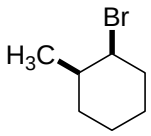
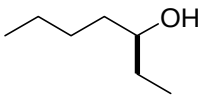
CHM 1321—Midterm #2 – ANSWERS
Friday, March 16, 2007

Name: _____ Student Number: _____

1. Provide names the following molecules **(4 points)**: 2 points each; -1 per error

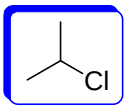
a) 

(1*S*,2*R*)-1-bromo-2-methylcyclohexane

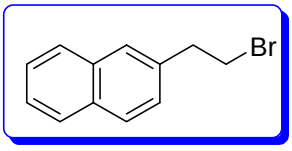
b) 

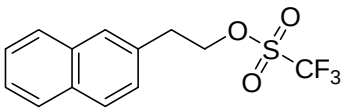
(*S*)-heptan-3-ol

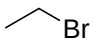
2. Circle the electrophile of each pair that will react more slowly in an S_N2 reaction ~~and give a brief explanation for each~~ **(3 points)**. 1 point each

a) 

vs 

b) 

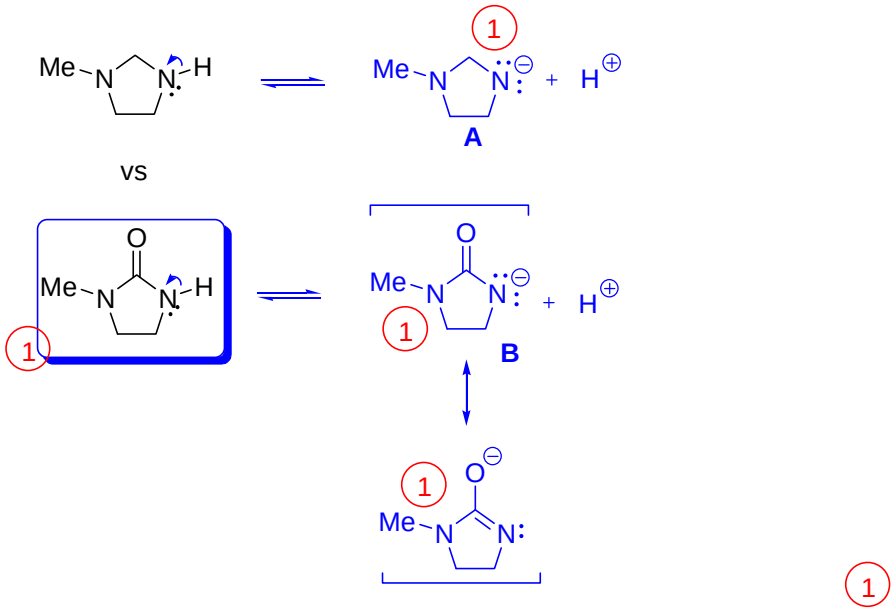
vs 

c) 

in DMSO
vs 

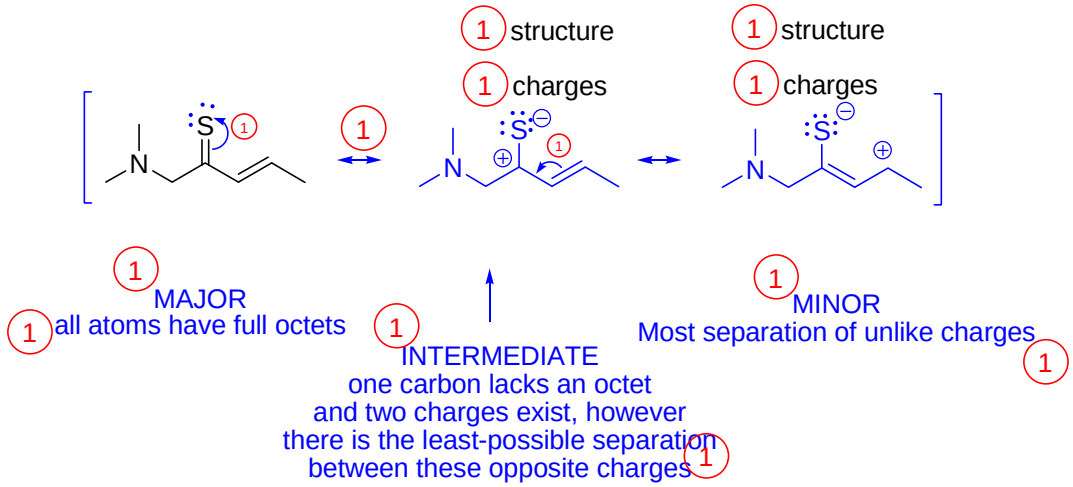
in MeOH

3. Predict which molecule will be the strongest acid and justify your choice. **(6 points)**



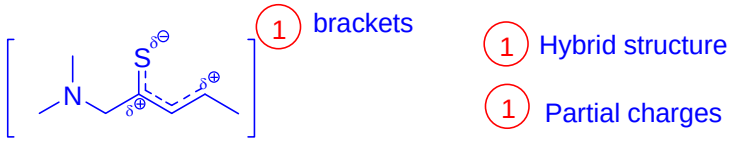
Compare conjugate bases. The first one (**A**) is not resonance-stabilized, while the second conjugate base (**B**) is resonance-stabilized. Because the charge is spread out in **B**, it is a weaker base and the conjugate acid is consequently stronger.

4. a) Draw the resonance forms for the following molecule using arrow notation to show the movement of electrons. **(7 points)**



4. b) Identify the major, minor, and intermediate (if applicable) resonance contributors and explain your reasoning. **(6 points)** **See above**

4. c) Draw the resonance hybrid structure. **(3 points)**

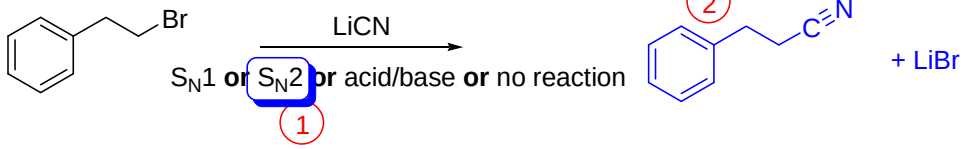


5. a) Give the products of the following reactions **(10 points)**

b) Identify whether each process would be S_N1, S_N2, acid/base, or no reaction. **(5 points)**

NOTE: Mechanisms are not required, but some marks might be given for an incorrect answer with a plausible mechanism.

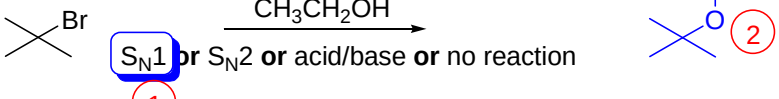
a)



S_N1 **or** S_N2 **or** acid/base **or** no reaction

1

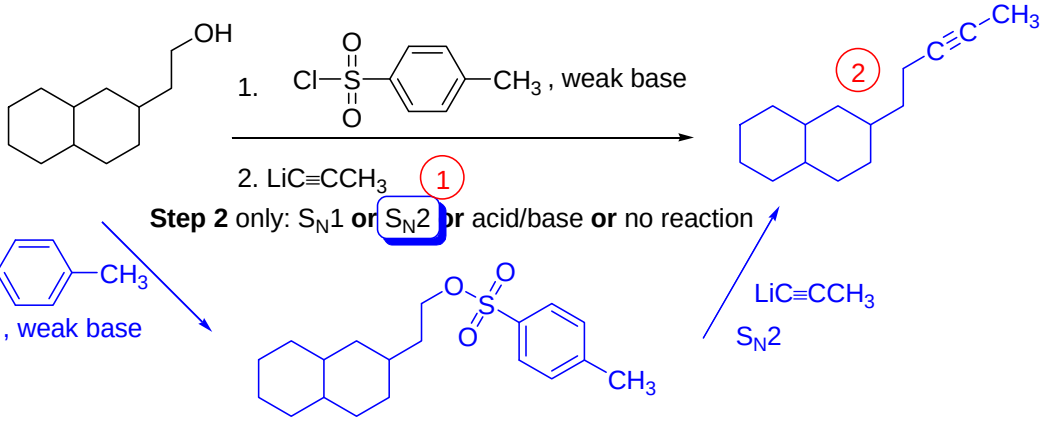
b)



S_N1 **or** S_N2 **or** acid/base **or** no reaction

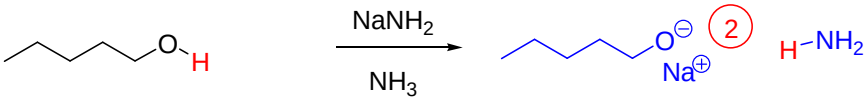
1

c)



1

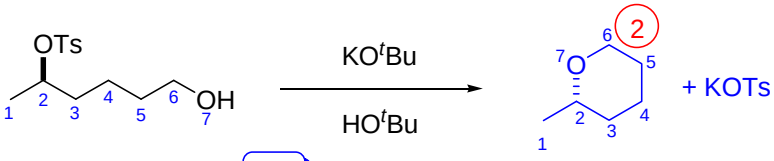
d)



S_N1 **or** S_N2 **or** acid/base **or** no reaction

1

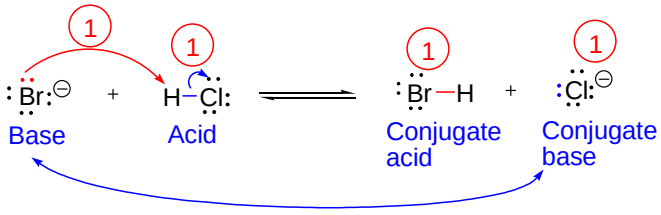
e)



S_N1 **or** S_N2 **or** acid/base **or** no reaction

1

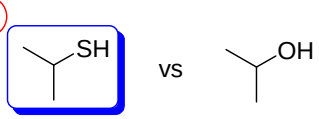
6. Write the equation for the following reaction using arrow notation. Predict whether the reaction will favor the starting materials or products and justify your choice. **(8 points)**



- Compare bases.
- Br is lower than Cl in the periodic table and Br is therefore bigger than Cl
- Br is better able to stabilize or spread out the negative charge because of its larger size
- Br is therefore a weaker base
- The equilibrium will favour the weaker base (starting materials)

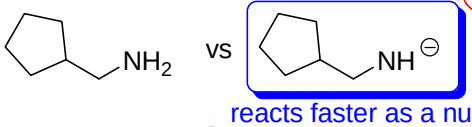
7. Circle the better nucleophile of each pair for an S_N2 reaction and briefly justify your choice for each. **(12 points)**

a)



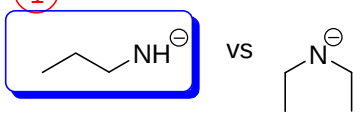
Sulfur is larger than oxygen (lower in the periodic table) and holds its electrons less tightly than O. It is therefore a better electron-donor than O.

b)



reacts faster as a nucleophile
conjugate bases are better nucleophiles than their conjugate acids since they are better able to donate electons.
The charge on the conjugate base raises the energy of the starting materials relative to the conjugate acids. This nucleophile will give a lower activation energy and faster reaction

c)

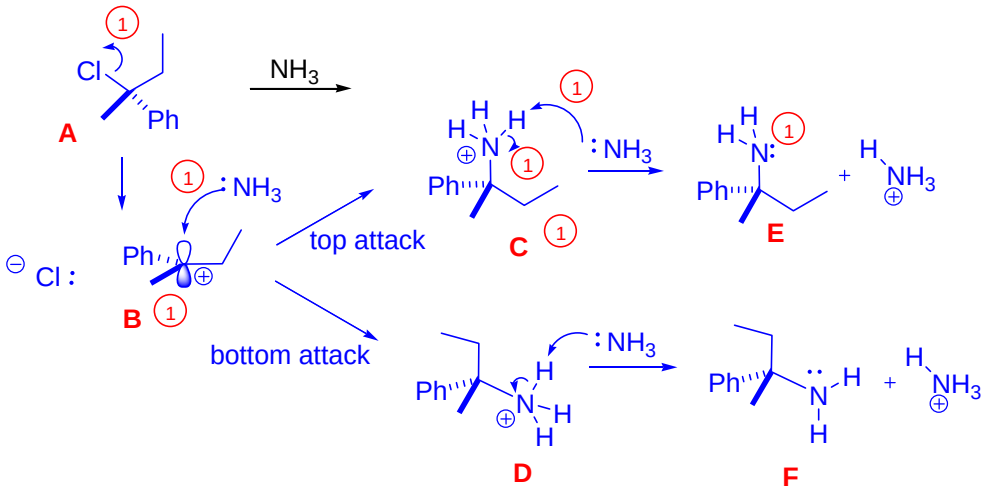


Reacts faster as a nucleophile because the N is is less crowded (primary)
Therefore the transition state will be less crowded and lower energy.
A lower energy transition state means a faster reaction

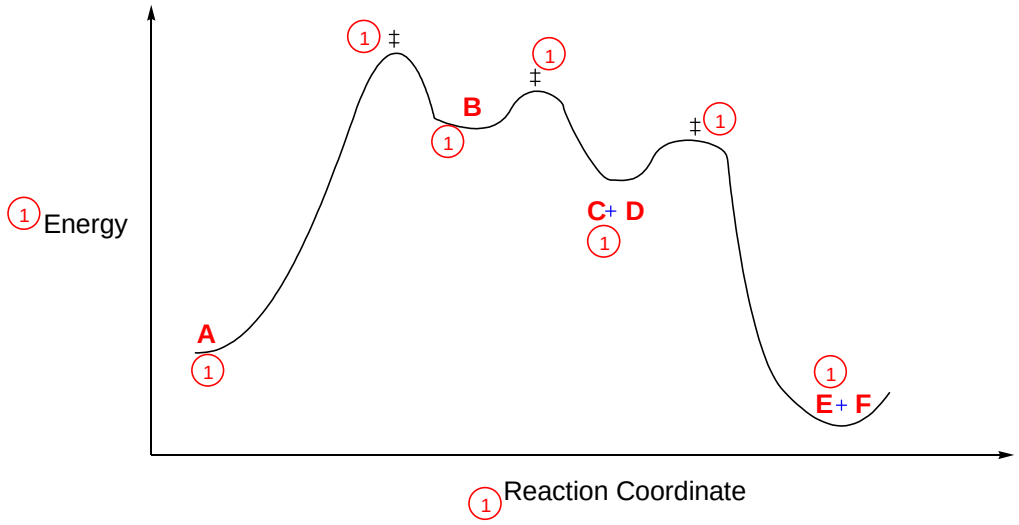
d)

O is a better nucleophile than F because it is the least electronegative of the pair and therefore has a weaker hold on its electrons.

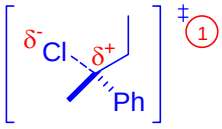
8. a) Provide a mechanism for the following transformation: **(7 points)**



8. b) Draw the reaction coordinate diagram for this reaction. **(9 points)**



8. c) Draw the transition state of the rate-determining step. **(3 points)**

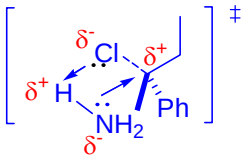


1 dotted Cl-C

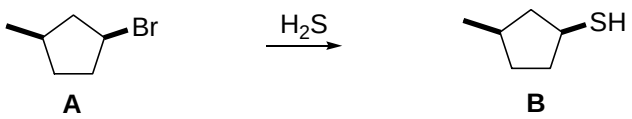
1 Partial charges

8. d) Would the reaction be faster using NH_3 or acetone as the solvent? Explain. **(4 points)**

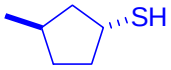
The reaction would be faster (1 point) using NH_3 as the solvent because this polar, protic solvent stabilizes the transition state (1 point) and resulting carbocation. It does this by hydrogen-bonding (1 point) with the leaving group and donation of electrons to the positive charge (1 point) being generated.



9. A researcher attempts to make compound **B** using the following reaction but does not succeed.



a) What is the true product of the reaction? **(1 point)**



b) Suggest a way to synthesize **B** starting with **A**. Show the structure the intermediate(s). Note: more than one step is required. **(5 points)**