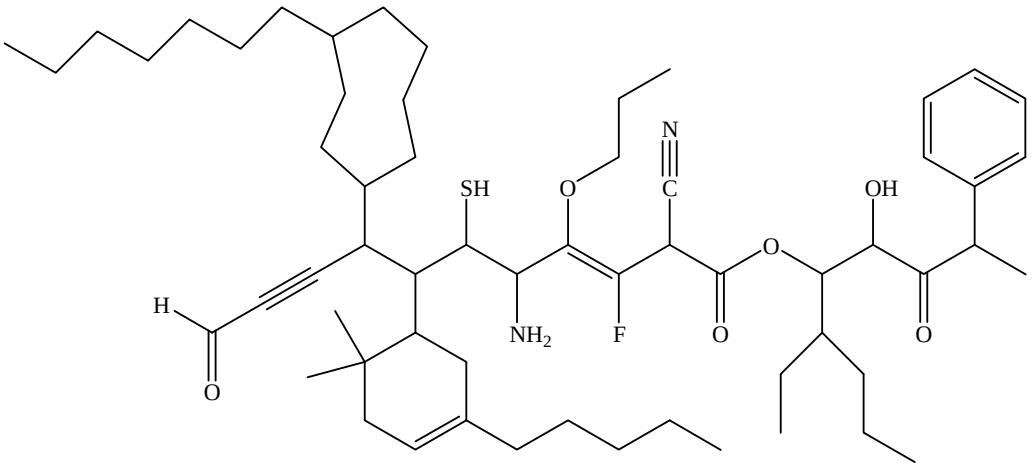
Chem 201 Midterm
Fall, 2012 Name _____
Beauchamp

Problems	Points	Credit
1. Functional Group Nomenclature (1 large structure)	25	
2. Special Types of Carbons and Substituents (21)	21	
3. Types of Isomers, Degrees of Unsaturation	25	
4. Forces of Interaction and Physical Properties	24	
5. Cyclohexane Conformations, Newman Projections	24	
6. Newman Projections, Conformational Energies	30	
7. 2D Lewis Structures (1)	15	
8. 3D Structure, Hybridization, Angles, Shapes (1)	24	
9. Stereochemical Analysis	25	
10. Resonance, Formal Charge, Arrows	15	
11. Acid / Base Chemistry, Explanation, Curved Arrows, Formal Charge	30	
Total	258	

This is a long exam. It has been designed so that no one question will make or break you. The best strategy is to work steadily, starting with those problems you understand best. Make sure you show all of your work. Draw in any lone pairs of electrons, formal charge and curved arrows to show electron movement where appropriate. Do your best to show me what you know in the time available.

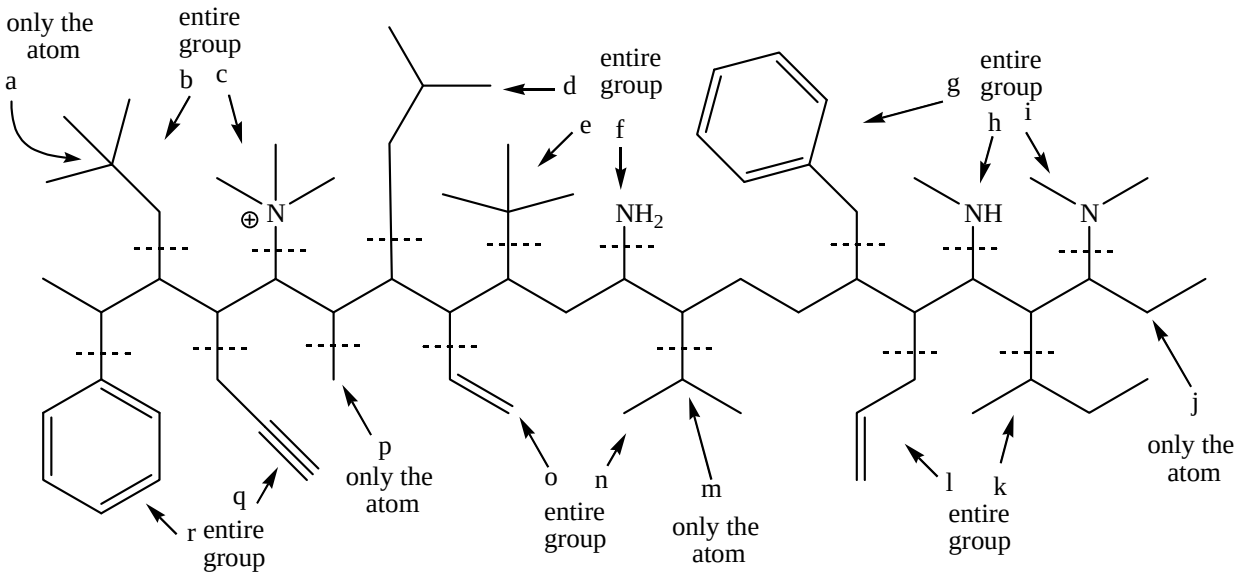
All glory comes from daring to begin. Eugene Ware

1. Provide an acceptable name for the following molecule. (25 pts)



2. Match the arrows with the terms. Some arrows may be associated with more than one term. (21 pts)

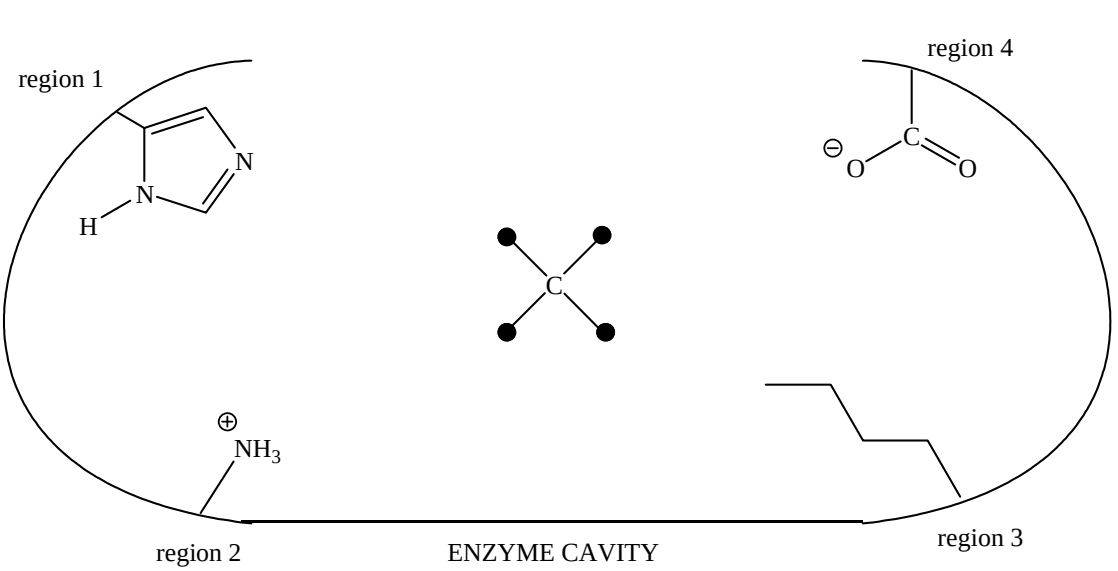
1. methyl _____
2. methylene _____
3. methine _____
4. primary _____
5. secondary _____
6. tertiary _____
7. quarternary _____
8. isopropyl _____
9. isobutyl _____
10. sec-butyl _____
11. t-butyl _____
12. neopentyl _____
13. vinyl _____
14. allyl _____
15. propargyl _____
16. phenyl _____
17. benzyl _____
18. primary amine _____
19. secondary amine _____
20. tertiary amine _____
21. quaternary ammonium ion _____



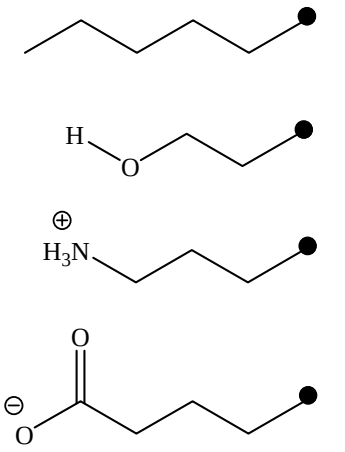
3. Use the formula $C_6H_{12}O_2$ to draw examples for each type of isomerism indicated. This will require that you draw at least two structures to show these differences. What is the degree of unsaturation? (25 pts)

skeletal isomers	positional isomers	functional group isomers
conformational isomers	enantiomers	diasteromers

4. a. The active site of an important liver enzyme has just been discovered. Four key regions are shown in the enzyme cavity, just below. As an employee of Bronco Pharmaceutical, you are trying to design an inhibitor molecule that will strongly bind to the key regions of the active site so that the normal substrate cannot get in and react. You have a variety of branches that you can attach to a central sp^3 carbon atom. Pick appropriate branches and show how your molecule will sit in the enzyme cavity. Give a very brief explanation (1-2 words) for why each branch has its special affinity. (12 pts)

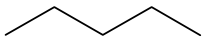


Available Branches, (acidic or basic groups are drawn as they would appear at the body's pH)

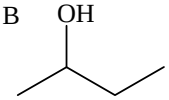


b. Match the compounds with their boiling points with a brief explanation. (12 pts)

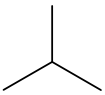
boiling points: 1420°C, 100°C, 80°C, 36°C, -1°C, -12°C

A 

MW = 72 g/mol

B OH 

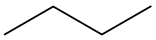
MW = 74 g/mol

C 

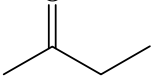
MW = 58 g/mol

D KCl

MW = 74 g/mol

E 

MW = 58 g/mol

F O 

MW = 72 g/mol

5. Draw all possible chair conformations of isopropylcyclohexane. Which conformation is more stable? Draw it first. Provide a reason for your answer. Draw a Newman projections of the less stable conformation using the $C_1 \rightarrow C_2$ and $C_5 \rightarrow C_4$ bonds to sight along. Point out any gauche interactions shown in your Newman projection. If the axial energy of an isopropyl group is 2.1 kcal/mole what are the relative percents of each conformation? Sketch an energy diagram that shows how the energy changes with the conformational changes. (24 pts)

$$K = 10^{\frac{-\Delta G}{2.3RT}}$$

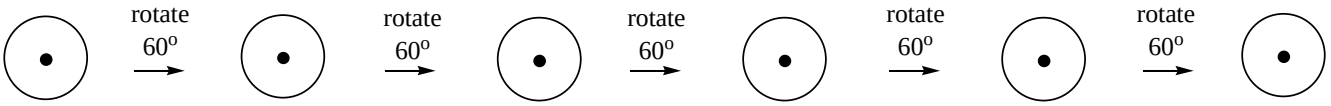
R = 2 cal/mol-K
T = 300 K

6. Use a Newman projection of the C2→C3 bond of 3-methylpentane to **show the most stable conformation first**. Rotate through all of the eclipsed and staggered conformations. Using the energy values provided in the table below, calculate the relative energies of the different conformations. Plot the changes in energy in the graph diagram provided. Hint: Draw a 2D structure first and "bold" the bond viewed in your Newman projection, then decide your line of sight. (30 pts)

2D structure

Eclipsing Energy Values (kcal/mole)	
H/H	+1.0
H/CH_3	+1.3
H/ethyl	+1.4
CH_3/CH_3	+2.5
CH_3/ethyl	+2.8
CH_3/H gauche	+0.0
ethyl/H gauche	+0.1
CH_3/CH_3 gauche	+0.8
CH_3/ethyl gauche	+1.0

most stable conformation

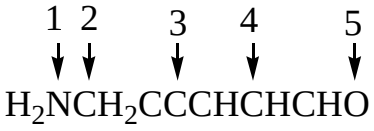


ΔH^o = ΔH^o = ΔH^o = ΔH^o = ΔH^o = ΔH^o =

7. Draw an acceptable Lewis structure (2D) for each of the following. Show <u>all</u> single, double and triple bonds with one, two or three lines. Include all lone pairs of electrons as two dots. Include formal charge, if present at the atom where present. Identify any functional groups by name (i.e. ketone, amide, etc.) (15 pts)

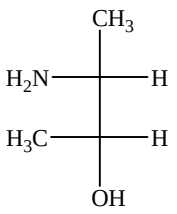
$$\left[(CH_3)_3NCH(OCH_3)CHCHCCCOCH_2CO_2CHCH_3CHOHCHCNCO_2\right]^{\oplus\ominus}$$

8. Draw a 3-D structure for the following molecule. Show bonds in front of the page as wedges, bonds in back of the page as dashed lines and bonds in the page as simple lines. Show orbitals for pi bonds and lone pairs along with their electrons. Identify the hybridization, bond angles and descriptive shape for all numbered atoms. (24 pts)

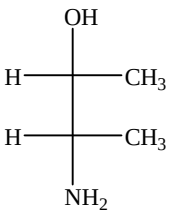


Atom	Shape	Hybridization	Bond Angles	# σ bonds	# π bonds	# lone pairs
1						
2						
3						
4						
5						

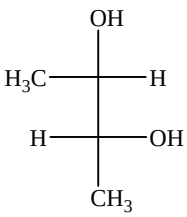
9. For the following set of Fischer projections answer each of the questions below by circling the appropriate letter(s) or letter combination(s). Hint: Redraw the Fischer projections with the longest carbon chain in the vertical direction and having similar atoms in the top and bottom portion. Classify all chiral centers in the first structure as R or S absolute configuration. (25 pts)



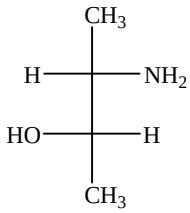
A



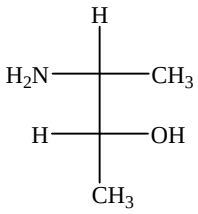
B



C



D



E

a. Which are optically active? A B C D E

b. Which are meso? A B C D E

c. Which is not an isomer with the others? A B C D E

d. Which pairs are enantiomers? AB AC AD AE BC BD BE CD CE DE

e. Which pairs are identical? AB AC AD AE BC BD BE CD CE DE

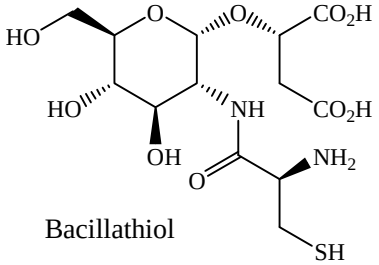
f. Which pairs are diastereomers? AB AC AD AE BC BD BE CD CE DE

g. Which pairs, when mixed in equal amounts will not rotate plane polarized light? AB AC AD AE BC BD BE CD CE DE

h. Draw any stereoisomers of 3-amino-2-butanol as Fischer projections, which are not shown above. If there are none, indicate this.

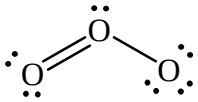
i. Would anything change if, in compound D, the OH was replaced with a NH_2 group? How about compound E?

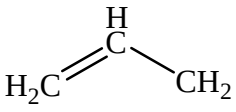
j. Some gram positive bacteria use the following thiol as a reducing reagent in the cytosol. Circle all chiral centers. How many stereoisomers are possible with that many chiral centers? (Org. Lett. 2012, 14, 5207-9)

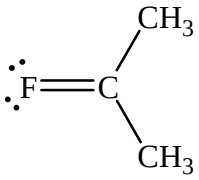


Bacillathiol

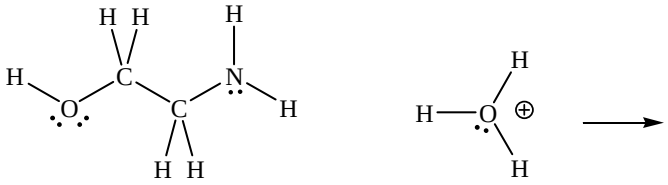
10. Indicate all formal charges present in the following structures. Assume all electrons are shown as lines or dots. If other reasonable resonance structures are possible, draw one additional resonance structure using the proper arrow conventions. (15 pts)

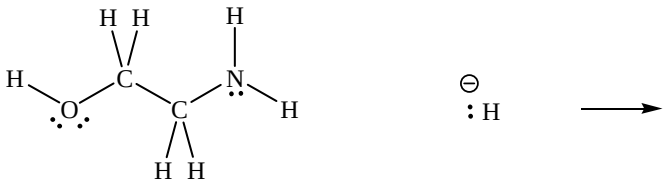






11. Write the expected products from the following reactions and explain your reasoning. (24 pts)





Extra question (not used) - Draw any simple example of the given functional group using the indicated number of carbons. Provide a name for your example of the a. ester and b. nitrile at the bottom. (24 pts)

aldehyde	ketone	ether	acid chloride
ester	alkene	thiol	bromoalkane
alcohol	nitrile	carboxylic acid	alkyne
amide	anhydride	aromatic	amine

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Assume 100% on midterm = 200 points

	Overall Average	**Exam Avg with 25% of HW grade of 100%**	
A	85-100	80	(exam points = 160)
B	70-84	60	(exam points = 120)
C	55-69	40	(exam points = 80)
C-	50-54	33	(exam points = 66)
D	40-49	20	(exam points = 40)
F	below 40%	below 20%	