Chem 112A: First Midterm

October 6th, 2011

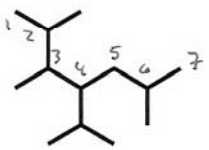
Please provide all answers in the space provided. You are not allowed to use a calculator for this exam, but you may use (previously disassembled) molecular model kits. Including the title page, there should be **9** total questions spread over **6** pages. There is also a seventh page that should be blank. You can use this last page for scratch paper if you need it, but please remember to copy your answers into appropriate exam question.

Name: Key

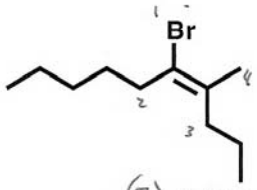
GSI/Section: _____

(1)	_____	(8 points)
(2)	_____	(12 points)
(3)	_____	(5 points)
(4)	_____	(12 points)
(5)	_____	(10 points)
(6)	_____	(8 points)
(7)	_____	(12 points)
(8)	_____	(15 points)
(9)	_____	(18 points)
TOTAL	_____	(100 points)

1. Provide accurate chemical names for each of the following compounds (4 points each):

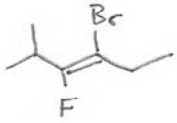
a. 

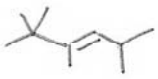
4-isopropyl-2,3,6-trimethyl-heptane

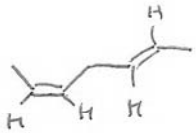
b. 

(E)-5-bromo-4-methyl-4-decene

2. Provide clear structures of each of the following alkenes (3 points each):

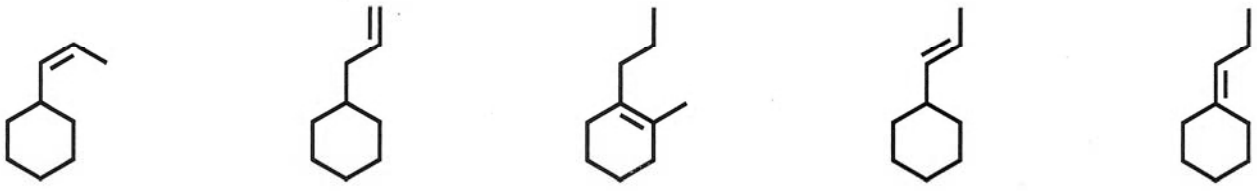
a. (*E*)-4-bromo-3-fluoro-2-methyl-3-hexene 

b. (*E*)-2,2,3,5-tetramethyl-3-hexene 

c. (2*Z*,5*E*)-2,5-heptadiene 

d. 2-isopropyl-4-tertbutyl-1-octene 

3. The hydrogenation of each of the following alkenes is an exothermic process. Rank them by the amount of energy that is released during this reaction, with (1) corresponding to the alkene that would be the *most* exothermic when hydrogenated and (5) corresponding to the alkene that would be the *least* exothermic (5 points).

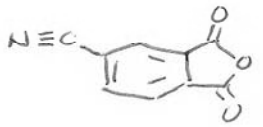


2 1 5 3 4

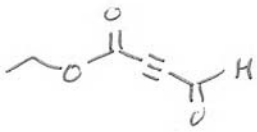
Less stable alkene ⇒ more heat released

4. For each of the following questions, draw an example of an organic molecule that contains all of the functional groups that are listed (3 points each). Many answers possible.

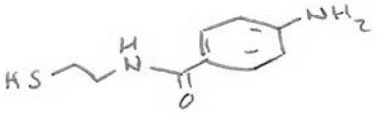
   a. An anhydride, an aromatic ring, and a nitrile group



   b. An ester, an aldehyde, and an alkyne

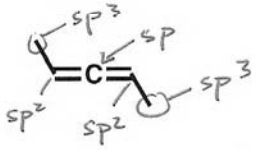


   c. A thiol, an amide, and an aniline



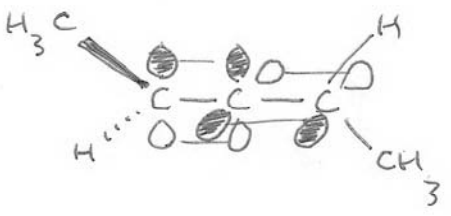
   d. An ~~amide~~ 3° -amine, a ketone, and an alcohol

5. The following 5-carbon compound is called an *allene*.



   a. Label each of the 5 carbons in the structure above with the appropriate hybridization (4 points).

   b. In the space below, provide an accurate three dimensional drawing showing the location of all of the orbitals that make up the π bonds of the molecule. You do not need to show any π* orbitals (6 points).

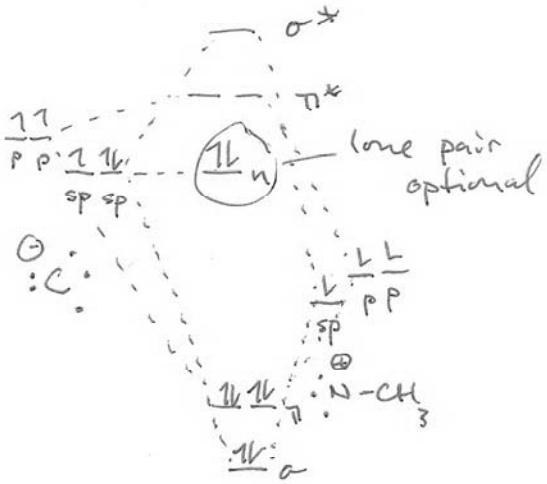


6. Isonitriles, such as the structure shown below, are useful synthetic reagents.

an isonitrile

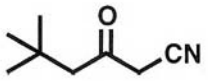
a. In the space below, provide an orbital interaction diagram for the carbon-nitrogen triple bond of this molecule. Also provide a reasonable three-dimensional sketch of the Lowest Unoccupied Molecular Orbital(s) (8 points).

Orbital Interaction Diagram:

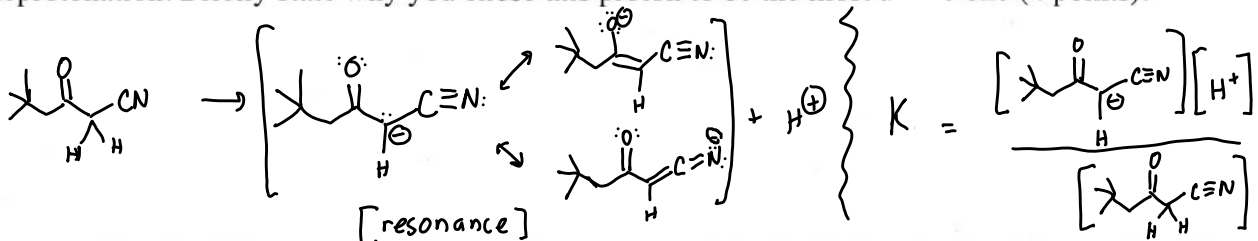


LUMO sketch:

7. The following compound has a pK_a value of 10:



a. Determine which proton is the most acidic and provide an appropriate K_a equation showing its deprotonation. Briefly state why you chose this proton to be the most acidic one (4 points).



b. Suppose 1 mole of the compound drawn above was combined with 1 mole of sodium methoxide ($NaOCH_3$). Given that the pKa of methanol is 15, what will be the equilibrium position of this acid/base reaction (4 points)?

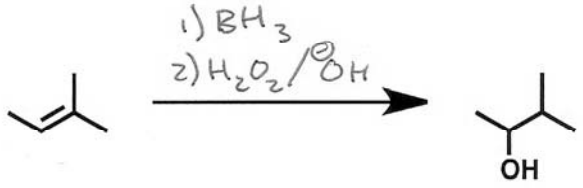
$K_{eq} = (15 - 10) = 10^5$

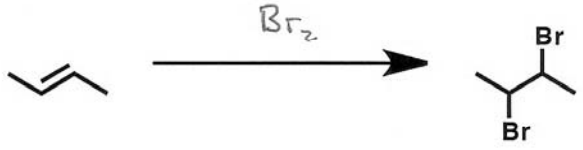
7. (continued)

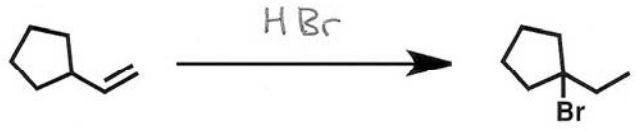
c. Decide whether the reaction described in (b) would be exothermic or endothermic and provide an estimate for ΔG° for the reaction (4 points).

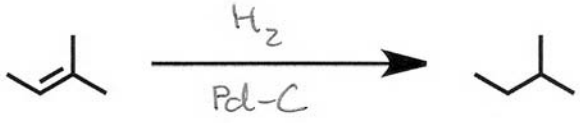
$\Delta G^\circ = -5(1.36) = -6.80 \frac{kcal}{mol}$ ∴ exothermic

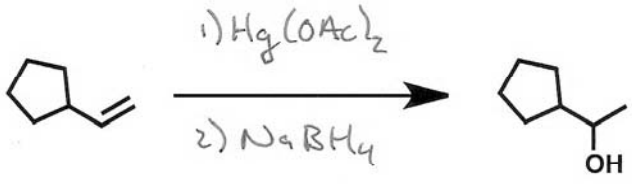
8. Fill in the missing reagents for each of the following organic transformations (3 points each).

a. 

b. 

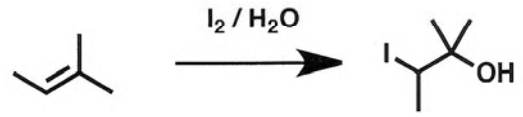
c. 

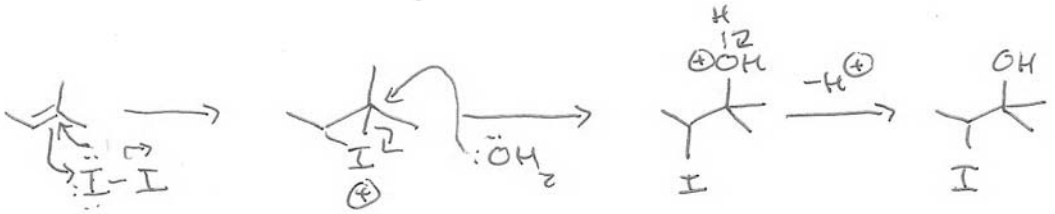
d. 

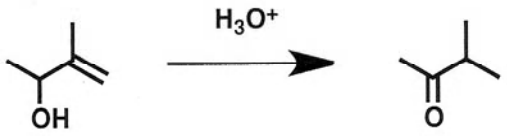
e. 

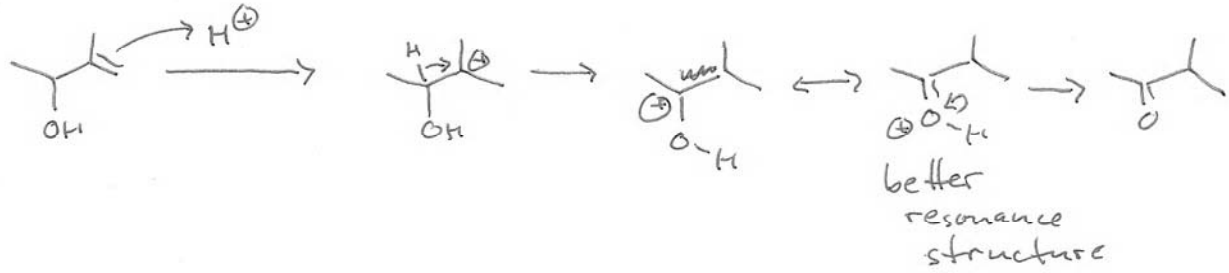
H_3O^+ not OK

9. Provide detailed arrow pushing mechanisms for each of the following reactions (6 points each).

a. 



b. 



c.