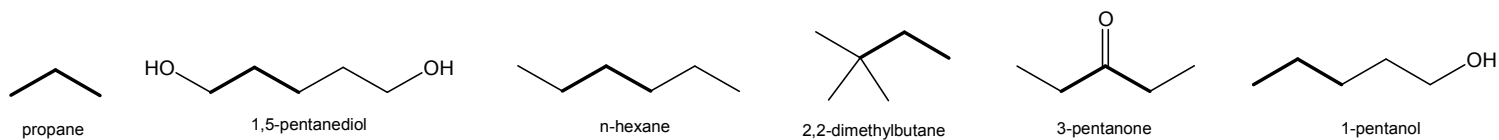
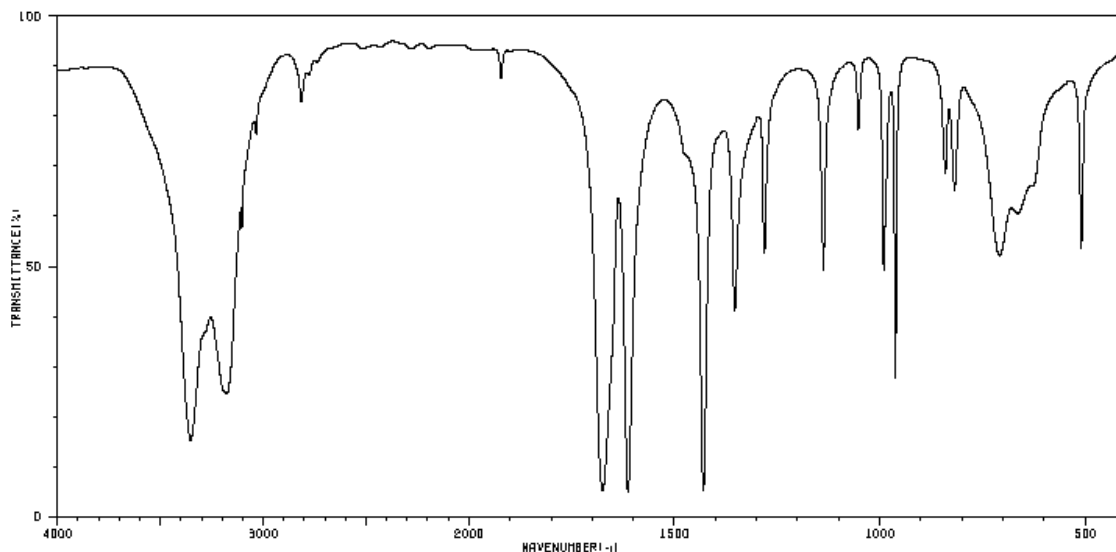


1. a. (6 pts) Number the following structures in order of increasing boiling point, with 1 being the lowest boiling and 6 being the highest boiling.

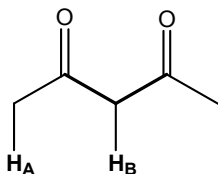


- b. (5 pts) What is the relationship between *n*-hexane and 2,2-dimethylbutane. Account for the difference in boiling point of these two molecules.

2. (10 pts) Use the following IR data to derive a reasonable structure for unknown compound **GRIO**, C₃H₅NO.

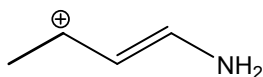


3. (12 pts) Predict whether H_A or H_B has the lower pK_a. Justify your answer. Your answer must include a combination of words and relevant structures.



4. (10 pts) For the molecule CH_3OCN , draw a three dimensional Lewis structure, including all lone pairs. On your Lewis structure, clearly label all orbitals that overlap to form each of the bonds in the molecule.

5. (15 pts) For the species below, (a) Draw two additional resonance structures that are at least as stable as the structure shown below, including formal charges and lone pairs where necessary. (b) Evaluate which structure is the major contributor. Briefly explain.

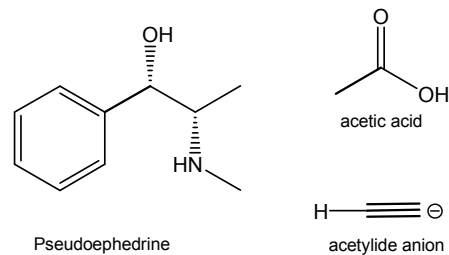


6. (3 pts) Draw the structure of any secondary haloalkane that contains a total of 5 carbons.

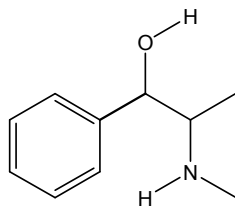
7. (8 pts) Two resonance structures (shown below) are required to describe carbon monoxide, CO . (a) Include formal charges on the resonance structures if necessary. (b) Briefly explain why the carbon atom in carbon monoxide is capable of acting as a Lewis acid. Be specific. (c) Briefly explain why the carbon atom in carbon monoxide is capable of acting as a Lewis base. Be specific.



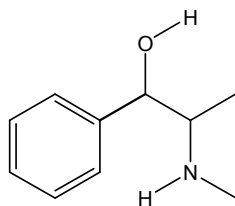
8. (16 pts) In the US, a salt form of pseudoephedrine is manufactured by Johnson & Johnson and sold under the name Sudafed. Pay close attention to the alcohol and amine functional groups and consider their relative acidities.



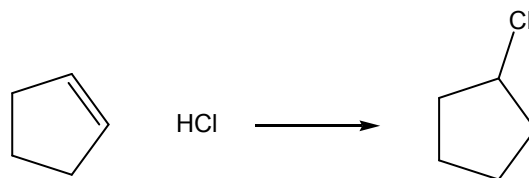
- a. Use curved arrows to draw the balanced acid/base reaction of pseudoephedrine (already shown) and acetic acid. Is the ΔG for this reaction >0 or <0 ? Justify your answer by showing your work.



- b. Use curved arrows to draw the balanced acid/base reaction of pseudoephedrine (already shown) with acetylide anion. Are the reactants or products more stable? Justify your answer by showing your work.



9. (15 pts) The reaction shown below is a reaction **THAT YOU HAVE NEVER SEEN BEFORE**. **DON'T PANIC**. (a) Draw complete Lewis structures of the two reactants. (b) Propose a reasonable mechanism for the reaction by drawing curved arrows to show the movement of electrons. HINT: This reaction requires two separate LA/LB reactions. Focus on drawing the arrows and products of the first, then move on to the second.



CHEMISTRY 301
11:15 AM Section
EXAM 1
29 Sept 2010

Name: _____

Page	Points	Score
2	33	
3	36	
4	31	
Total	100	

Acid	pK_a
HI	-9
H ₂ SO ₄	-9
HBr	-9
HCl	-7.3
CH ₃ CH ₃ OH ₂ ⁺	-2.4
C ₆ H ₅ SO ₃ H	-0.6
H ₃ O ⁺	-1.7
HNO ₃	-1.3
HF	3.2
CH ₃ COOH	4.8
H ₂ CO ₃	6.5
HCN	9.1
NH ₄ ⁺	9.4
C ₆ H ₅ OH	10.0
HCO ₃ ⁻	10.2
CH ₃ NH ₃ ⁺	10.6
H ₂ O	15.7
CH ₃ CH ₂ OH	17
CH ₃ COCH ₃	19
HC≡CH	26
H ₂	35
NH ₃	36
H ₂ C=CH ₂	44
CH ₄	49

Approx. Freq. (cm ⁻¹)	Intensity	Shape	Interpretation
3500-3600	med	shrp	OH no hydrogen bonding
3000-3600	med-str	broad	OH hydrogen bonding
3300-3500	med	var	NH hydrogen bonding
3200-3300	med-str	shrp	sp CH
>3000	var	var	sp ² CH
<3000	var	var	sp ³ CH
2700-2800	med	shrp	aldehyde CH
2100-2300	wk-med	shrp	triple bonds
1700-2000	weak	var	aromatic overtones
1700-1800	str	shrp	most carbonyl
1600-1700	str	shrp	amide carbonyl, etc
1600	var	shrp	CC double bond
1450-1600	med	mult	Aromatic
1500+, 1250+	str	shrp	Nitro
1360-1380	weak	shrp	methyl bend
1000-1300	str	shrp	CO or CN
700-900	var	shrp	CCl
700-900	var	shrp	C=CH out-of-plane bend
600-700	var	shrp	CBr