CHEM 233, Fall 2018 Midterm #3 Ian R. Gould

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) _____

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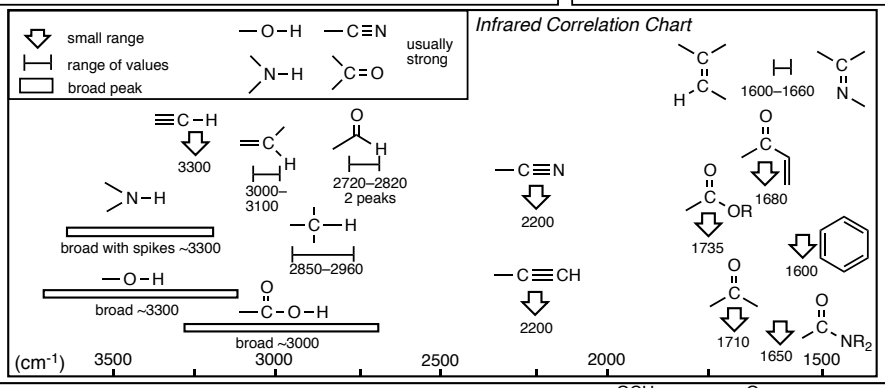
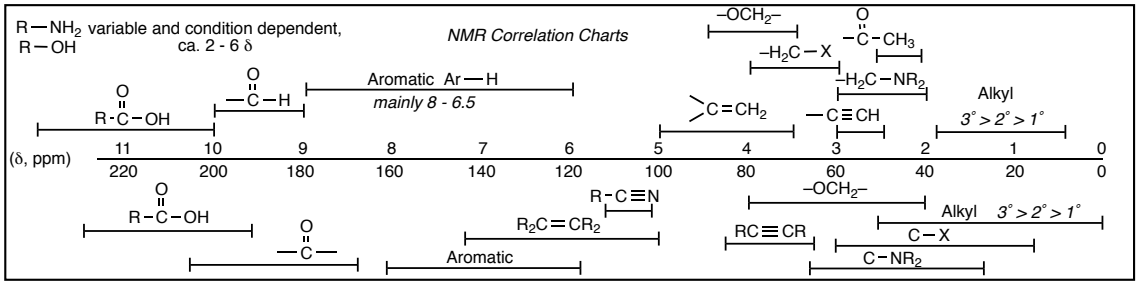
- *PRINT YOUR NAME ON EACH PAGE!*
- *READ THE DIRECTIONS CAREFULLY!*
- *USE BLANK PAGES AS SCRATCH PAPER*
  work on blank pages will not be graded...
- *WRITE CLEARLY!*
- *MOLECULAR MODELS ARE ALLOWED*
- *DO NOT USE RED INK*
- *DON'T CHEAT, USE COMMON SENSE!*

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 NUMBER BECAUSE YOU WOULDN'T BELIEVE THE NUMBER OF STUDENTS WHOSE NAMES WE CAN'T READ!

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

Points by question

1_____/14

2_____/20

3_____/32

4_____/16

5_____/8

6_____/25

7_____/34

8_____/26

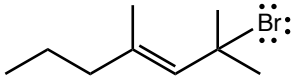
Points Removed for cover errors ____/2

Extra Credit_____/5

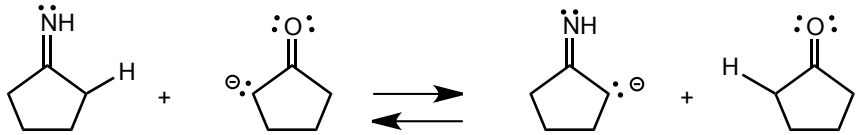
Total (incl Extra)_____/175+5

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

Question 1 (14 pts.) Give the IUPAC name for the following structure.



Question 2 (20 pts) For the following Bronsted acid/base equilibrium
a) add the curved arrow pushing for reaction in **both** directions and **ADD ALL REASONABLE MISSING RESONANCE CONTRIBUTORS AS APPROPRIATE**
b) indicate the stronger and weaker acid and base on each side and give a brief explanation for your choice
c) indicate which reaction is faster **AND** on which side the equilibrium lies
d) indicate which acid has the smaller and which the larger pKa



Extra Credit (5 pts) Dr. Gould had a conversation with his daughter about which topic?

cis- and trans-	saturated and unsaturated	acids and bases	Markovnikov and Anti-Markovnikov

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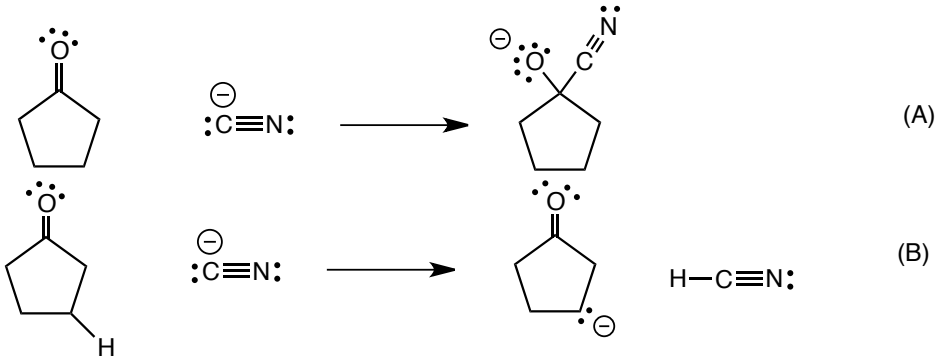
Question 3 (32 pts.) For reactions (A) and (B) shown.

a) Add the curved arrows that illustrate bond-making and bond-breaking, indicate the Lewis acids bases (LA/LB) and whether they are also Brønsted acids/bases (BA/BB)

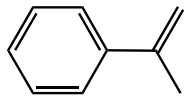


b) Reaction (A) is exothermic and reaction (B) is endothermic. Draw a reaction energy diagram for both reactions ON THE SAME DIAGRAM (do not draw 2 diagrams) and label the axes. Indicate which curve is for which reaction and indicate the activation energies for each reaction and include a **drawing of both transition states** and indicate their **positions** on the diagrams.

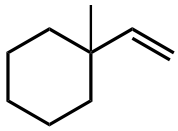
c) Briefly explain why reaction (A) is exothermic and reaction (B) is endothermic

d) Briefly explain which reaction is faster and which has the EARLIER transition state in terms of the Hammond postulate.

Question 4 (16 pts.) Give the missing major organic products OR reagents/conditions as appropriate for each of the following reactions, include all non-bonding electrons.

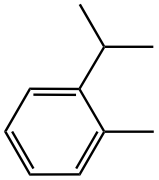
a) 

$\xrightarrow[\text{inert solvent}]{\text{HBr}\quad CCl_4}$

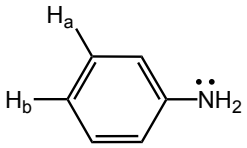
b) 

$\xrightarrow[\text{HCl (catalytic)}]{H_2O}$

Question 5 (8 pts.) How many signals would be observed in a proton decoupled ^{13}C NMR spectrum of the following molecule?

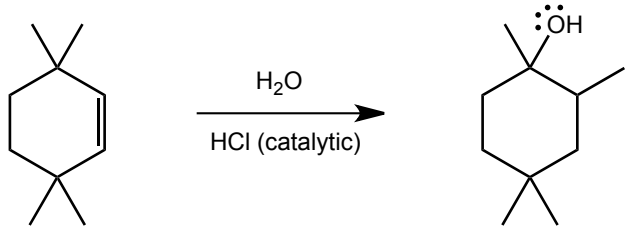


Question 6 (25 pts.) Which of the hydrogen atoms H_a or H_b would have the SMALLER chemical shift in a proton NMR spectrum? Give a brief explanation that includes the terms "electron density" and "shielding" and "deshielding", and include drawings of MINOR RESONANCE contributors to support your arguments.



Question 7 (34 pts.) For the following reaction:

a) Give a curved arrow-pushing mechanism for the following reaction. Indicate the Lewis acid and base (LA, LB) for each intermolecular step, and whether they are also Bronsted acids and bases (BA, BB). Indicate the RATE DETERMINING STEP for the mechanism.

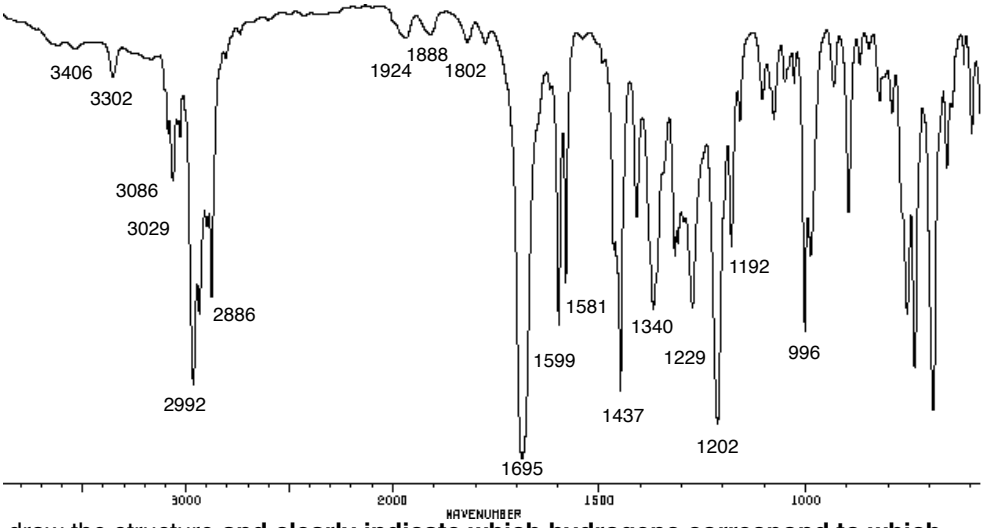


b) Draw reaction energy diagram with properly labelled axes for the mechanism that you drew, Indicate the **ACTIVATION ENERGY FOR EACH STEP**, indicate the **POSITIONS OF THE TRANSION STATES FOR EACH STEP (but do NOT draw the transition states)**, indicate the **REACTION EXOTHERMICITY** and the **RATE DETERMINING STEP**

Question 8 (26 pts) Provided are spectra for a compound with molecular formula $\mathbf{C_{10}H_{12}O}$

a) Give the degrees of unsaturation _____

b) On the infrared spectrum, indicate which peaks correspond to which functional groups (including C(sp^3)-H). Indicate **BOTH the functional group**, and where appropriate, **the specific BOND** in the functional group that corresponds to the peak**.**



c) draw the structure **and clearly indicate which hydrogens correspond to which signals in the proton nmr spectrum (only)**