Easily Legible Printed Name:_____

HEM 3351 (100), Fall 2016
Professor Walba
First Hour Exam
September 20, 2016

scores:

1) 20

2) 20

3) 20

4) 20

5) 20

_____

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

Signature: Key

Recitation TA Name: _____

Recitation day and time: _____

This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear Ziploc bag. Please put all your answers on the test in the appropriate place. Use the backs of the pages for scratch (there are two additional blank scratch sheets after the last page of the exam). DO NOT PUT ANSWERS ON THE SCRATCH SHEETS.

PLEASE read the questions very carefully!

PLEASE legibly print your name on each page of the exam.

Partial Periodic Table

1A							8A
1 H	2A	3A	4A	5A	6A	7A	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	

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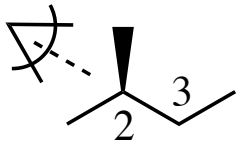
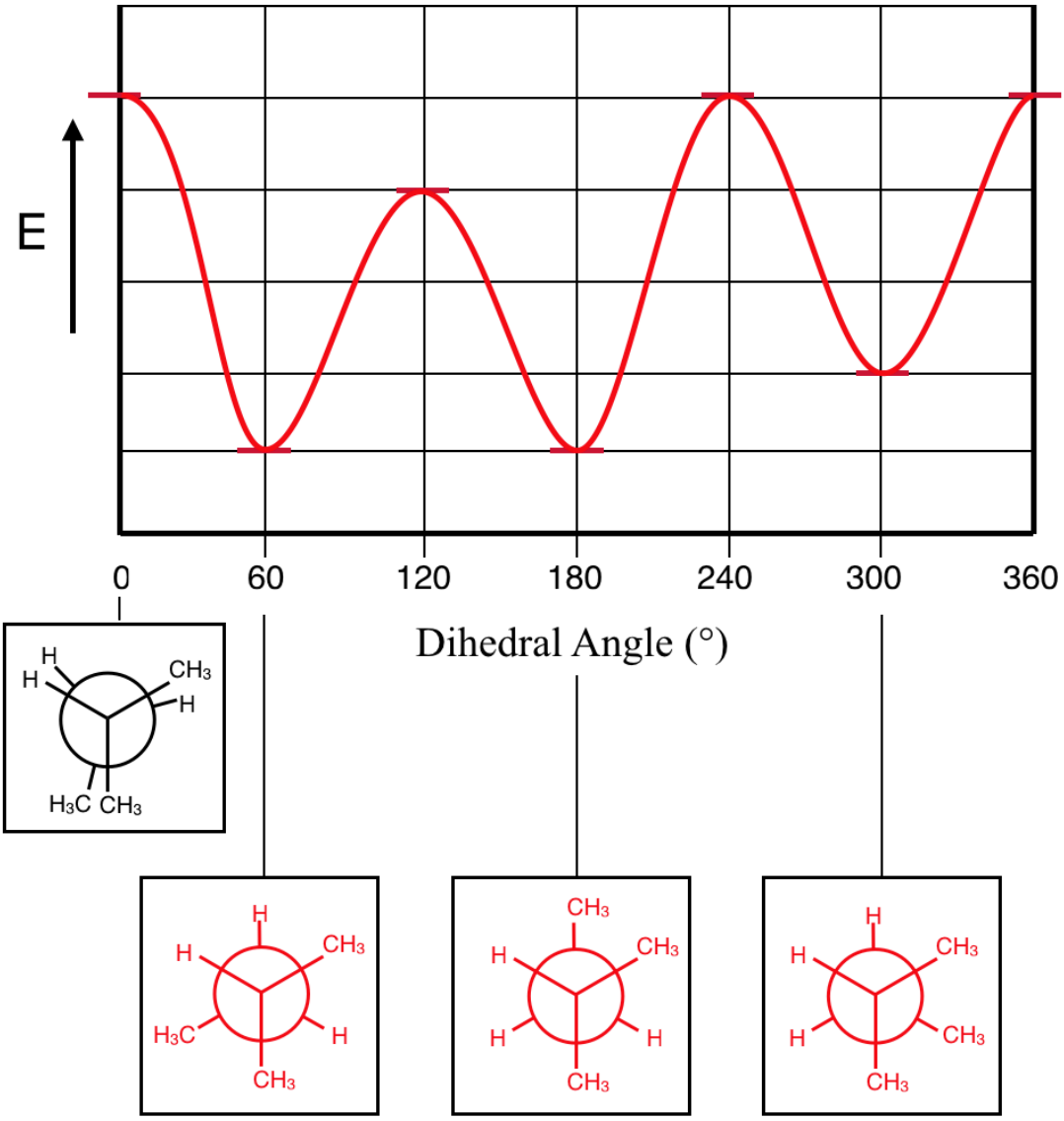
1 (20 pts) a) For 2 methylbutane (structure shown at right), sighting down the C2-C3 bond, define the eclipsed conformation shown in the Newman projection on the energy diagram below as having 0° dihedral angle.



Draw Newman projections of the three **staggered** conformations of 2-methylbutane, sighting down the C2-C3 bond, in the boxes. Please **rotate the back carbon clockwise** moving from 0° to 60°, 180°, and 300°.

Complete the energy diagram by indicating the relative energy of **all** the conformations (eclipsed, staggered, and everything in between) in the rotation from 0° to 360° = 0° using a smooth curve.



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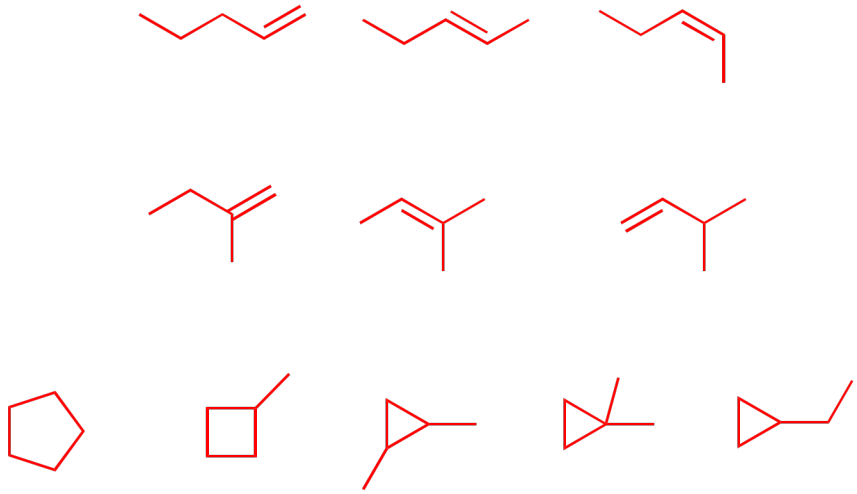
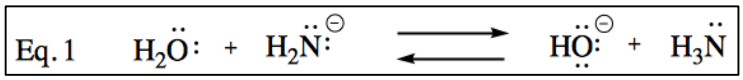
2) (20 pts) a) Draw skeletal structures (molecular graphs NOT showing the hydrogens) for all possible constitutional isomers AND alkene stereoisomers with molecular formula C_5H_{10}. Draw each isomer only once. Points will be deducted for missing structures, and for drawing the same structure more than once.



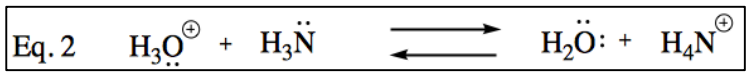
b) Referring to the equilibrium shown in Eq. 1



1. Is K_{eq} greater than 1 or less that 1? Greater than one
2. Which side of the equation is more stable? Right side
3. Give a **very short** explanation for your answer.

The relative stability of the ions dominates the relative energy. Oxygen is more electronegative than nitrogen. Therefore, the hydroxide ion is more stable than the amide anion. The right side of the equation is more stable, and Keq > 1

c) Referring to the equilibrium shown in Eq. 2



1. Is K_{eq} greater than 1 or less that 1? ? Greater than one
2. Which side of the equation is more stable? Right side
3. Give a **very short** explanation for your answer. Nitrogen is less electronegative than oxygen. Therefore, the ammonium cation is more stable than the hydronium cation. The right side of the equation is more stable, and Keq > 1

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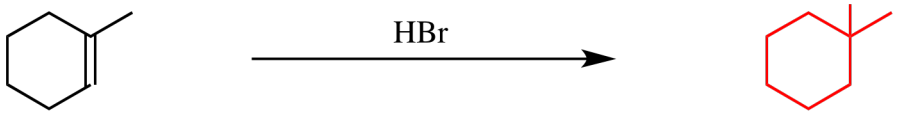
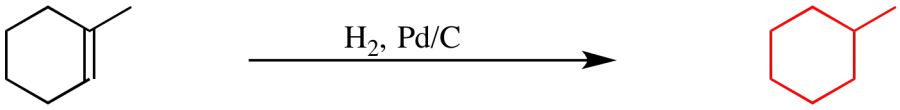
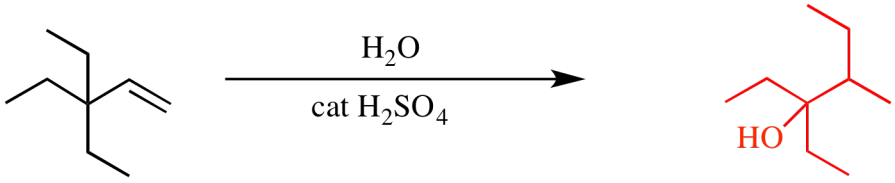
3) (20 pts) Draw the skeletal structure (molecular graph) for the **single major product** of each of the following reactions.

a) 

b) 

c) 

d) 

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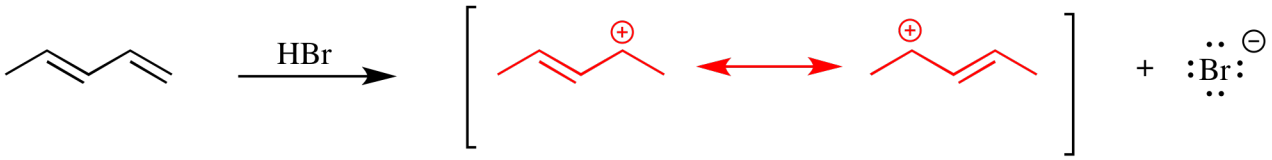
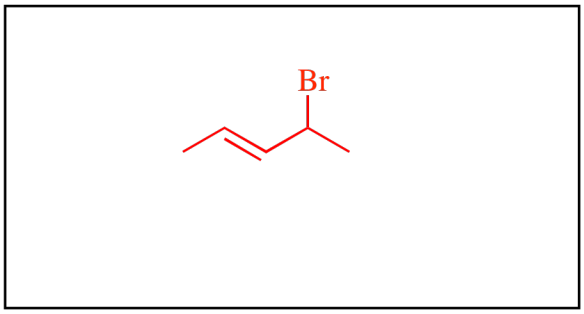
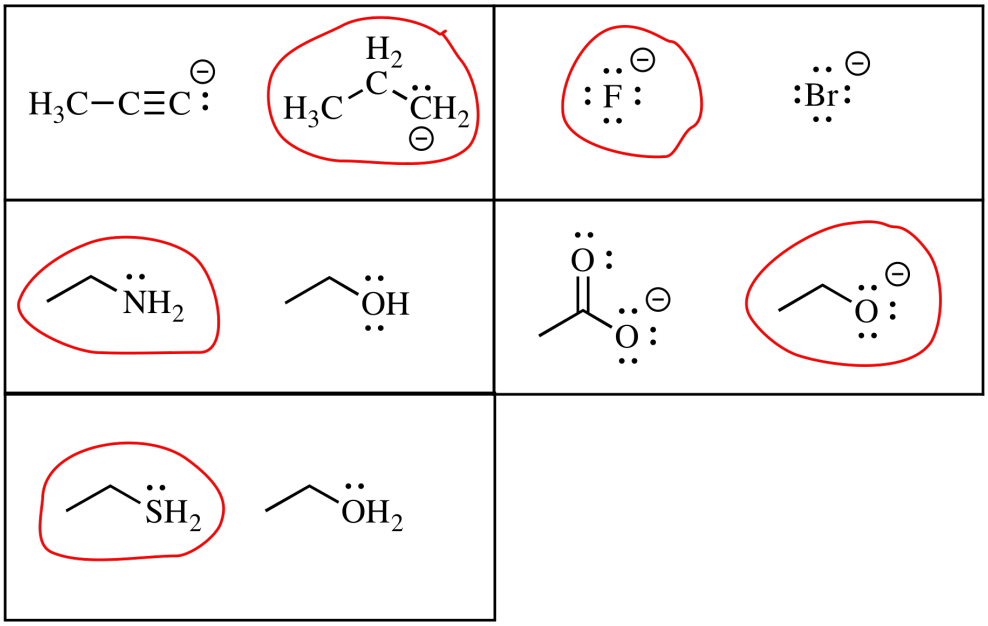
4) (20 pts) a) Reaction of 1,3-pentadiene (diene - pronounced "dye een" - means two double bonds) with HBr gives a single product in high yield. The product comes from a carbocation intermediate with geometry (bond lengths) that cannot be described by a single valence bond structure. Representing the structure of this cation requires the valence bond with resonance model. Draw the resonance structures representing the cation reactive intermediate in the square brackets, and give the structure of the product in the box below the vertical arrow.





b) For each of the following pairs of structures, circle the stronger base.



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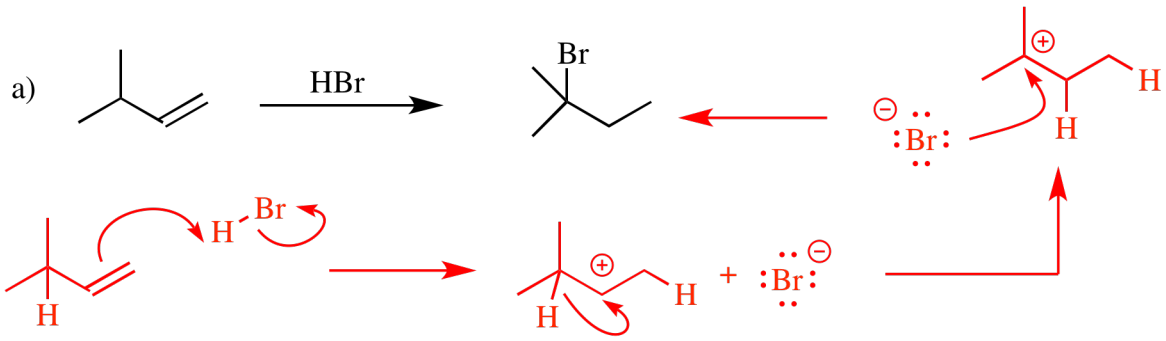
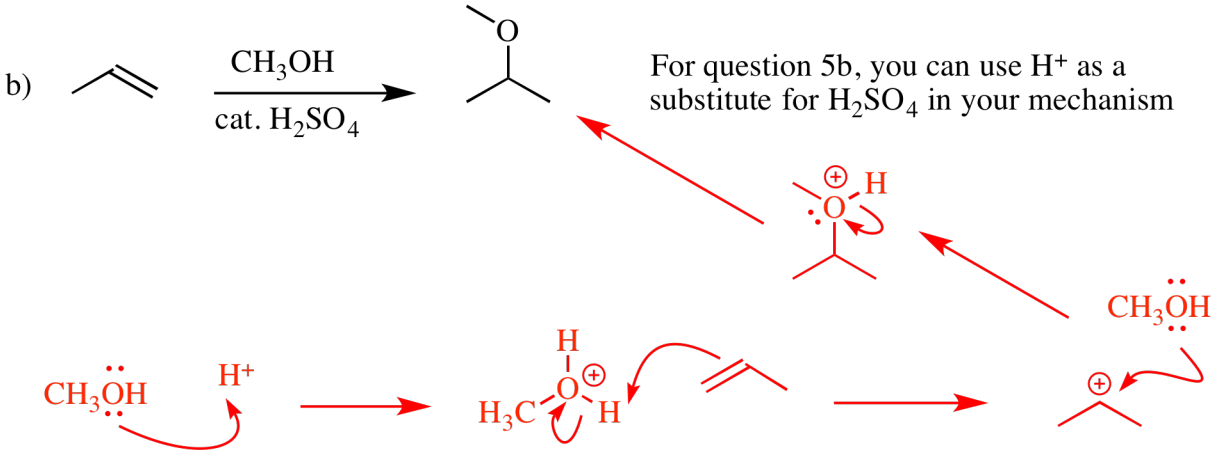
5) (20 pts) Propose an arrow-pushing mechanisms for each of the following reactions. Show all **intermediates** in your mechanisms, but DO NOT try to show transition states. Be sure structures are complete, including all lone pairs.

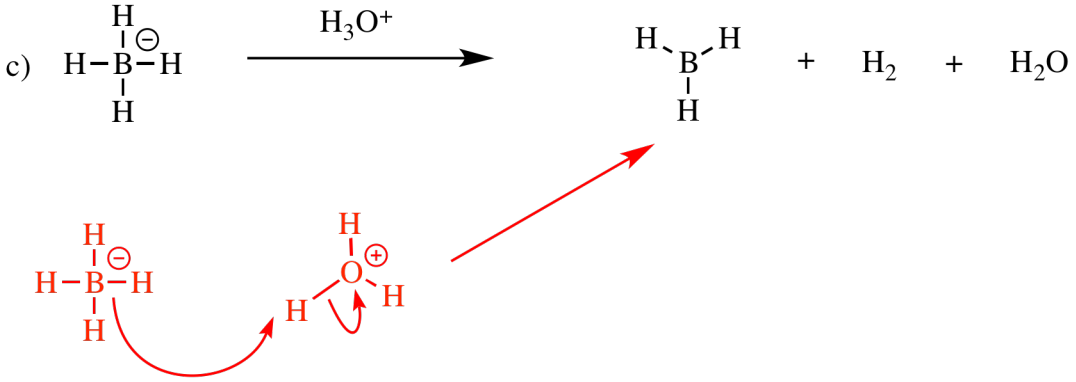
a)



b)



c)



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