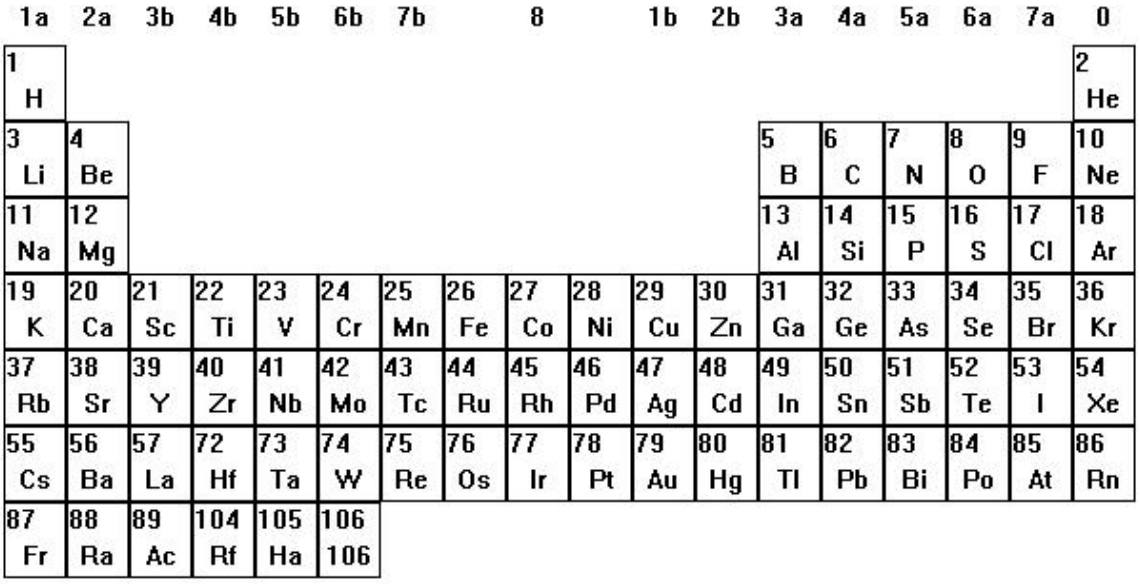
CHM 2120A
Midterm #1
October 7, 2015

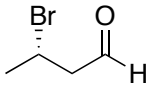
First Name: _____ Last Name: _____

Student Number: _____ Seat number: _____

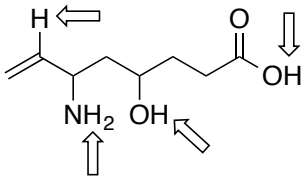
Approximate total number of marks: 72
The marks are given as a guide and are subject to change.
You can write in pen or in pencil.
Molecular models can be used but not shared.
Calculators or any other electronic devices may not be used for any reason.
There is a pK_a table on the last page.



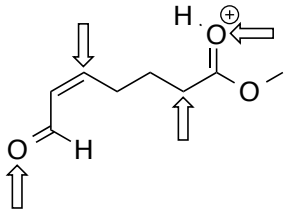
1. Name the following molecule. **(3 points)**



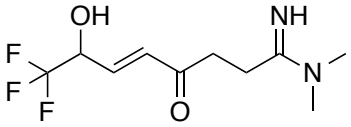
2. Estimate the pK_a value of each of the indicated protons. (**4 points**)



3. What is the hybridization of each of the indicated atoms? **(4 points)**

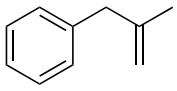


4. Point to the most acidic proton (→) and circle the most basic atom. **(2 points)**

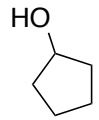


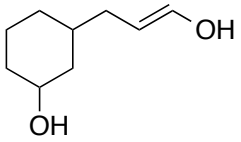
5. Protonate each of the molecules below. **(2 points)**

a) 

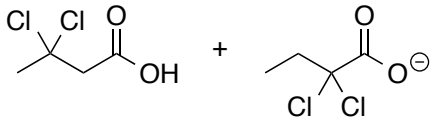
b) 

6. Deprotonate each of the compounds below. **(3 points)**

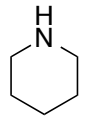
a) 

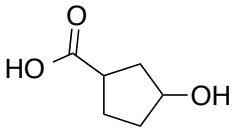
b) 

7. For the following reaction:
   a. Draw the mechanism and products. **(5 points)**
   b. Determine the direction of the equilibrium. **(1 point)**
   c. Justify your answer in part b. **(3 points)**

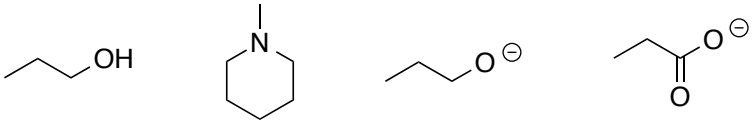


8. Draw the predominant form of each of the following compounds at pH 7. **(3 points)**

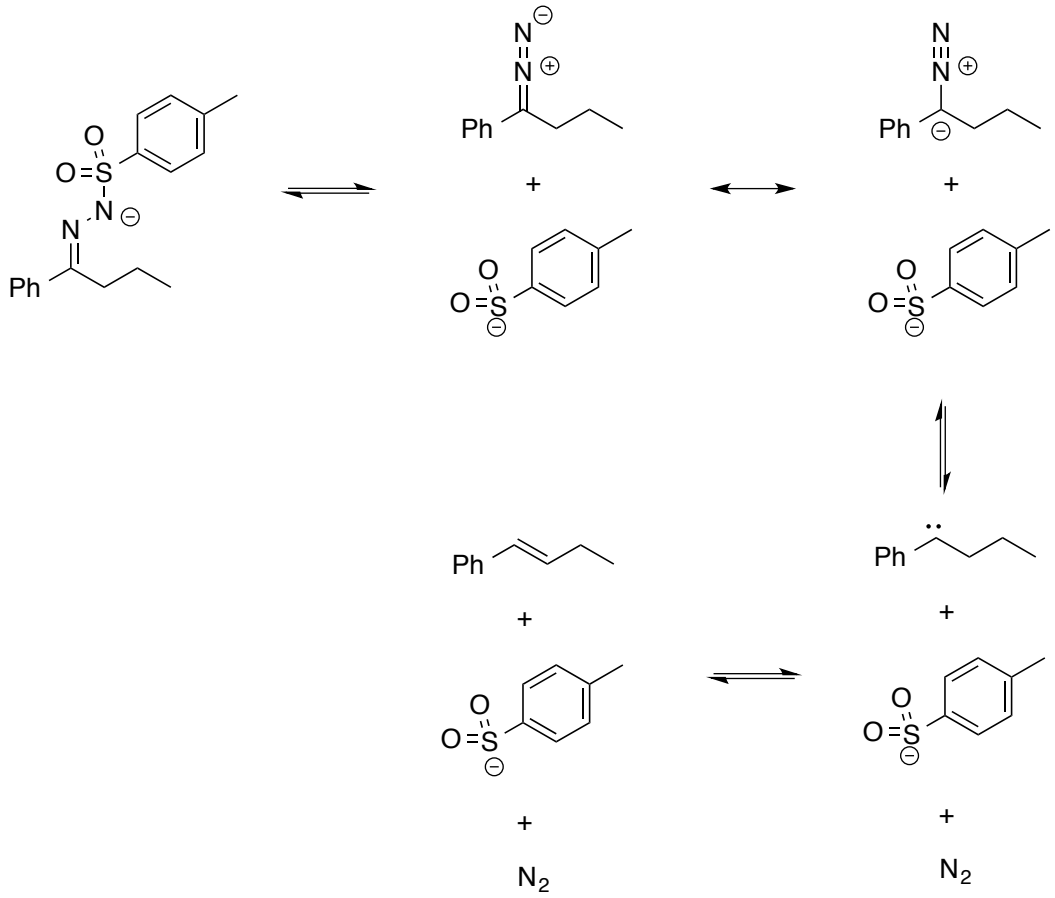
a) 

b) 

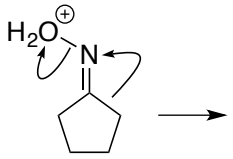
9. For the following compounds:
   a. Circle the strongest base for an E2 reaction. **(1 point)**
   b. Underline the bulkiest base for an E2 reaction. **(1 point)**



10. Add curved arrows to describe the mechanism for the following reaction (expand the structures as necessary). All reagents and intermediates have already been shown. **(7 points)**

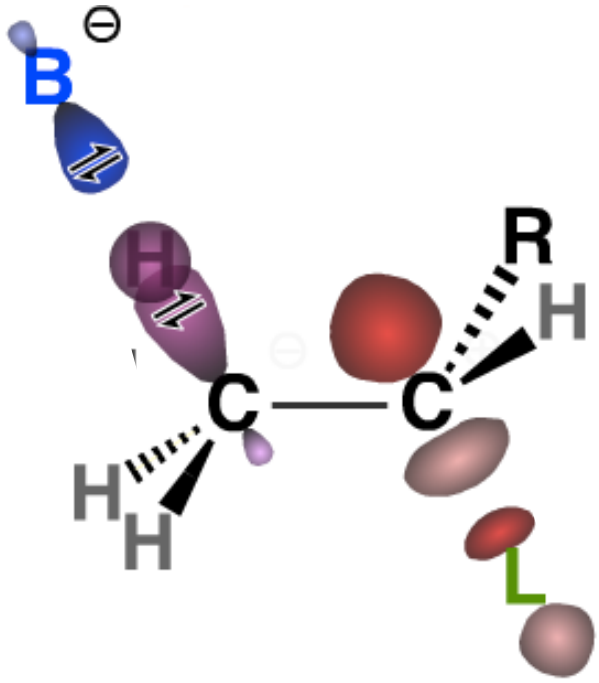


11. Draw the product of the reaction step shown below. **(2 points)**

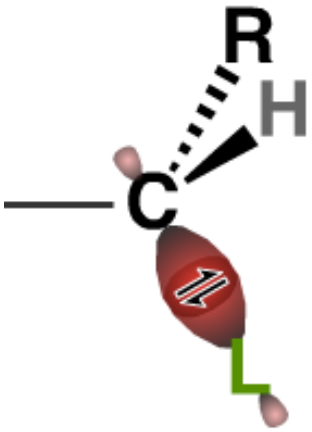


12. The following images represent the orbitals involved in an E2 reaction. Label each orbital and describe how each orbital is involved in the reaction. **(7 points)**

All reactants (B=base):

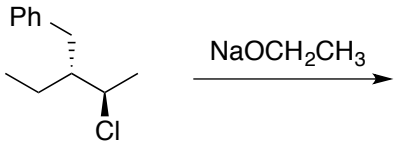


Expansion of carbon–leaving group (L) bond:



13.

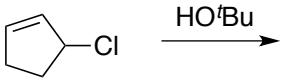
a. What is the major mechanism type for the reaction below? **(1 point)** _____
b. Draw the starting material in the Newman structure of its reactive conformation. **(3 points)**
c. Draw the mechanism and the major organic product. **(3 points)**



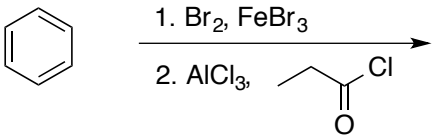
d. Explain the mechanism above. **(3 points)**

14. Draw the major organic product(s) for the following reactions. **(3 points each; total 9 points)**

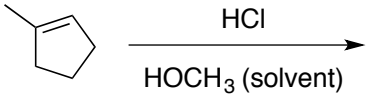
a.



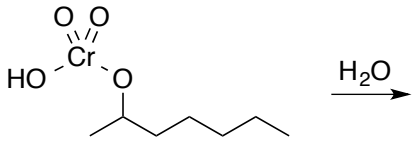
b.



c.



15. Draw the mechanism and products of the reaction below. **(3 points)**



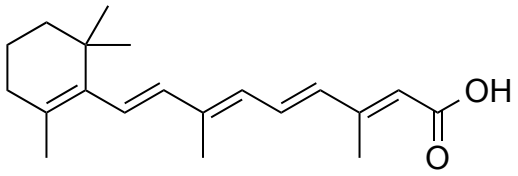
16. Add the appropriate reagents to effect the following transformations: **(2 points)**

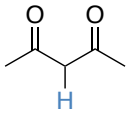
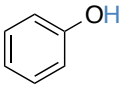
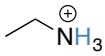
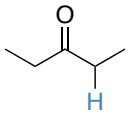
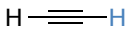
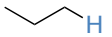
a.

b.

BONUS!

a) How many isoprene units are present in Vitamin A, shown below? **(1 point)**
b) Circle each of the isoprene units. **(2 points)**



Acid	pK_a value (H_2O solvent)	Acid	pK_a value (H_2O solvent)
HI	-10		9
H_2SO_4	-3		
HBr	-9		9.9
HNO_3	-1.3		
HCl	-8		10.6
HF	3.17	H_2O	15.7
	-3.8		17
	-2.6		20
	-6.2		24
H_3O^+	-1.7	H_2	36
$CH_3OH_2^+$	-2.2	NH_3	38
	4.76		50
			51