Key

CHM 2120B - MIDTERM #1

Date: Oct. 10, 2018 Duration: 90 minutes
Professor : Claudia El Nachef

First name: _____ Last name:_____

Student #: _____

- **Total number of points : 62**
- Molecular models are allowed.
- You can write with pen or pencil but regrading won't be possible if written in pencil.
- You should submit all scratch papers with the exam copy.
- A simplified pKa table is provided on the last page.

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												

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

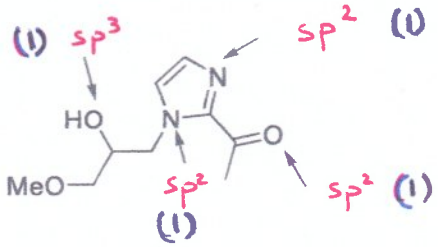
Cellular phones, unauthorized electronic devices or course notes (unless an open-book exam) are not allowed during this exam. Phones and devices must be turned off and put away in your bag. Do not keep them in your possession, such as in your pockets. If caught with such a device or document, the following may occur: you will be asked to leave immediately the exam and academic fraud allegations will be filed which may result in you obtaining a 0 (zero) for the exam.

By signing below, you acknowledge that you have ensured that you are complying with the above statement.

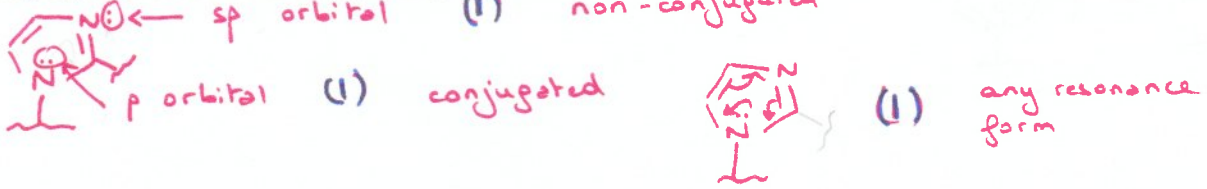
_____

GOOD LUCK!

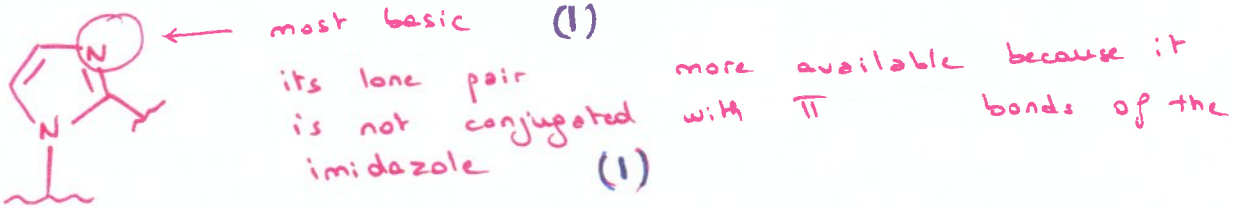
1. a) Identify the hybridization state of each of the atoms indicated by an arrow. **(4 points)**



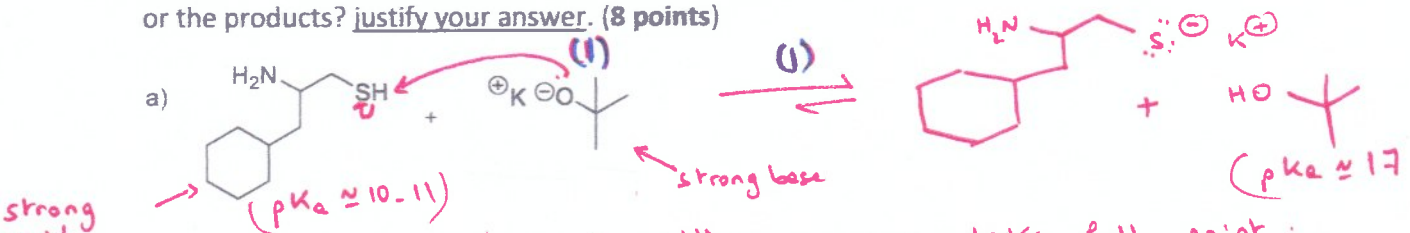
b) Indicate in what orbitals do the lone pairs of both nitrogens reside. Explain your answer using appropriate structure. **(3 points)**



c) Circle the most basic nitrogen atom and explain briefly your choice. **(2 points)**



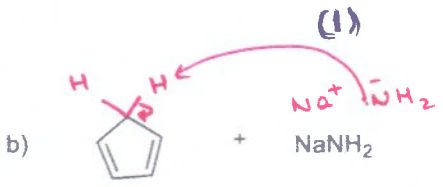
2. Complete each of the following reversible reactions. Use curved arrows to show the mechanism. Once products are established, show by using uneven equilibrium arrows, in each of the following cases, what side does the equilibrium favor, the starting materials or the products? <u>justify your answer</u>. **(8 points)**



(2) for justification : either answers take full point :

* either compare both pKa the thiol is more acidic than the alcohol (conjug acid) (show pKa)

* or compare relative stability. Thiolate (conjugate base) are more stable than alkoxides because of the atom size. Sulfur is bigger than oxygen ⇒ it will allow the negative charge to be dispersed more (more polarizable)

b)  + $NaNH_2$

(1)

+ NH_3

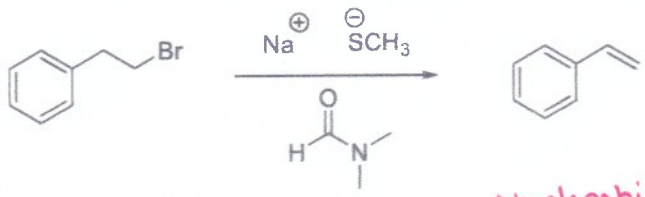
pKa ≈ 15 (stronger acid)

(stronger base)

pKa ≈ 38

(2) * Amide is the latter is aromatic ring stronger base than cyclopentadiene anion because stabilized by resonance - leading to an so even more stable anion (least basic

3. a- Explain why this following reaction will not work as shown: **(2 points)**
   b- Give the correct product of this reaction. **(2 points)**
   c- How would you only make the alkene shown? **(3 points)**



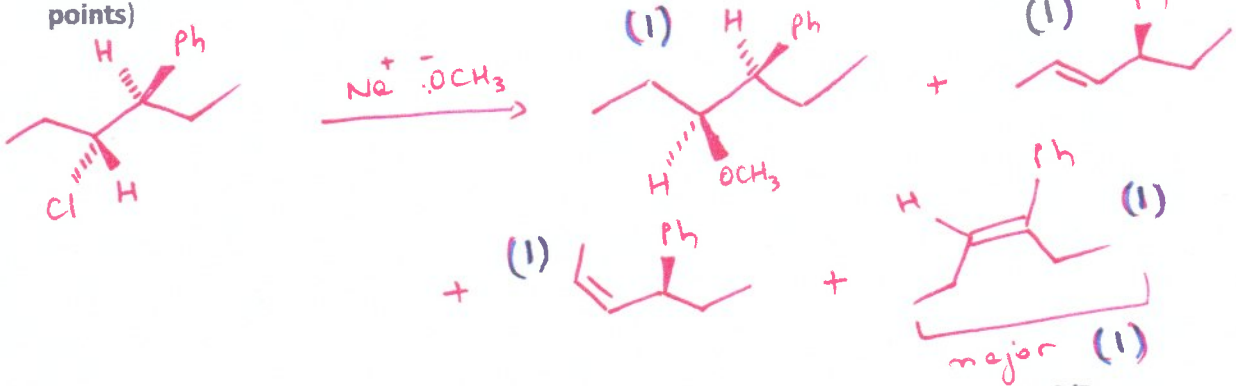
a- Thiolate is a strong Nucleophile with pKa of its conjugate acid ≈ 11 => not a strong base => favoring S_N2 not E2. (primary alkyl halide, polar aprotic solvent, no heating => all for S_N2

b- 

c- strong x Bulky base such as LDA, tBuOK, DBU or DBN would only generate the E2 product

or sodium hydride (strong base and never a nucleophile)

4. When (3*R*,4*R*)-3-chloro-4-phenylhexane is treated with sodium methoxide, alkenes are generated as well as a nucleophilic substituted product.
   a- Determine all the products from this reaction and indicate the one that is major. (5 **points**)



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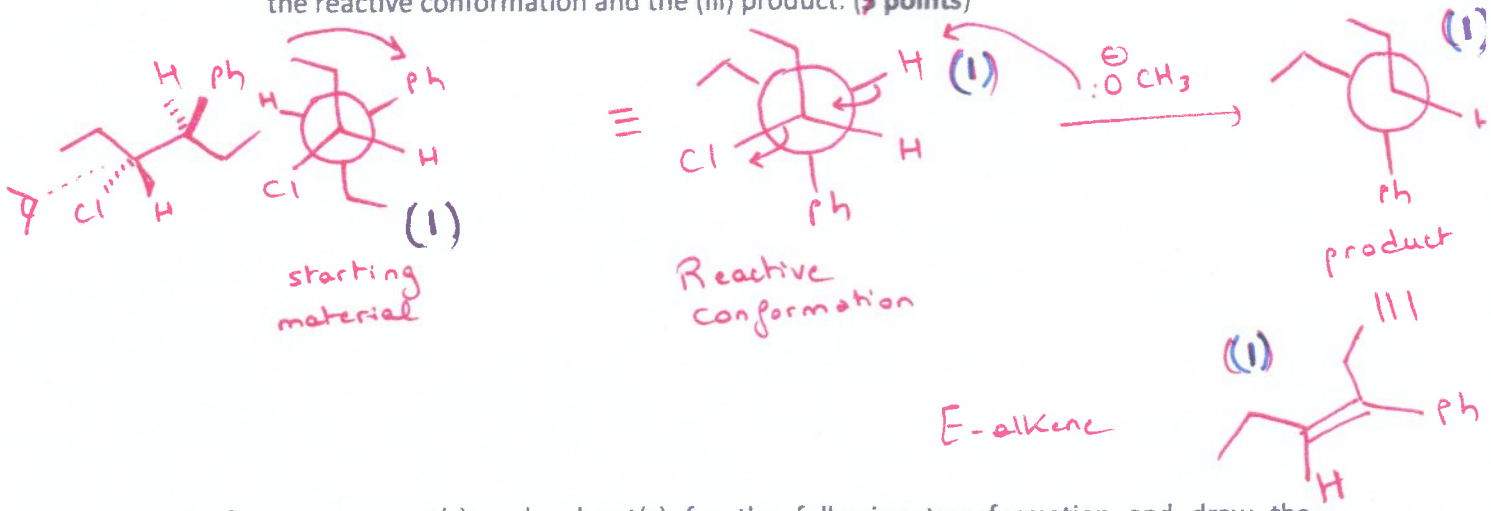
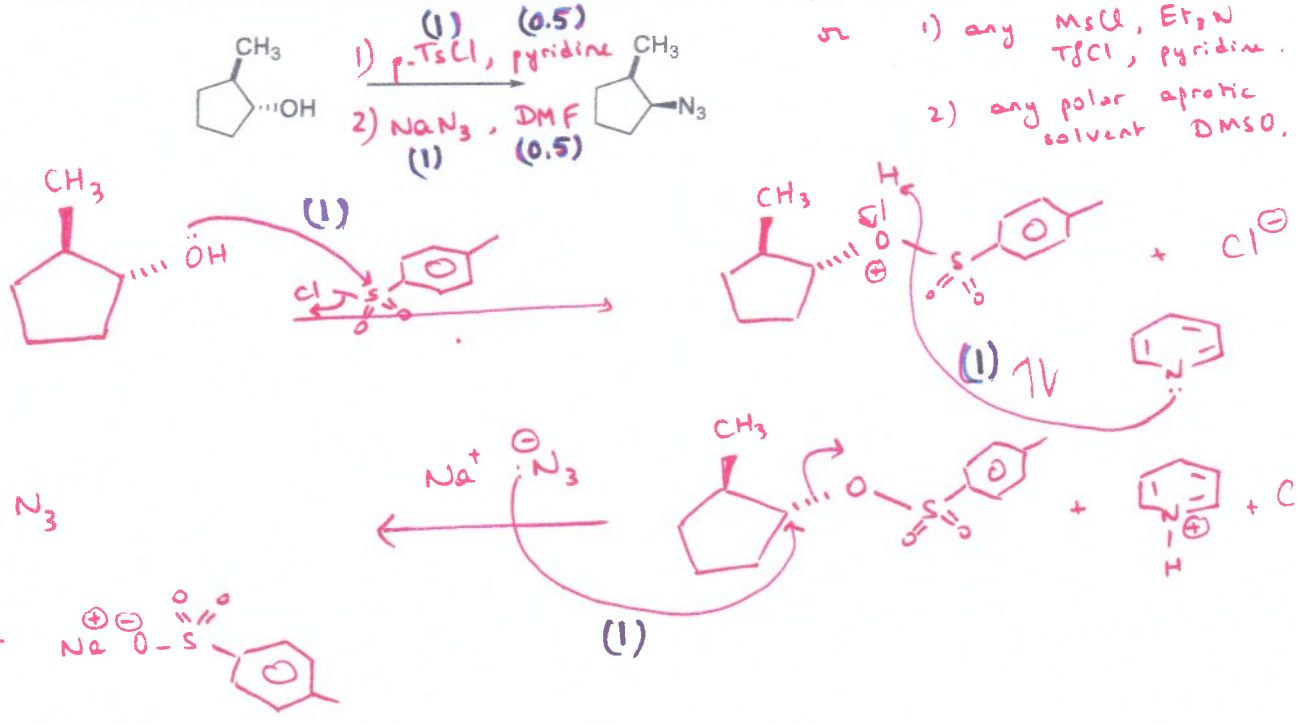
b- What is the IUPAC name of the product resulting from the substitution reaction? (**2 points**)

(3S, 4R) - 3- methoxy - 4 - phenylhexane

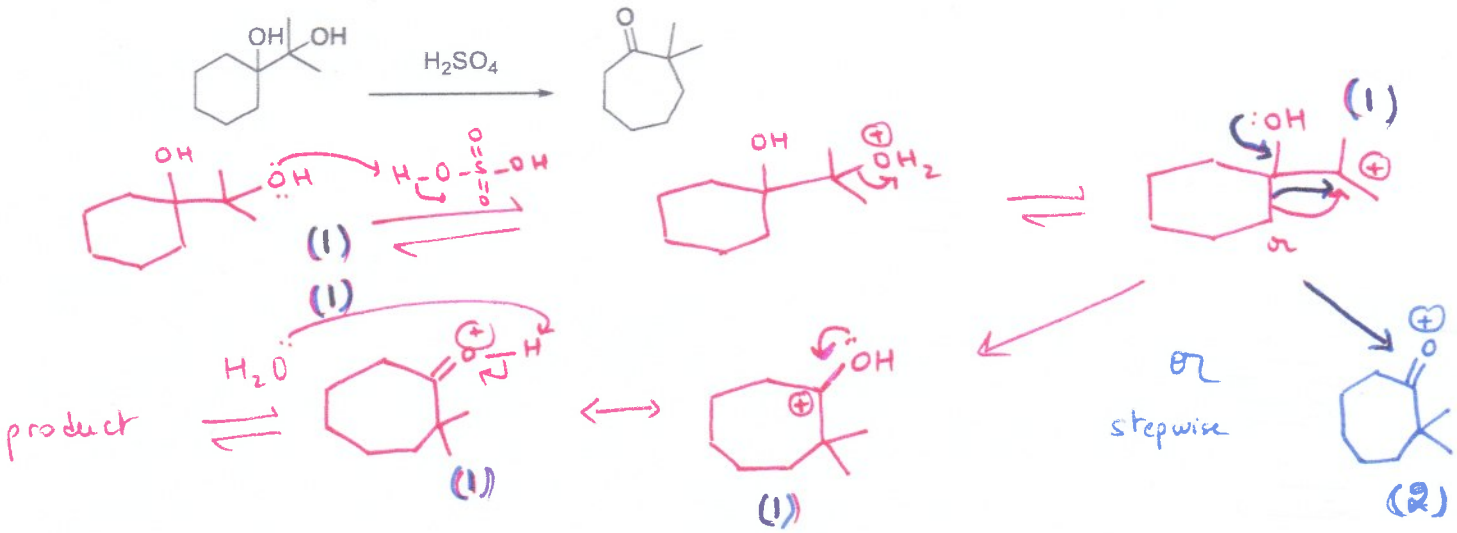
c- Draw the mechanism leading to the major product of this reaction. To support your answer, make sure to include the Newman projection of: (i) the starting material, (ii) the reactive conformation and the (iii) product. (~~5~~ 4 **points**)



5. Propose reagent(s) and solvent(s) for the following transformation and draw the mechanism for the formation of the intermediate and the final product. (**6 points**)

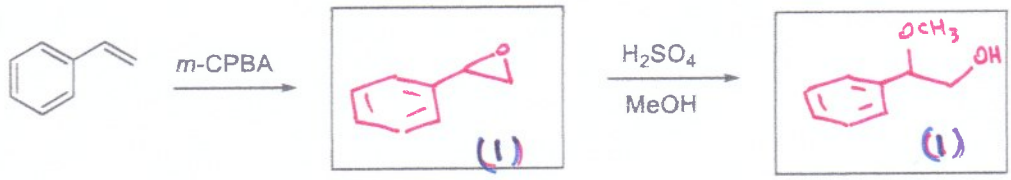


6. Suggest a mechanism for this following reaction: (**5 points**)



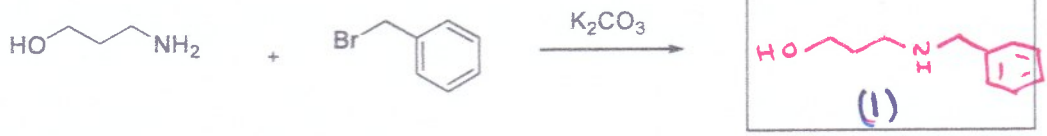
7. Draw the major product (s) of the following reactions and indicate what type of reaction mechanism took place. (**12 points**)

a)



S_N1 (1)

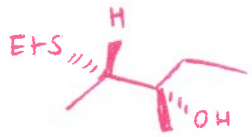
b)



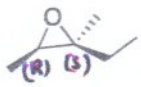
S_N2 (1)

c)

E2 (1)

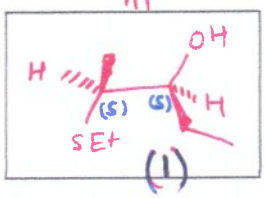


d)



1) NaSEt

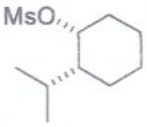
2) H_3O^+



(1)

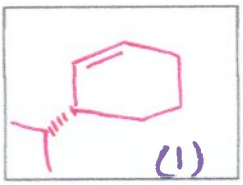
S_N2 (1)

e)



KO^tBu

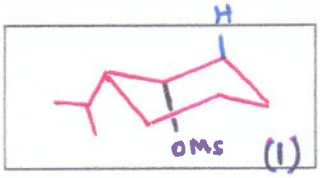
HO^tBu



(1)

E2 (1)

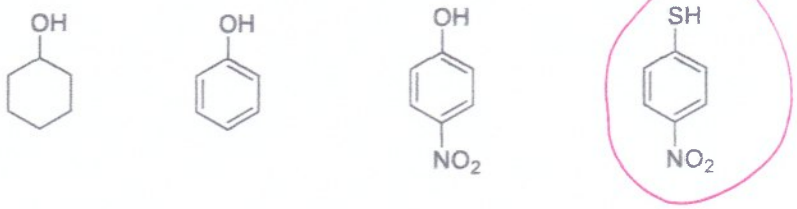
Show the reactive chair conformation



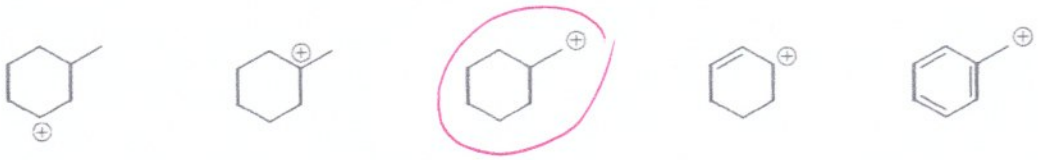
(1)

Molecule with the

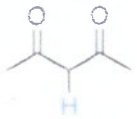
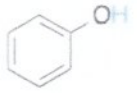
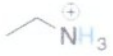
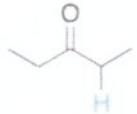
8. Circle the most acidic proton: **(2 points)**



9. Circle the carbocation with the highest energy. **(2 points)**



========== END OF EXAM ==========

Acid	pK_a value (H_2O solvent)	Acid	pK_a value (H_2O solvent)
HI	-10		9
HBr	-9		
HCl	-8		9.9
	-6.2		10.6
	-3.8	H_2O	15.7
H_2SO_4	-3		17
	-2.6		20
$CH_3OH_2^+$	-2.2		
H_3O^+	-1.7		24
HNO_3	-1.3	H_2	36
HF	3.17	NH_3	38
	4.76		50
			51
H_2S	7.00	BuSH PhSH	10-11 ≈7