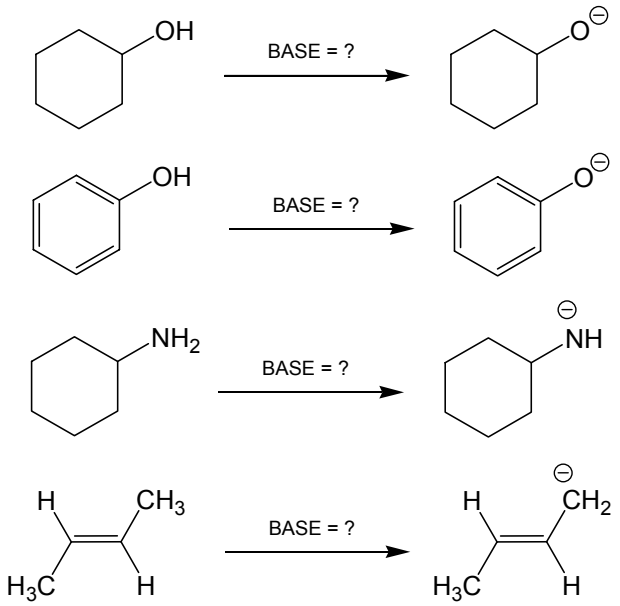
Chem 221 F08 Sect 01 Dr. C. Rogers **NAME:**

INTRODUCTORY ORGANIC CHEMISTRY I --- **PROBLEM SET #1**

INSTRUCTIONS: ANSWER ALL QUESTIONS ON THESE PAGES. HAND IN (stapled, with no extra pages please) **AT THE BEGINNING OF CLASS on Thursday Oct.2nd**. LATE SUBMISSIONS WILL **NOT** BE ACCEPTED (EARLY IS FINE). ALL MATERIAL CAN ALL BE FOUND IN THE CLASS NOTES AND IN BRUICE CHAPTERS 1, 2 & 7.

 # 1. For each of the reactions below, list all the bases (from the table) that would be strong enough to perform the indicated deprotonation.

Available bases
$(CH_3CH_2)_2NH$
NaOH
NaH (pK_a of H_2 is 35)
$NaOCH_2CH_3$
$NaNH_2$



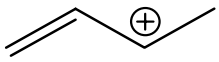
 # 2. Circle the most acidic H in each compound below, then rank the compounds in order of increasing acidity (put the most acidic one on the right-hand side). **Briefly** justify how their structures allowed you to make this decision (point form only, please). Then, look up their pK_a values (see Bruice Appendix II) and verify that the pK_as are consistent with your ranking and explanation….

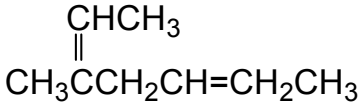
$(CH_3)_3N$ CH_3CH_2OH $CH_3CH_2CH_2CH_3$ $(CH_3)_3NH^+$ $CH_3CH_2NH_2$

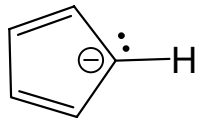
 # 3. Draw line (skeletal) structures of the following compounds and rank them in order of increasing boiling point. Explain your choice briefly.

$(CH_3)_3COC(CH_3)_3$ $CH_3(CH_2)_3O(CH_2)_3CH_3$ $CH_3(CH_2)_7OH$

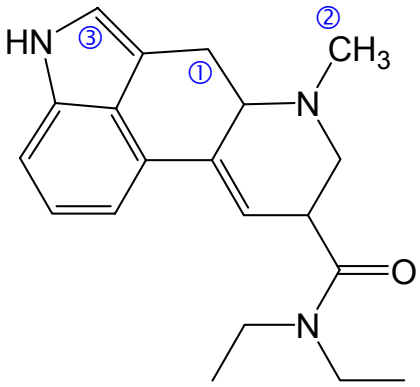
 # 4. Which of the following species is resonance-stabilized? For those that have resonance, draw the resonance structures…and for those that don't have resonance, provide a few words explaining why they don't.







 # 4. Lysergic acid diethylamide (LSD), shown here, is a hallucinogenic substance known on the street as "acid". It is a synthetic derivative of a natural compound found in a fungus of the ergot family. Answer the following questions about this molecule:



a) Draw on all "implied" hydrogen atoms and lone pairs.

b) Which orbitals are involved in the σ-bond between the carbonyl carbon and the attached ring?

c) Label the N atoms and the three numbered C atoms as 1°, 2°, 3° as appropriate.

d) Consider the C-H bonds on the three numbered atoms. Which of those C-H bonds would be the longest? Why?

Now consider the acid-base properties of this molecule.

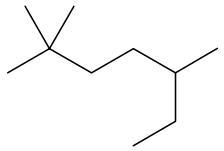
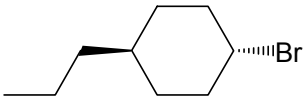
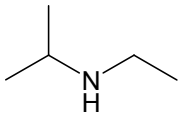
a) The pK_a of the most acidic hydrogen in LSD, the amino group NH shown above, is unusually low (around ~7.8). Using Appendix II in the Bruice text, find (and draw) the small molecule that has a nitrogen atom in a similar environment with pK_a ~17.

1. Based on these pK_a values, which of these two molecules is easier to deprotonate?

2. Why are these two N-H's pK_a values so different?

b) Based on LSD's pK_a, do you think this substance deserves its street name of "acid"? That is, would it produce a detectably acidic solution if dissolved in tap water at pH ~5.5? Explain.

 # 5. Complete the following table.

Systematic (IUPAC) name	**Line (skeletal) structure**
	
cis -1-ethyl-3-methoxycyclopentane	
	
4-cyclohexyloctane	
	

 # 6. Consider this incorrectly named molecule: "2-ethyl-5-chlorocyclohexane".

a) Write the correct name for this molecule, and draw its two geometric isomers.

b) Draw the chair-chair interconversion (ring-flipping) equilibrium for the *cis* isomer of this molecule, and label all the axial and equatorial positions.

c) In an equilibrium sample of this substance, which conformer from **(b)** would another molecule be most likely to collide with? Why?