

COMPLETE THIS SECTION : Up to TWO POINTS will be removed for incorrect/missing information!

PRINTED FIRST NAME _____ PRINTED LAST NAME _____

Person on your LEFT (or Empty or Aisle) _____

Person on your RIGHT (or Empty or Aisle) _____

Class you are REGISTERED FOR (onground or hybrid) _____

The room where most students will take the test for your class, i.e. LS A-191 for onground and PS H-152 for hybrid) _____

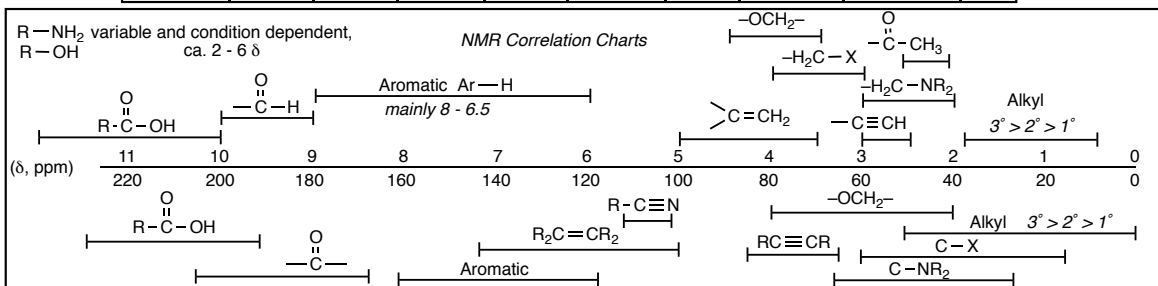
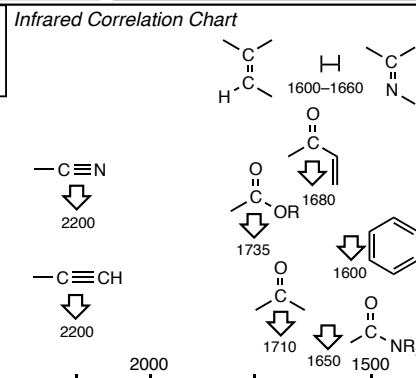
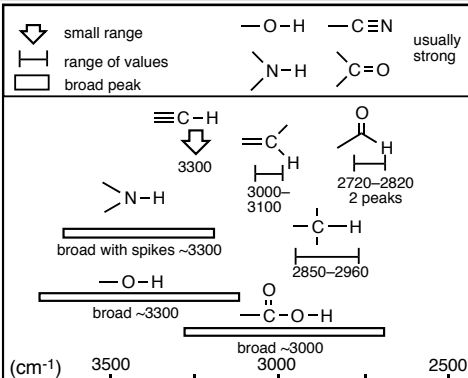
****YOU ARE NOT ALLOWED TO TAKE SPARE COPIES OF THIS EXAM FROM THE TESTING ROOM****

- | | |
|---|----------------------------------|
| • PRINT YOUR NAME ON EACH PAGE! | • WRITE CLEARLY! |
| • READ THE DIRECTIONS CAREFULLY! | • MOLECULAR MODELS ARE ALLOWED |
| • USE BLANK PAGES AS SCRATCH PAPER | • DO NOT USE RED INK |
| work on blank pages will not be graded... | • DON'T CHEAT, USE COMMON SENSE! |

H	He
Li Be	B C N O F Ne
Na Mg	Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn	Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd	In Sn Sb Te I Xe
Cs Ba Lu Hf Ta W Re Os Ir Pt Au Hg	Tl Pb Bi Po At Rn

Interaction Energies, kcal/mol

	Eclipsing	Gauche
H/H	-1.0	Me/Me -0.9
H/Me	-1.4	Et/Me -0.95
Me/Me	-2.6	i-Pr/Me -1.1
Et/Et	-3.1	t-Bu/Me -2.7



**YOU MUST COMPLETE THIS PAGE WITH YOUR NAME
(EVEN THOUGH YOU ALREADY DID THIS ON THE COVER PAGE)
AND ALSO GIVE YOUR ASU OR POSTING ID NUMBER**

we need this information because we will not be able to read the names of many students!

PRINTED
FIRST NAME _____ *PRINTED*
LAST NAME _____ *ASU ID or*
Posting ID _____

Points by question

1 _____ /14

2 _____ /24

3 _____ /20

4 _____ /12

5 _____ /20

6 _____ /24

7 _____ /63

8 _____ /10

9 _____ /8

10 _____ /40

11 _____ /30

12 _____ /36

13 _____ /40

14 _____ /20

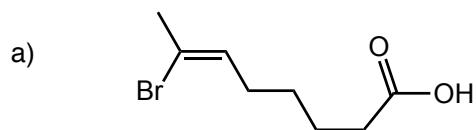
15 _____ /14

Points Removed for cover errors _____ /2

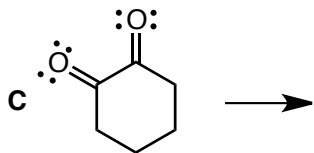
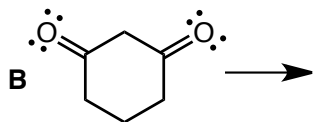
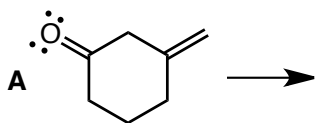
Extra Credit _____ /5

Total (incl Extra) _____ /375+5

Question 1 (14 pts.) Provide a IUPAC name for the following structure, do not forget to use E/Z and R/S as appropriate.



Question 2 (24 pts) Rank the following in order of increasing Bronsted acidity, and provide a BRIEF explanation. You MUST draw the structures of ALL OF the conjugate base anions including ALL reasonable resonance contributors



_____ < _____ < _____
weakest strongest

Extra Credit Question (5 pts). What kind of functional group is hydrolyzed to form soap?

carboxylic acid

ester

amide

aldehyde

Question 3 (20 pts.) For the following acid/base equilibrium:

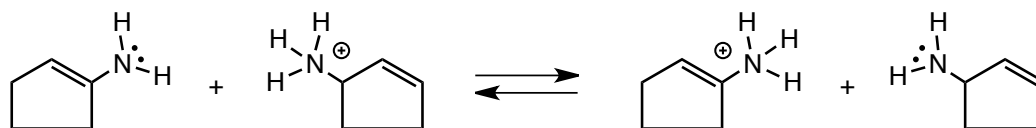
a) draw the curved arrows showing bond making/breaking

b) indicate which is the STRONGER and the WEAKER acid and base on each side

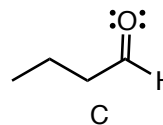
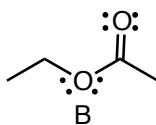
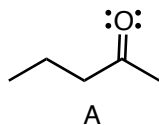
c) Indicate which acid has the larger and which the smaller pKa

d) give a BRIEF explanation for your choice of stronger/weaker that includes the phrase "energy of the electrons"

e) Indicate which reaction (left to right or right to left) is faster and which is slower and indicate on which side the equilibrium lies

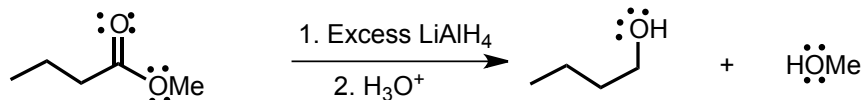


Question 4 (12 pts.) Rank in order of increasing equilibrium constant for formation of a hydrate. Give a BRIEF explanation.



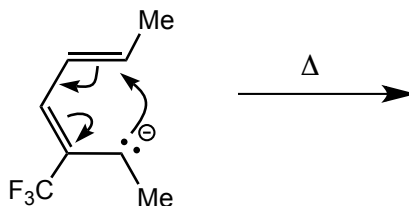
___ < ___ < ___
 smallest largest

Question 5. (20 pts.) Give a curved arrow-pushing mechanism for the reduction of the provided ester to butanol and methanol. You must draw the Lewis structure of the $^-AlH_4$ anion and you MUST show exactly where each proton comes from and goes to here, no $+H^+$ and $-H^+$ notation, and you must also show how the methanol is formed.



Question 6 (24 pts) For the electrocyclic ring closure reaction below, and using the curved arrow-pushing provided:

a) Give the ALLOWED product

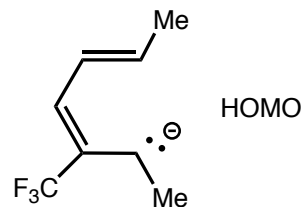


c) How many electrons are involved in this reaction

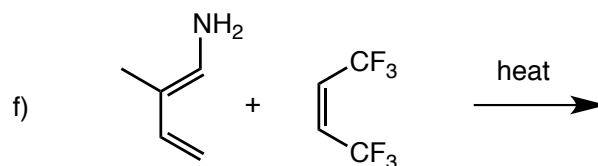
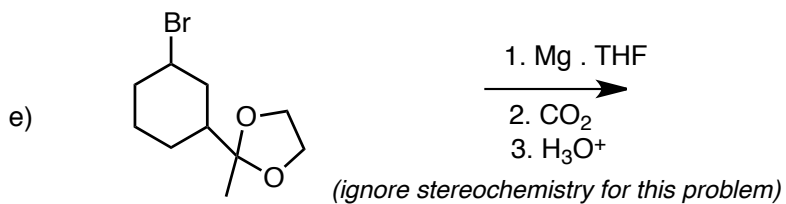
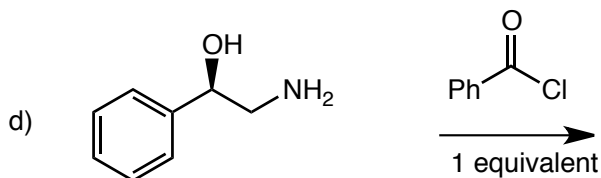
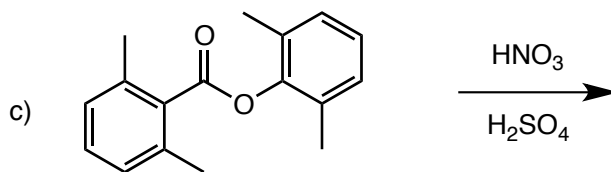
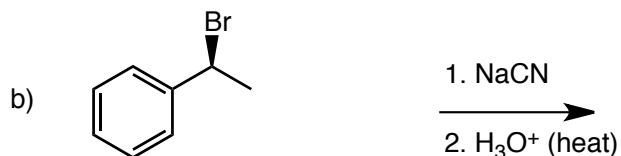
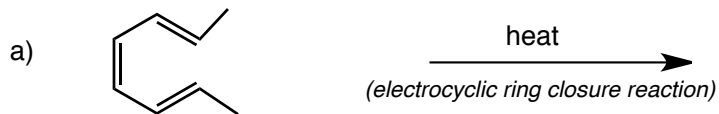
d) Does the ALLOWED reaction proceed via a disrotatory or a conrotatory ring closure

e) Does the allowed reaction proceed via a Huckel or a Mobius transition state? Give a BRIEF explanation

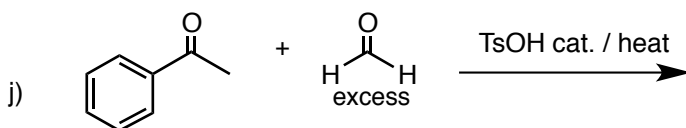
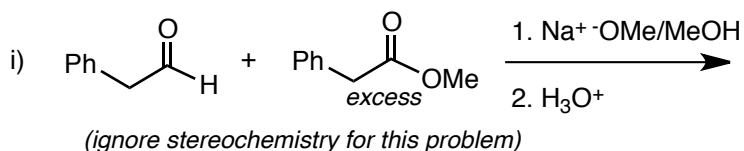
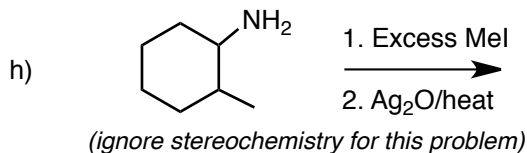
f) Draw the HOMO of the reactant anion ON TOP of the structure to the right



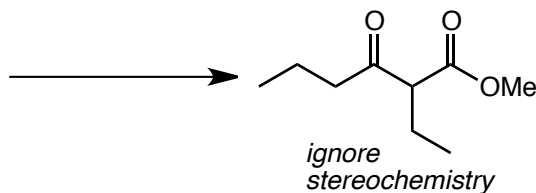
Question 7 (63 pts) Provide the missing major organic products or reagents/conditions for the following reactions. **Do not forget to include stereochemistry as appropriate** and INDICATE ANY RACEMIC MIXTURES.



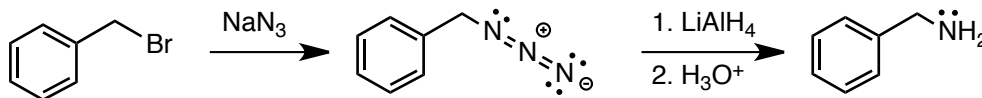
Question 7, Contd... Provide the missing major organic products for the following reactions. **Do not forget to include stereochemistry as appropriate** and INDICATE ANY RACEMIC MIXTURES.



Question 8 (10 pts) Give all reactants/reagents and conditions that would be used to give the provided structure below. Indicate whether the reaction is a Aldol reaction or a Claisen reaction.

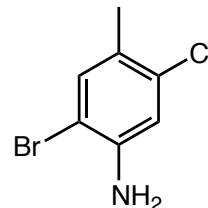
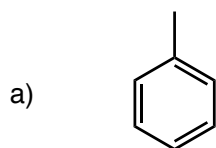


Question 9 (8 pts.) One method of synthesizing a primary amine is to convert a bromide into an azide by doing an S_N2 reaction with sodium azide (NaN₃), and then reducing with lithium aluminum hydride. In the provided box, draw a complete Lewis structure of the azide anion, including all non-bonding electrons and formal charges. This is not a reagent memorization problem, it is working out how to do an S_N2 reaction problem.

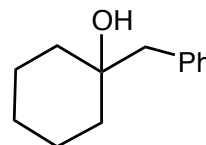
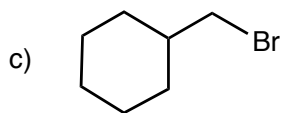
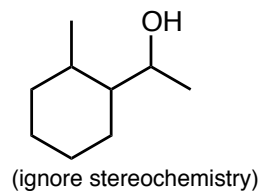
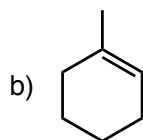


Lewis structure
of the azide anion

Question 10 (40 pts.) Show how you would make the target compounds on the right from the starting compounds on the left. Show reagents and conditions where appropriate, and the structures of important intermediate compounds. Do not show any (arrow pushing) mechanisms. **If necessary, you must indicate steps that require separation of isomers**



These questions use only reactions from the "minimal" sets that were provided on the class website

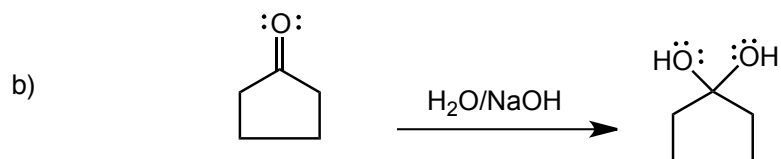
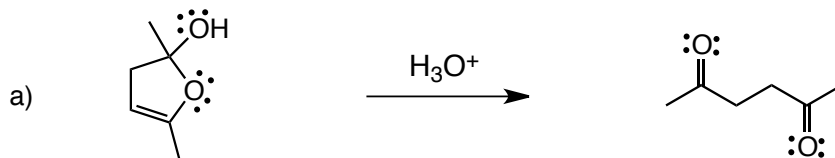


Question 11 (30 pts.) Give a curved arrow-pushing mechanism for the following reaction

Show where all protons come from and go to (no $+H^+/-H^+$)

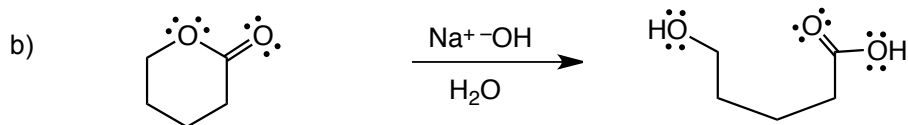
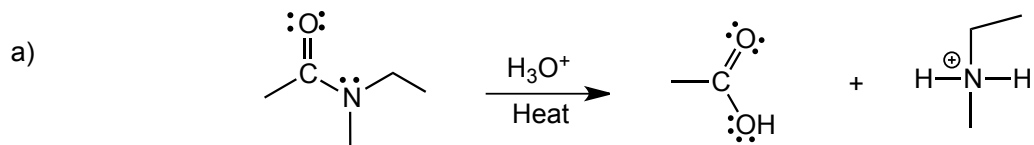
Show all resonance contributors to the intermediate structures

Label the Lewis acid/base and and Bronsted acids/bases as appropriate

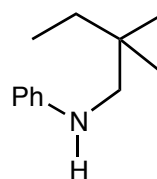
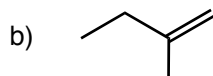
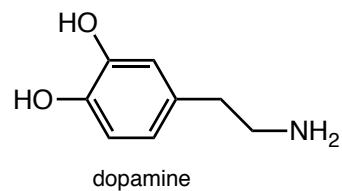
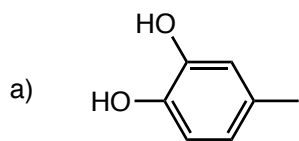


Question 12 (36 pts). Give a curved arrow pushing mechanisms for the following two reactions.

- 1) Add non-bonding electrons and C-H bonds to the line-angle structures as required.
- 2) Indicate the Lewis acid/Lewis base (LA, LB) at each INTERMOLECULAR step as appropriate, and whether they are also Brønsted acids/bases (LA/BA, LB, BB)
- 3) **YOU DO NOT HAVE TO DRAW RESONANCE CONTRIBUTORS for intermediates**
- 4) GIVE THE NUMBER OF STEPS IN YOUR MECHANISMS
- 5) Show where ALL protons come from and go to, no abbreviated $+H^+/-H^+$ notation

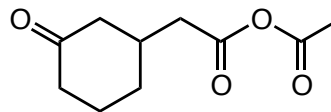
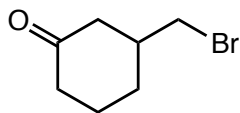


Question 13 (40 pts.) Show how you would make the target compounds on the right from the starting compounds on the left. Show reagents and conditions where appropriate, and the structures of important intermediate compounds. Do not show any (arrow pushing) mechanisms.



Question 14 (20 pts.) Synthesize the (target) molecule on the right from the starting molecule the left. this can not be done in one reaction. Give reagents and conditions and the intermediate molecules at each step. Do not show any mechanisms or transient intermediates. *Ignore stereochemistry!*

a)



Question 15 (14 pts.) Give the structure of the ketone (in the provided box) and ALL OTHER reagents/conditions (on the reaction arrow) you would use to synthesize amphetamine via a reductive amination

