CHEMISTRY 3311, Fall 2004
Professor Walba
First Hour Exam, September 23

scores:

1) 26

2) 20

3) 20

4) 18

5) 16

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100

CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Name (printed): Key

Signature: ______________________

Recitation TA Name: ______________________

Recitation day and time: ______________________

This is a closed-book exam. The use of notes, models, calculators, scratch paper, or any other paraphernalia will not be allowed during the exam. Please put all your answers on the test. Use the backs of the pages for scratch.

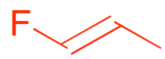
PLEASE read the questions carefully!

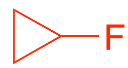
Partial Periodic Table

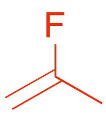
1A	2A	3A	4A	5A	6A	7A	8A
1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
						35 Br	
						53 I	

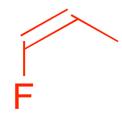
Name:_________________________________

1) (26 pts) a) Draw a valid valence bond structure for each of the possible isomers (both constitutional isomers and stereoisomers) with the molecular formula C_3H_5F. Draw each isomer ONLY ONCE.

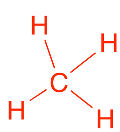
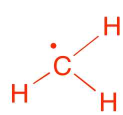
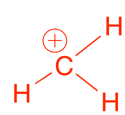
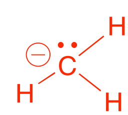




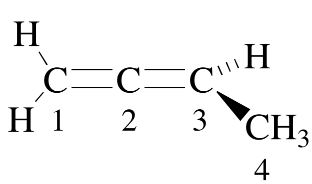




b) Draw a valid valence bond structure for each of the following molecules. Carefully show all lone pairs, unpaired electrons, and formal charges in your structures.

CH_4	CH_3	$(CH_3)^+$	$(CH_3)^-$
			

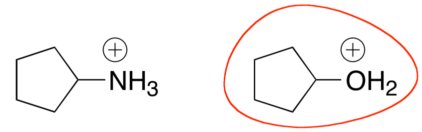
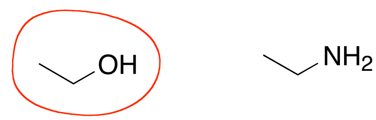
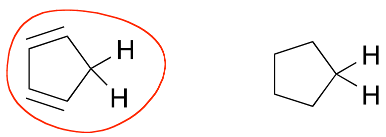
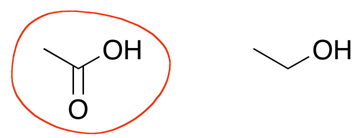
c) For 1,2-butadiene, indicate the hybridization of each carbon. Put your answer for each carbon in the box to the right its number.



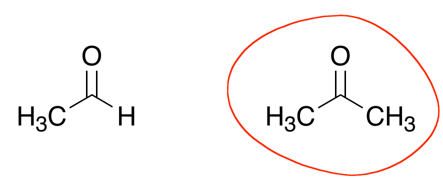
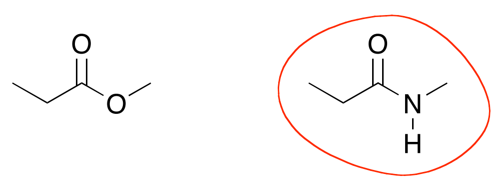
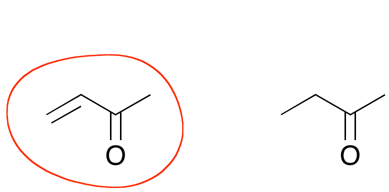
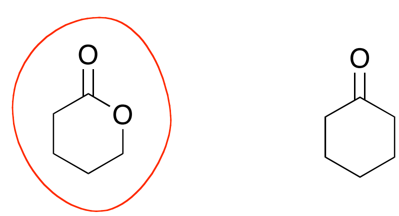
1	sp^2	3	sp^2
2	sp	4	sp^3

Name:___________________________________

2) (20 pts) a) Circle the stronger Brønsted acid in each of the following pairs of structures.

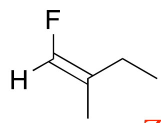
H_2O H_3O^+	
CH_3NH_2 CH_3CH_3	
	

b) Circle the compound with the more stable carbonyl group in each of the following pairs of compounds.

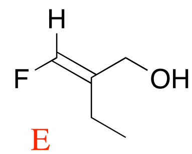
	
	

Name:____

3) (20 pts) a) Give the stereochemical descriptor (E or Z) for the following alkenes.

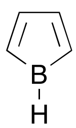


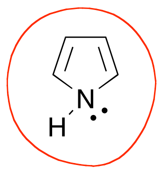
Z

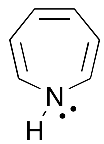


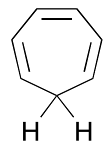
E

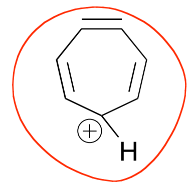
b) Circle the aromatic compounds in the following list.



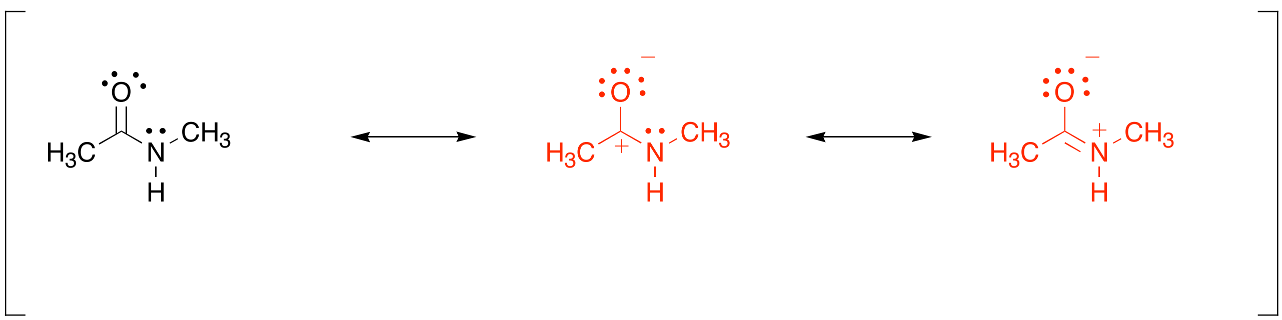




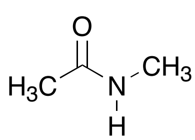




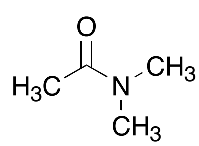
c) I have given a valence bond structure of N-methylacetamide below. Give the two additional major resonance contributors to the structure. Be sure to show all lone pairs and formal charges in your structures.



d) N-methylacetamide has a higher boiling point than N,N-dimethylacetamide. In one short sentence, explain why this is the case.



boiling point = 205°C

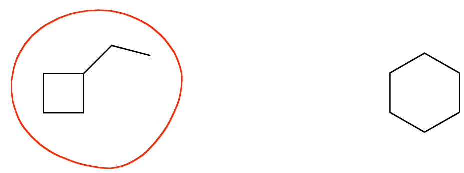


boiling point = 166°C

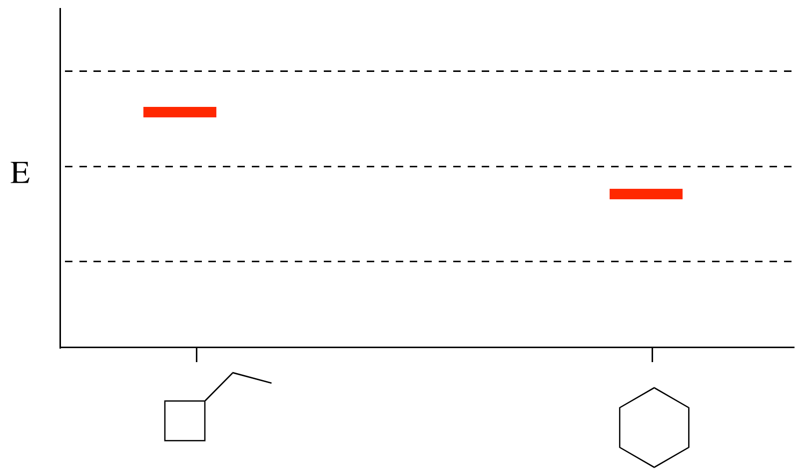
N-methylacetamide has a higher boiling point because it can participate in intermolecular hydrogen bonding.

Name:____

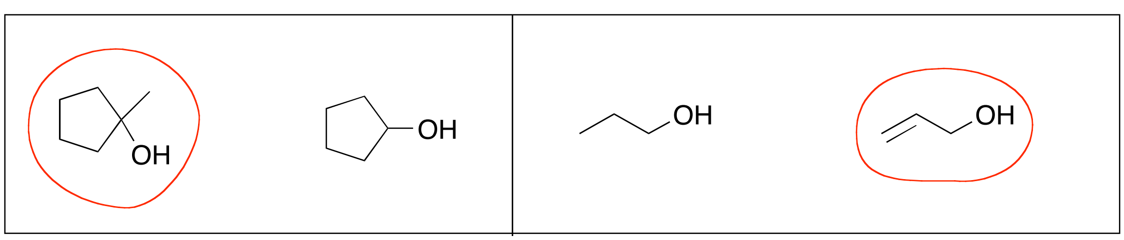
4) (18 pts) a) Circle the compound with the higher heat of combustion (that is, the one that gives off the most heat when you burn it in oxygen).



b) On the following energy diagram, very clearly indicate the relative energy of the two isomers given in part 4a by drawing a short horizontal line above each structure indicating its energy. Make sure it's easy to see your lines, and that it's clear which isomer has higher energy.

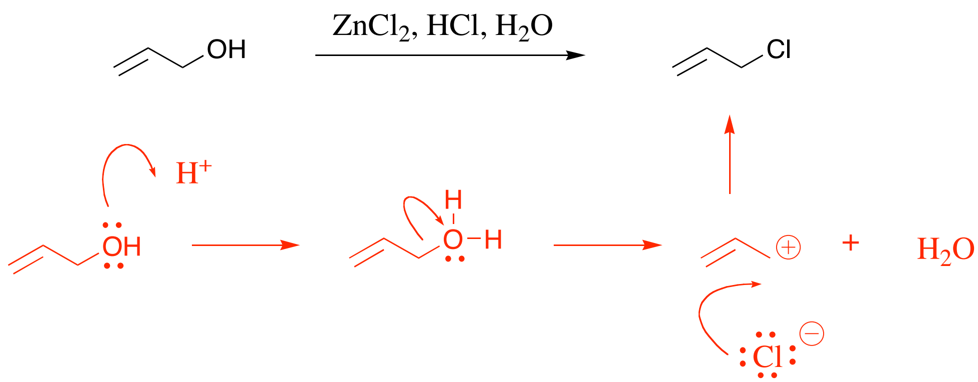


c) For each of the following pairs of alcohols, circle the one that would react faster with Lucas reagent.

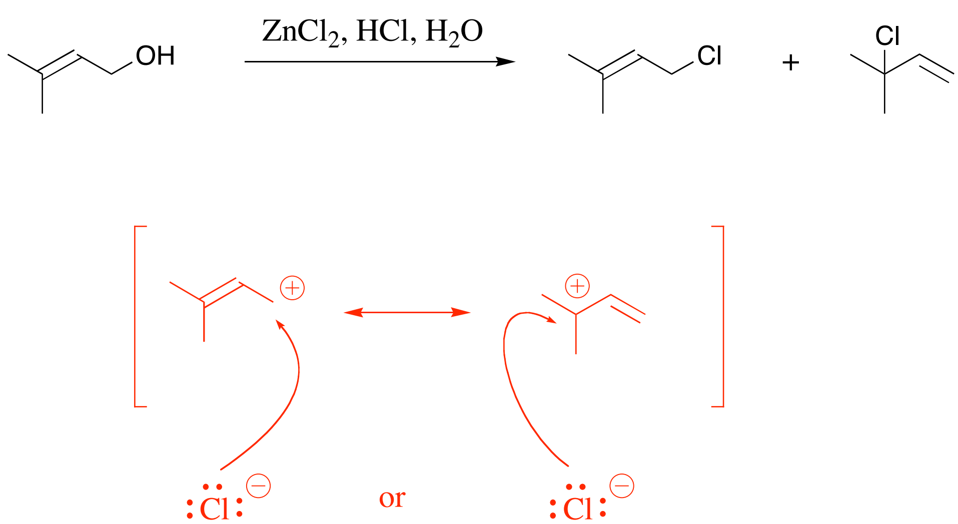


4) – continued

d) Propose an arrow-pushing mechanism for the following transformation. Assume for this purpose that the reagent [$ZnCl_2$, HCl, H_2O] = H^+. Show only one valence bond structure for each intermediate in your mechanism, but be sure to give all the intermediates.

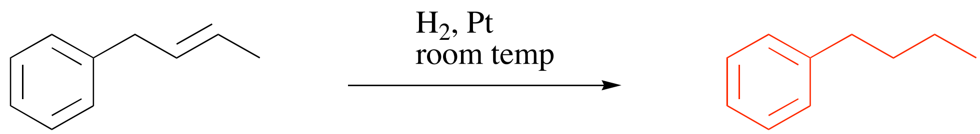


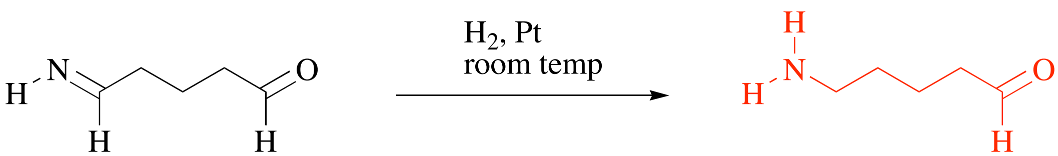
e) [Note – this is a hard question, but hay, it's only five points. However, it might be a good idea to finish the rest of the exam before you tackle this question] When the 3-methyl-2-butanol reacts with Lucas reagent, two isomeric products are formed, as shown below. Using resonance structures, show how this happens.



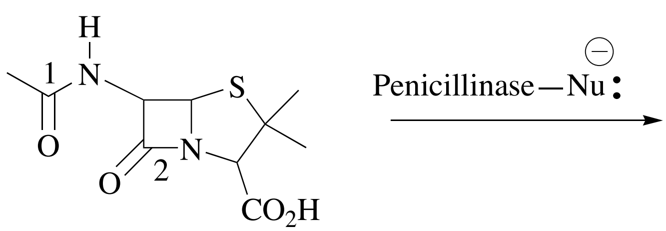
Name:______________________________________

5) (16 pts) Give the single major organic product of each of the following reactions. In both cases, only one product is formed, in high yield. Assume that there is excess hydrogen gas (as usual in a catalytic hydrogenation), but that the reaction is only allowed to proceed for a few hours at room temperature.

a) 

b) 

c) Penicillin was the first important antibiotic (it kills bacteria). Unfortunately, many bacteria have developed resistance to penicillin by making an enzyme called penicillinase. For our purposes, penicillinase is a giant molecule with a nucleophile on it, as indicated below. Penicillin has two amide groups, with the amide carbonyls labeled 1 and 2 on the structure. The penicillinase nucleophile attacks one of those carbonyls, which ends up making the penicillin harmless to the bacteria. A key point is that one of the carbonyl groups is much more reactive than the other.



Penicillin

c) Which carbonyl group is the most reactive one? #2

d) Propose a structure for the intermediate formed when the penicillinase—Nu:$^-$ reacts with penicillin.