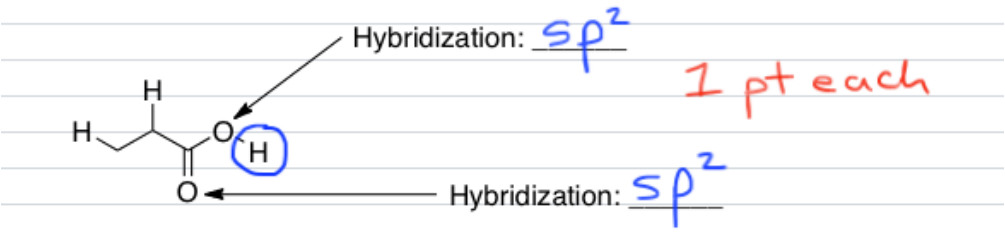
CHM 1321 B
Midterm 2
March 17, 2011
ANSWERS – Total: 55 possible marks
Note: The points are given as a guide and are subject to minor changes.

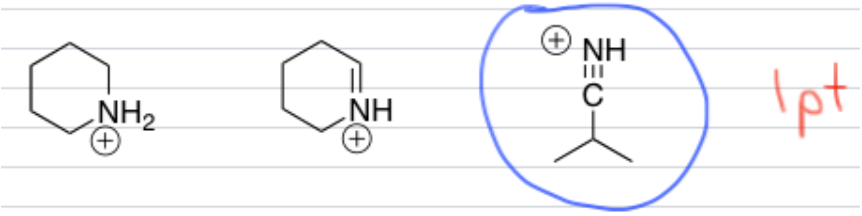
Last name: _____ First name: _____

Student Number: _____ Seat Number: _____

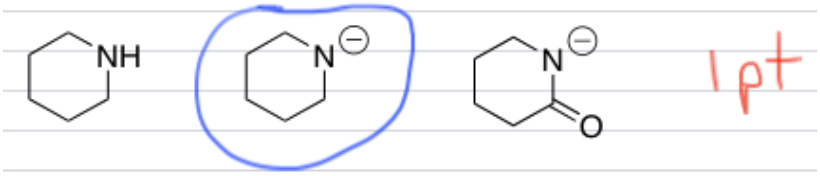
1. For the carboxylic acid shown below:
   a. Circle the most acidic proton. **(1 point)**
   b. What is the hybridization of each of the oxygen atoms? **(2 points)**



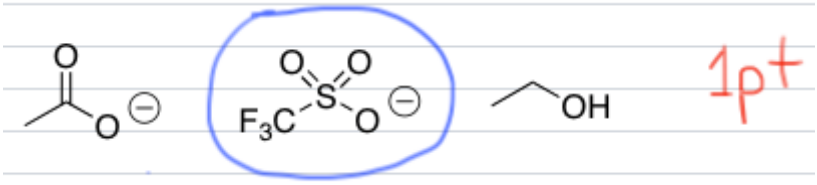
2. Circle the strongest acid in the following set: **(1 point)**



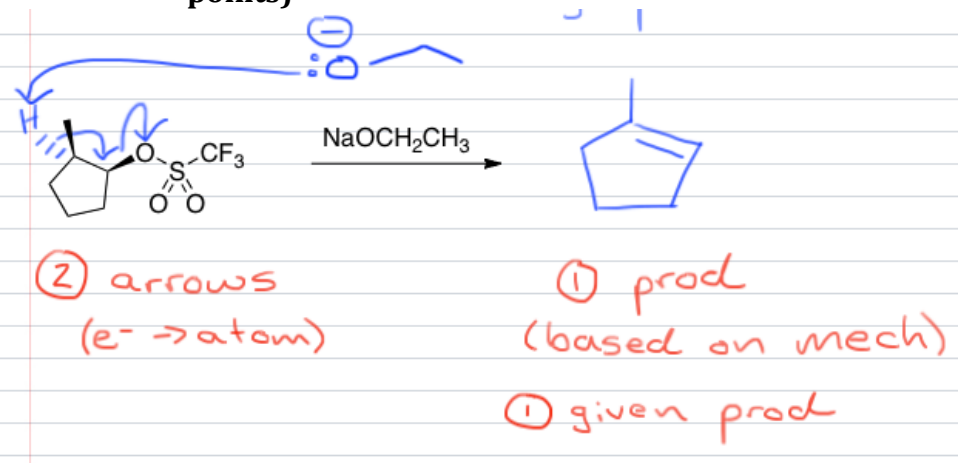
3. Circle the best nucleophile in the following set: **(1 point)**



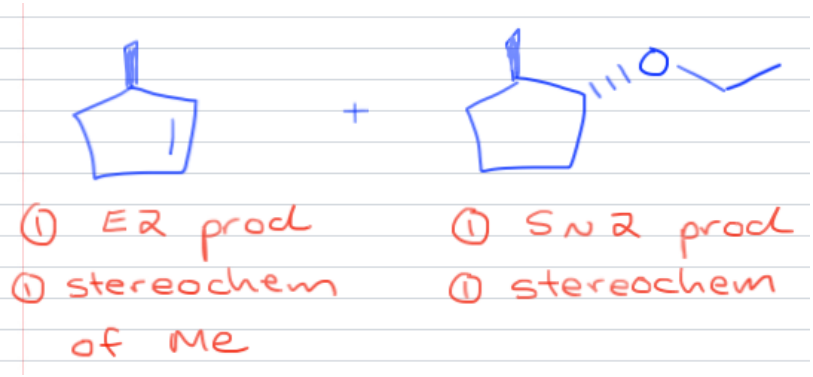
4. Circle the best leaving group in the following set: **(1 point)**



5. For the following reaction:
   a. Draw the mechanism to show the formation of the **major** organic product: **(4 points)**

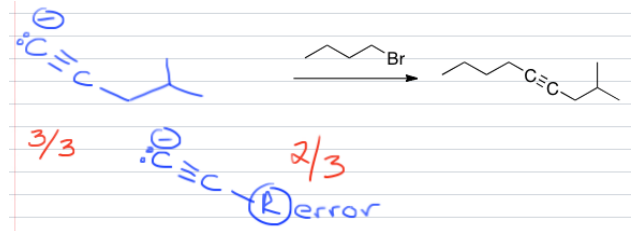


   b. Draw the two minor products. **(4 points)**

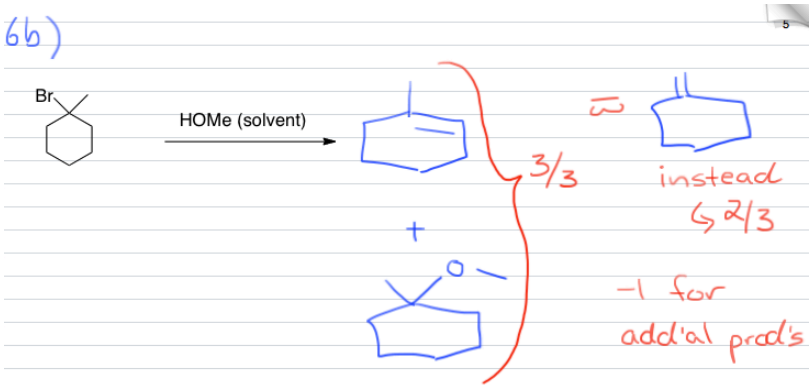


6. Draw the starting material **OR** the major product(s) for each of the following reactions: **(3 points each, total = 12 pts)**

a.



b.



6.

c.

3/3 ✓ right stereo

2/3 ✓ wrong "

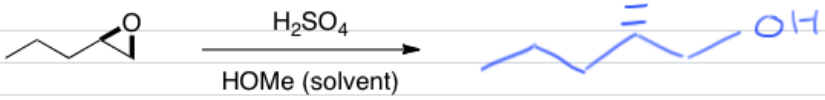
1/3 for S_N2 on sp^2

2/3 E2 - most stable

1/3 E2 - least "

d.

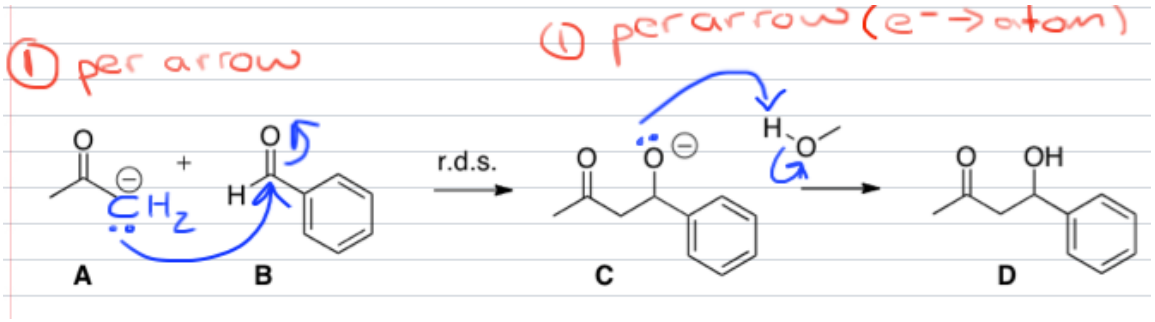
6d)



① isomer ① regio

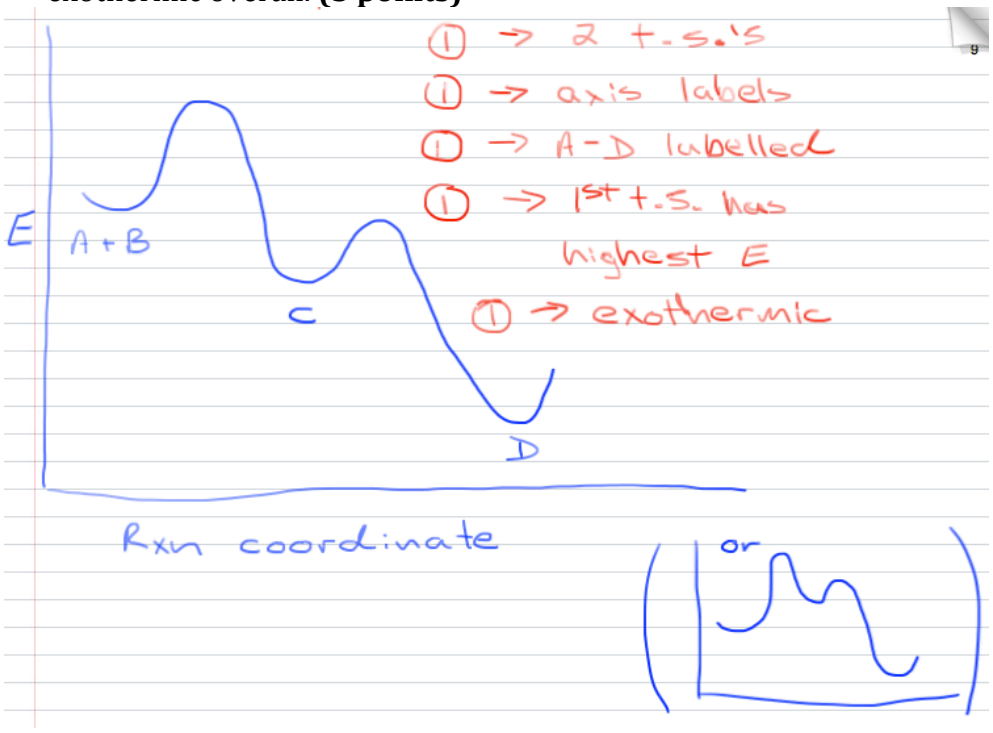
① stereo

7. Consider the following reaction in which **C** is the only intermediate:



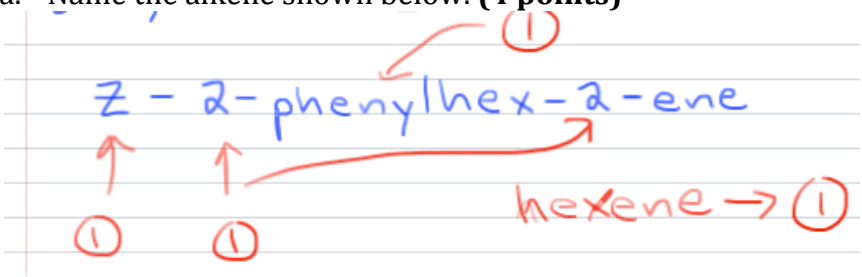
a. Draw the mechanism for each of the steps shown in reaction above. **(5 points)**

b. Draw and label the reaction coordinate diagram for this reaction, which is exothermic overall. **(5 points)**

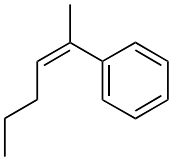


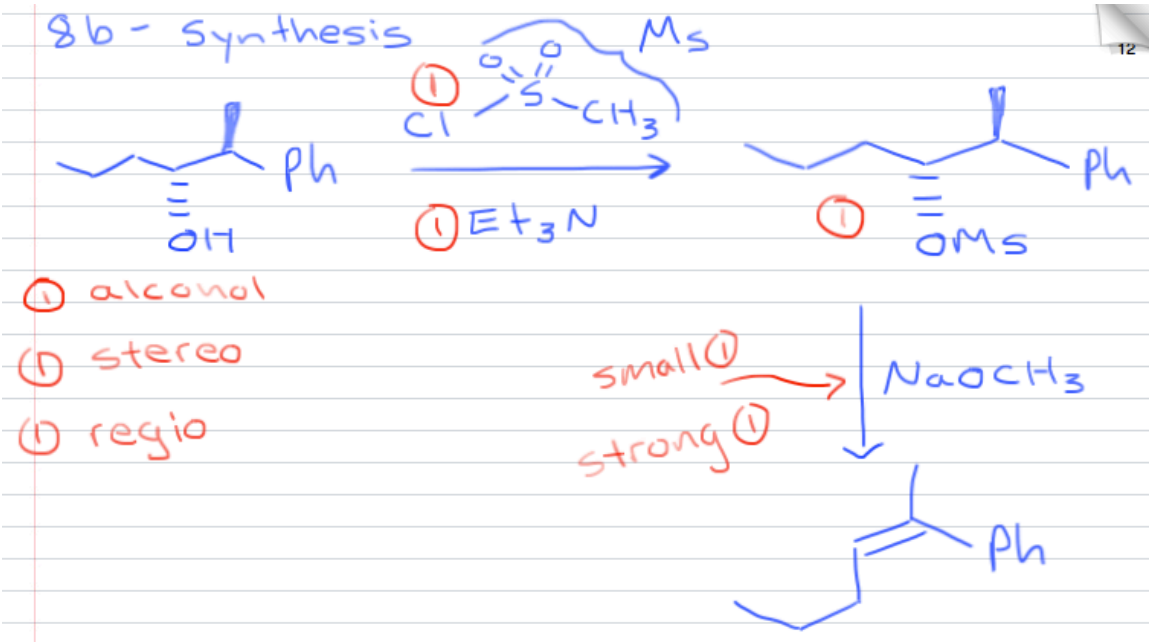
8.

a. Name the alkene shown below. **(4 points)**



b. Propose a synthesis of the following alkene from any alcohol starting material plus any other reagents. Be sure to take stereochemistry into account. It is not necessary to provide a retrosynthesis, mechanism or solvents. **(8 points)**



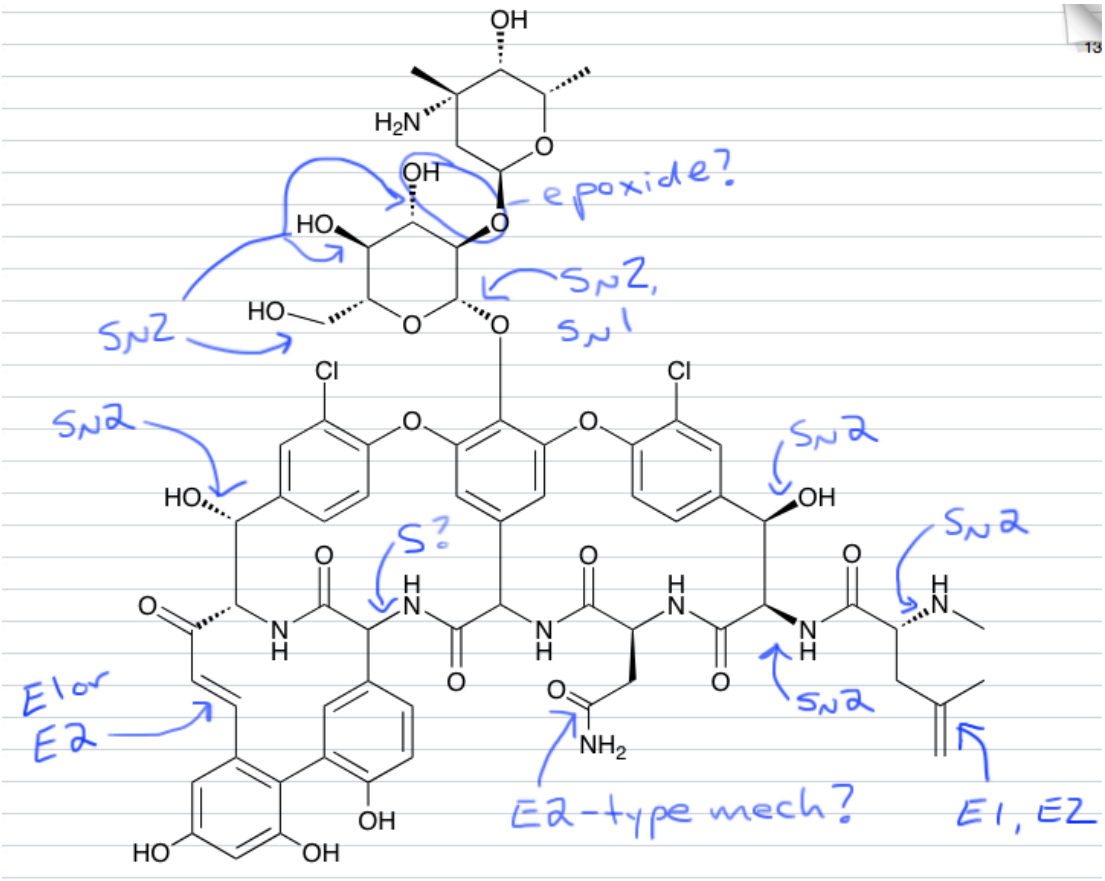


9. Consider the analog of Vancomycin shown below, which is an antibiotic of last resort against methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria.

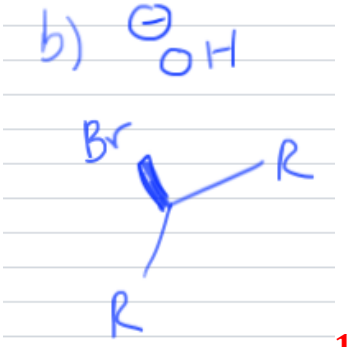
a. Identify the bonds that could be formed using reactions learned in this course, and name which reaction you could use for each one. An example is shown below.

	1 point	2 points	3 points	4 points
# of reasonable ideas:	1-2	3-5	6-8	> 9

1 mark lost if atoms were identified instead of bonds

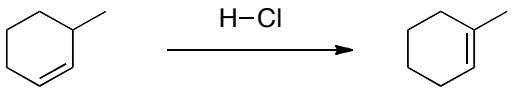


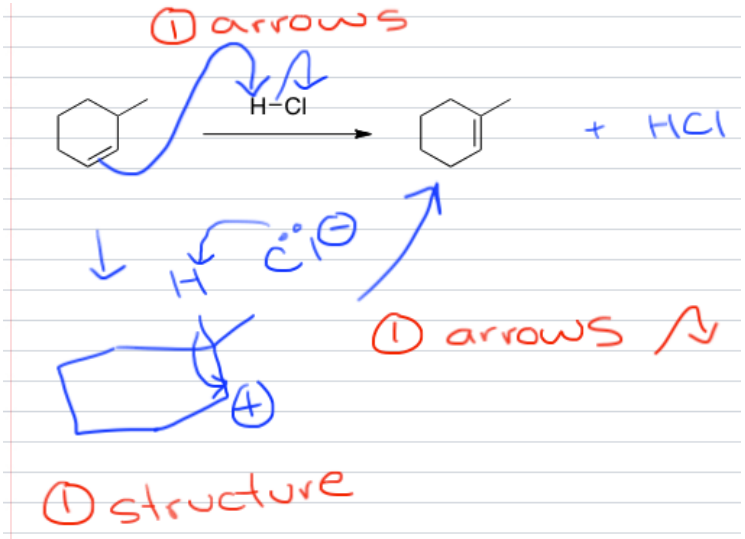
9. b. Select **one** reaction that would work well from part a and draw the appropriate starting materials, including stereochemistry as required. You can simplify the drawing by just including atoms near the reacting centre. **(3 points)**



1 point per reagent
1 point for stereochemistry/regiochemistry (as applicable depending on reaction selected)

BONUS! Propose a mechanism for the following transformation: **(3 points)**





1a	2a	3b	4b	5b	6b	7b		8			1b	2b	3a	4a	5a	6a	7a	0
1 H																		2 He
3 Li	4 Be												5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg												13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn		31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd		49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg		81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Ha	106 106													

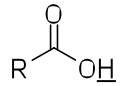
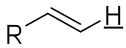
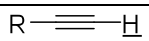
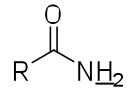
Approximate pKa's of Common Functional Groups

Note: the pKa value is quoted for the underlined "H"

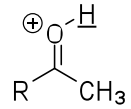
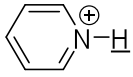
Strong acids:

Acid	pKa	Acid	pKa
HBr	-9	$\mathbf{H}_2SO_4$	-3
HCl	-7	$\mathbf{H}NO_3$	-1.4
HF	3	$\mathbf{H}OSO_2CF_3$	-14

Common organic functional groups:

Functional group	pKa	Functional group	pKa
RO**H** Alcohol	17	$\mathbf{H}_2$	35
$\mathbf{H}_2O$	15.7	$R_3C\mathbf{H}$ alkane	50
 Carboxlic acid	5	 Alkene	45
R_2NH Amine	40	 alkyne	25
 Amide	15	**H**CN	9.2

Protonated species:

Functional group	pKa	Functional group	pKa
$\mathbf{H}_3O^+$	-1.7	$N\mathbf{H}_4^+$ Ammonium	9
$R\text{-}O\mathbf{H}_2^+$ Protonated alcohol	-2	$R_3N\mathbf{H}^+$ Protonated amine	10
 Protonated ketone	-6	 Protonated pyridine	5