lanthanum 57 La 138.905	Cerium 58 Ce 140.12	Praseodymium 59 Pr 140.90765	Nd 60 Nd 144.242	Promethium 61 Pm [145]	Samarium 62 Sm 150.36	Europium 63 Eu 151.964	Gadolinium 64 Gd 157.25	Terbium 65 Tb 158.92534	Dysprosium 66 Dy 162.50015	Ho 67 Ho 164.93032	Er 68 Er 167.259	Tm 69 Tm 168.93048	Yb 70 Yb 173.05468
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** Actinide series

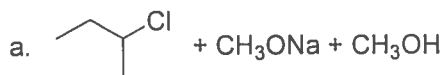
Actinium 89 Ac [227]	Thorium 90 Th 232.0377	Protactinium 91 Pa 231.036888	Uranium 92 U 238.02891	Np 93 Np [237]	Pu 94 Pu [244]	Am 95 Am [243]	Cm 96 Cm [247]	Bk 97 Bk [247]	Cf 98 Cf [251]	Es 99 Es [252]	Fm 100 Fm [257]	Md 101 Md [258]	No 102 No [259]
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Average: 62.0
Median: 66.0
St Dev: 22.2
Max: 96
Min: 9

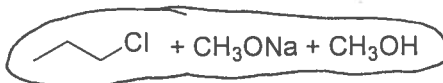
pKa Values

HI	-10	HN ₃	4.7	H ₂ O	15.7
HBr	-8	H ₂ S	7.0	Alcohol (ROH)	16-18
HCl	-6	NH ₄ ⁺	9.3	HC≡CH	26
H ₃ O ⁺	-1.7	HCN	9.4	Amines (e.g. LDA)	36
HF	3.2	Phenol	10	H ₂ C=CH ₂	45
CH ₃ COOH	4.7	RSH	10-12	CH ₄	60

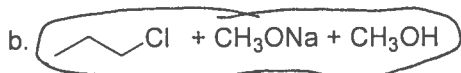
- 1) For each of the following pairs of reactions, circle the one that would be faster at S_N2 and explain why in under ten words. If both are equal, do not circle an option. (3 pts each)



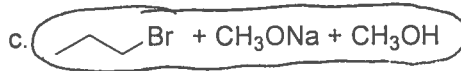
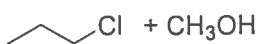
1° is faster than 2°



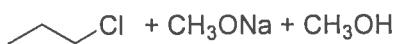
1 pt for circle,
2 pts for explanation.



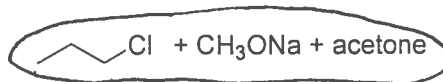
CH3O^- is a better nucleophile than CH3OH



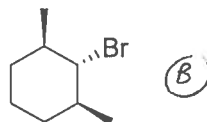
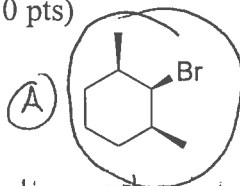
Br is a better leaving group than Cl.



S_N2 is faster in aprotic solvents.



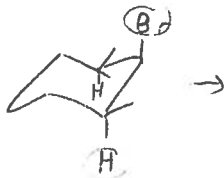
- 2) One of these molecules undergoes E2 elimination much faster than the other. Circle the faster molecule and explain why it is faster in under twenty words, but with as many structure drawings as you need. (10 pts)



4 pts for circle
6 pts for explanation.

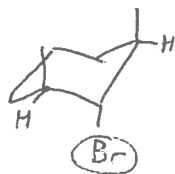
E2 requires antiperiplanar alignment \rightarrow both Br & H must be axial.

(A):



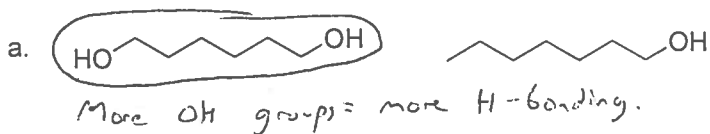
E2 easy.

(B)

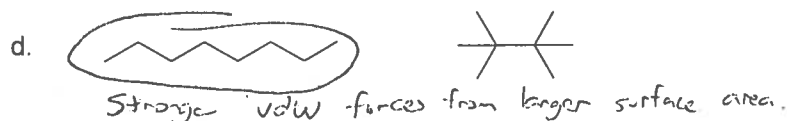
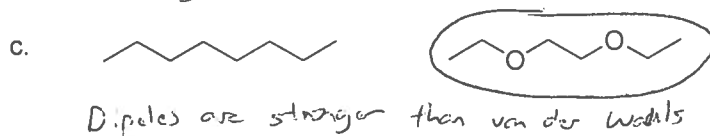
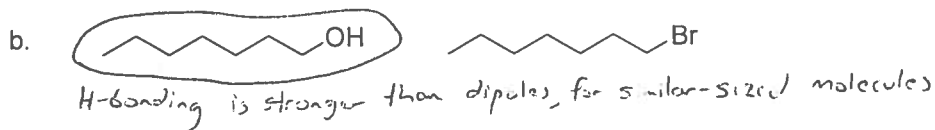


\rightarrow No E2 possible in chair structure.

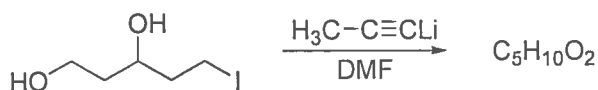
- 3) For each of the following pairs of reactions, circle the one with the higher boiling point and explain why it is higher in under ten words. (3 pts each)



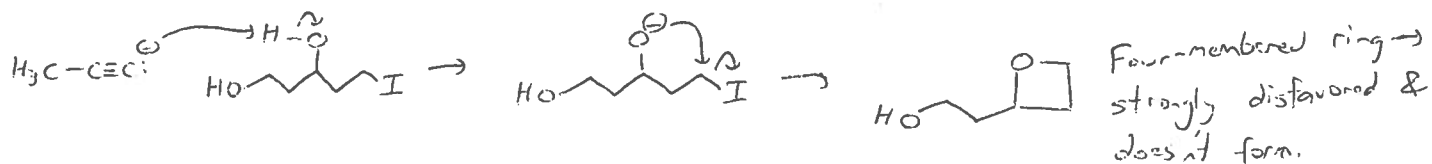
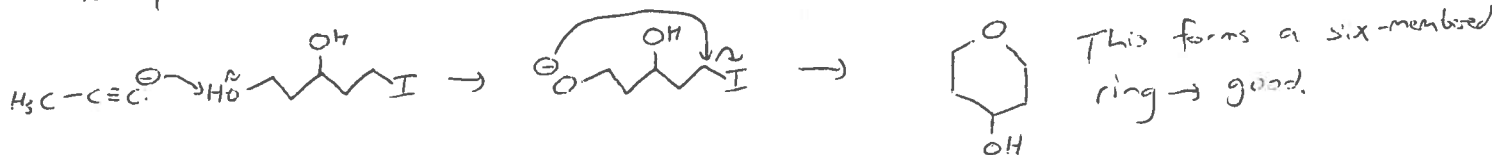
1 pt for circle,
2 pts for explanation.



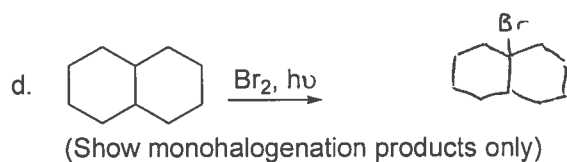
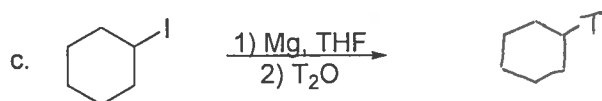
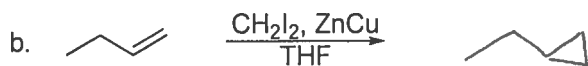
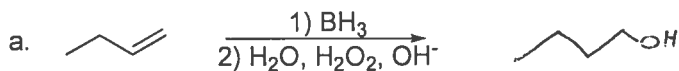
- 4) When the compound shown below is exposed to $\text{CH}_3\text{C}\equiv\text{CLi}$ in DMF, a single product is formed with the formula $\text{C}_5\text{H}_{10}\text{O}_2$. Show the structure of this product and the mechanism that forms it. (12 pts)



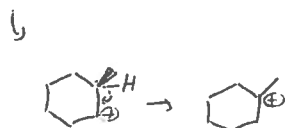
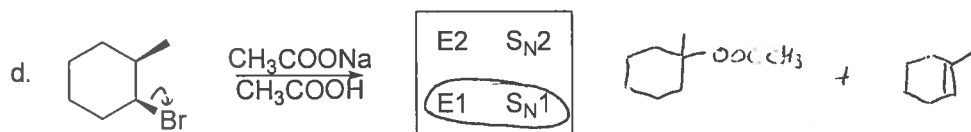
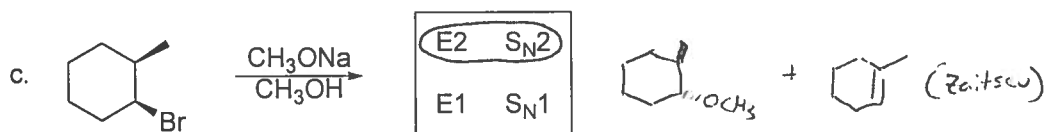
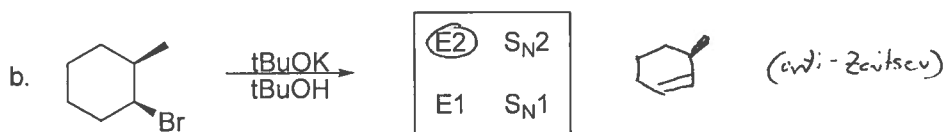
Two possibilities:



5) For each reaction shown below, predict the organic product(s). Ignore stereochemistry. (4 pts each)

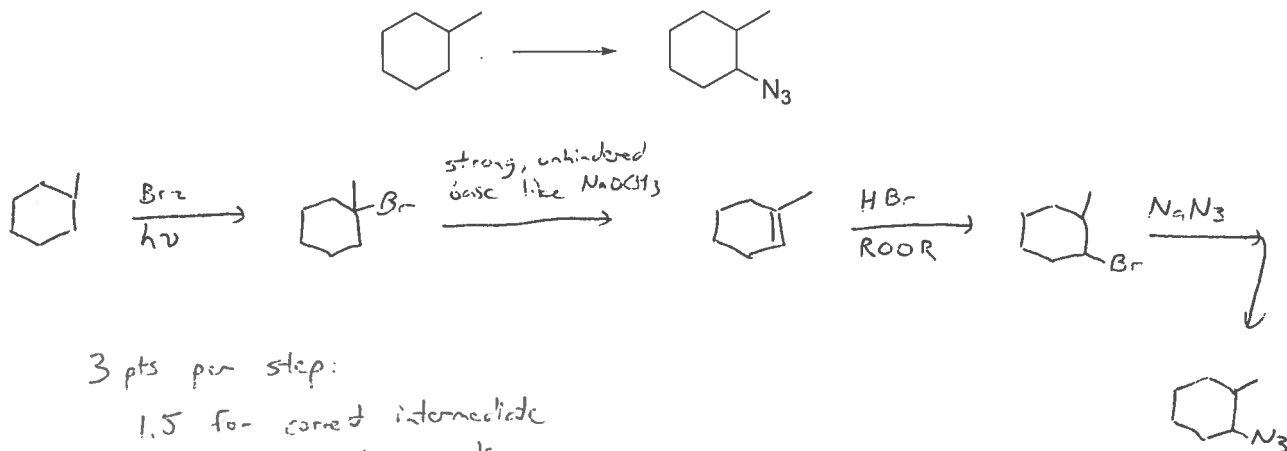


6) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If an elimination occurs, show only the major alkene product. If none of the mechanisms would take place in a reasonable time frame, write NR for No Reaction. (4 pts each)

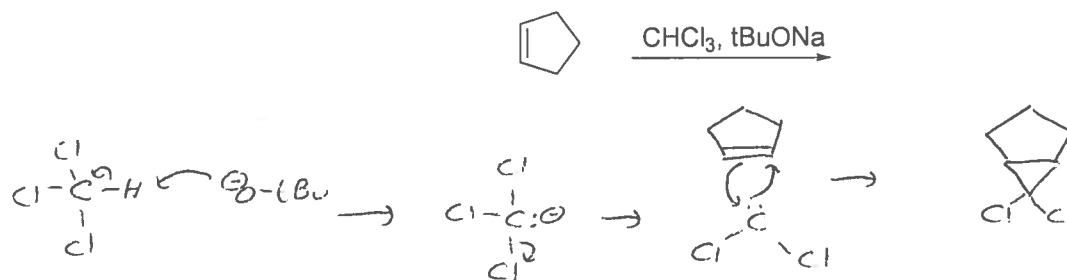


Each part:
2 points for mechanism(s)
2 points for product(s)

- 7) 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. (12 pts)



- 8) Show the mechanism and product of the following reaction. (10 pts)



2 pts for each mechanistic step
 4 pts for product