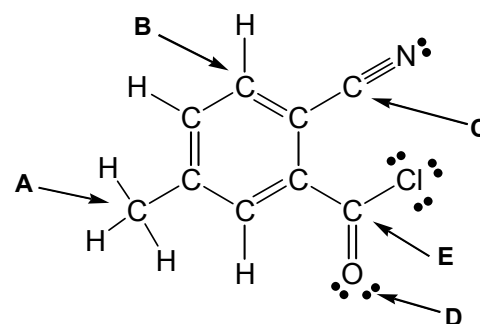
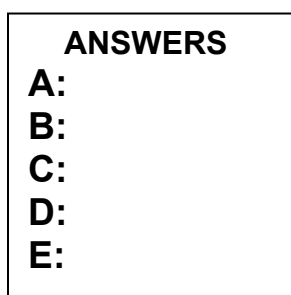


ORGANIC CHEMISTRY I -- W2005 section02  
**Sample MIDTERM TEST** (questions mostly from F2003 MT#1&2)

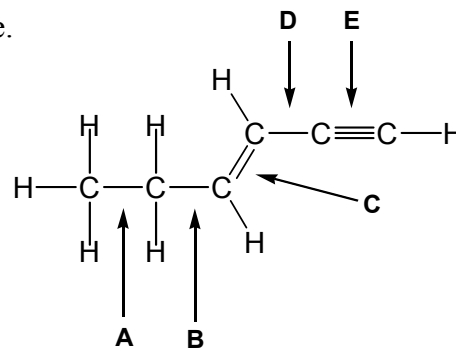
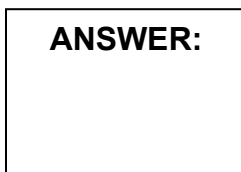
**INSTRUCTIONS:** This test paper includes 7 pages, 12 questions and a periodic table; check that your paper is complete. Answer all questions inside the boxes provided (except questions 11b & 12); information written elsewhere will not be marked. Model kits are allowed. **GOOD LUCK!**

**#1. (2 Marks)** What is the expected hybridization for each of the indicated atoms in this molecule?



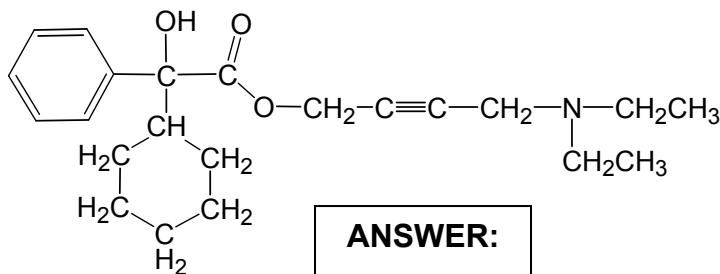
**# 2. (2 Marks)** Rank the bonds in terms of length for this molecule.

- a) longest **D** > **B** > **A** > **C** > **E** shortest  
b) longest **E** > **C** > **A** > **B** > **D** shortest  
c) longest **A** > **B** > **D** > **C** > **E** shortest  
d) longest **E** > **C** > **D** > **B** > **A** shortest  
e) longest **A** > **D** > **B** > **E** > **C** shortest



**# 3. (2 Marks)** The molecule shown here is oxybutynin, an anticholinergic compound. Which choice represents the list of functional group classes in oxybutynin?

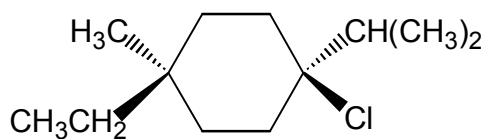
- a) 2 phenyl rings, an amine, an ester, an alkyne, a nitrile  
b) a nitrile, a ketone, an alcohol, a phenyl ring, an amine  
c) an alkyne, an ester, a phenyl ring, an amine, an alcohol  
d) an acid, an alcohol, a nitrile, an alkyne, 2 phenyl rings  
e) a phenyl ring, an amine, an alkyne, a ketone, an ether



**ANSWER:**

# 4. (2 Marks) How many secondary ( $2^\circ$ ) carbons are present in this structure?

ANSWER:

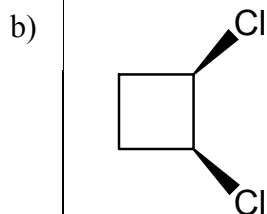
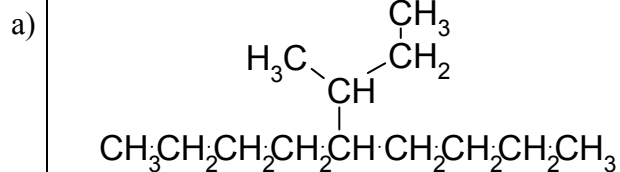


# 5. (4 Marks) Draw line structures for the following compounds:

a) *N*-methyl-1,3-dichloro-6-ethyl-2-octamine

b) *trans*-1-bromo-3-(1-methylethyl)cyclohexane

# 6. (4 Marks) Provide systematic IUPAC names for the following compounds:



CHEM 221 Fall 2003 Section 02 MIDTERM #1-A Name: \_\_\_\_\_

# 7. (6 Marks) There are many constitutional (structural) isomers with the molecular formula  $C_3H_6O_2$ .

a) In each box, draw one isomer that meets the criteria listed in that box (there are a number of correct possibilities). All atoms should be closed shell (full valence) and uncharged.

<p><b>ISOMER A:</b> one 3-atom ring; <b>both</b> oxygen atoms are part of the ring of atoms</p>	<p><b>ISOMER B:</b> one 3-atom ring; a <b>single</b> oxygen atom is part of the ring of atoms</p>	<p><b>ISOMER C:</b> one 3-atom ring; oxygen atoms are <b>not</b> part of the ring of atoms</p>
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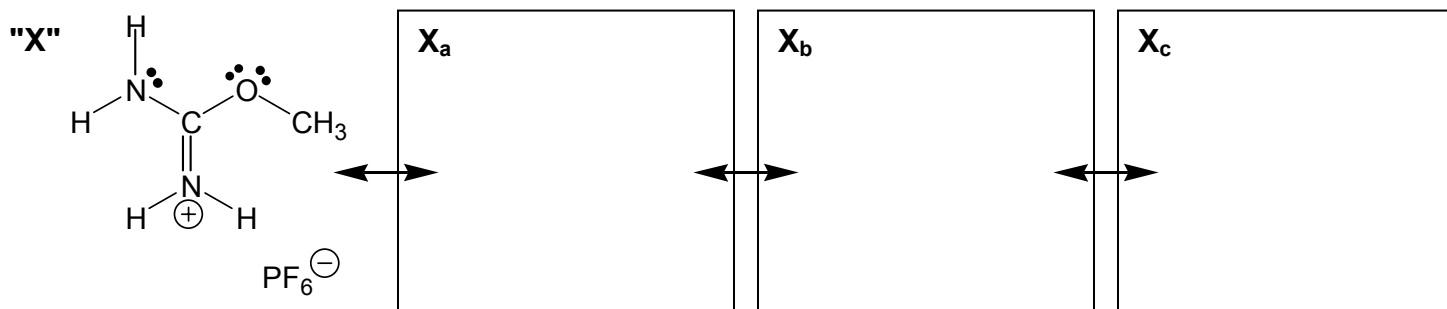
b) Based on the structures of the molecules, you should be able to confidently predict one of these isomers as being either the most or the least soluble in water. Choose which one you are going to identify, then explain your reasoning.

I will identify the: (circle one)		
most soluble in water		least soluble in water
Circle which isomer it is:	A	B C

**Explanation (include sketches of relevant intermolecular interactions):**

CHEM 221 Fall 2003 Section 02 MIDTERM #1-A Name: \_\_\_\_\_

- # 8. a) (3 Marks) There are three other significant resonance contributors for molecule "X" shown below. Draw them in the boxes provided. You do not need to draw the  $\text{PF}_6^-$  anion.



- b) (3 Marks) Rank the four structures **X**, **X<sub>a</sub>**, **X<sub>b</sub>**, and **X<sub>c</sub>** according to how much they contribute to the real structure of the molecule. Give a reason why the most important contributor is so stable, and why the least important contributor is so unstable.

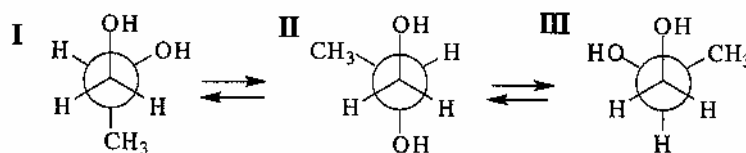
Most important	Least important
_____ >	_____ >
_____ >	_____ >
Why so stable?	Why so unstable?

- c) (2 Marks) Considering these resonance contributors, how do you think the molecule "really" looks? In the box on the left, the connectivity in molecule "X" is indicated by dotted lines. **Your task is to represent the 3-dimensional (3-D) representation of structure of "X" by writing over the dotted-lines: use lines, dashes and wedges to indicate spatial orientation with respect to the page.** Describe this 3-D structure by filling in the blanks in the other box (you can number the atoms in the structure for clarity).

<p>How I think "X" looks in 3-D:</p>	<p>These bond will NOT rotate freely:</p> <p>These atoms will be in the same plane:</p> <p>The reason for this is:</p>
--------------------------------------	--

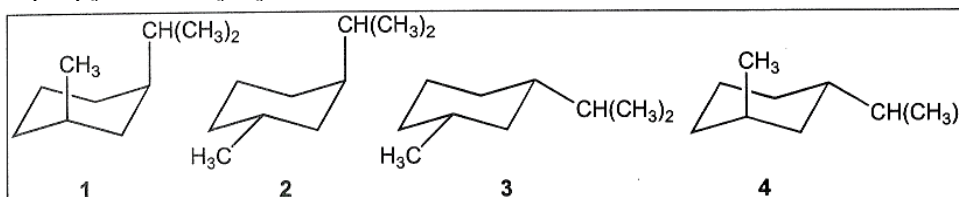
# 9. (\_\_\_/ 4 Marks) **CIRCLE YOUR CHOICE.** The three staggered forms of 1,2-propanediol are represented here as Newman projections. Taking into account **both** steric and electrostatic interactions between substituents, rank the conformers according to their relative stability.

- a) most stable **III** < **II** < **I** least stable  
 b) most stable **III** < **I** < **II** least stable  
 c) most stable **II** < **III** < **I** least stable  
 d) most stable **I** < **III** < **II** least stable  
 e) most stable **I** < **II** < **III** least stable

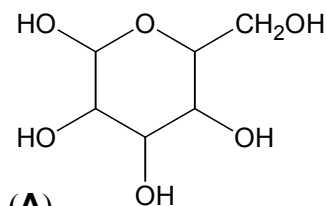


# 10. (\_\_\_/ 3 Marks) **CIRCLE YOUR CHOICE.** Which structure represents the most stable chair conformation of *trans*-1-isopropyl-3-methylcyclohexane?

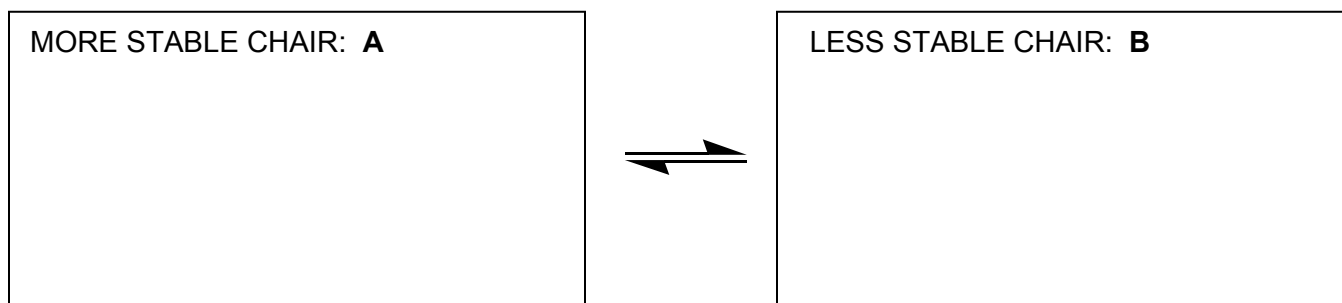
- a) 1  
 b) 2  
 c) 3  
 d) 4



# 11. (\_\_\_/ 5 Marks) The structure of glucose includes a six-membered ring. The relative orientations of the ring's substituents has not been shown in the drawing here, but the information in part (a) will allow you to figure it out.



- a) In the most stable conformation of glucose, the molecule adopts a chair conformation where all the substituents are equatorial. Draw this conformation (**A**), and show what the molecule would look like in the "flipped" chair conformation (**B**).



- b) Draw a planar representation of glucose (like that shown at the top of the question) that shows the dashes and wedges needed to illustrate the relative orientation of the substituents.

CHEM 221 Fall 2003 Section 02 MIDTERM #1-A Name: \_\_\_\_\_

# 12. (\_\_\_ / 8 Marks) You are asked to prepare 2-bromo-2-methylpropane, starting with an alkane precursor.

- a) What reagents and reaction conditions (*e.g.*, hot/cold, light/dark, relative amounts of reagents; we'll learn about solvents later) would you choose? Write a reaction equation that describes your choices.
- b) Would a significant amount of undesired products also form? Explain, and identify any undesired products you are talking about and how they would form.
- c) Would your answer to (b) be the same if you were talking about preparing 2-methyl-2-chloropropane instead? Explain.

-----THE END-----

**WebElements: the periodic table on the world-wide web**  
<http://www.webelements.com/>

<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">                 WebElements                  symbol                  atomic number             </div>																					
1 H 1.00794(7)																	18 He 4.002602(2)				
3 Li 6.941(7)	4 Be 9.012182(2)															5 B 10.811(7)	6 C 12.0107(8)	7 N 14.00643(4)	8 O 15.999(4)	9 F 18.9984032(3)	10 Ne 20.1797(6)
11 Na 22.98976928(2)	12 Mg 24.30409(4)															13 Al 26.9815386(8)	14 Si 28.08558(6)	15 P 30.973762(3)	16 S 32.06(5)	17 Cl 35.45(3)	18 Ar 39.948(1)
19 K 39.0983(1)	20 Ca 40.078(4)	21 Sc 44.955912(6)	22 Ti 47.867(1)	23 V 50.9415(1)	24 Cr 51.9961(6)	25 Mn 54.938044(1)	26 Fe 55.845(2)	27 Co 58.933195(5)	28 Ni 58.6934(4)	29 Cu 63.546(3)	30 Zn 65.38(4)	31 Ga 69.723(1)	32 Ge 72.64(1)	33 As 74.921595(6)	34 Se 78.96(3)	35 Br 79.904(1)	36 Kr 83.798(4)				
37 Rb 85.4678(3)	38 Sr 87.62(3)	39 Y 88.90584(2)	40 Zr 91.224(2)	41 Nb 92.90638(2)	42 Mo 95.94(1)	43 Tc 98	44 Ru 101.07(2)	45 Rh 102.90550(2)	46 Pd 106.9076(2)	47 Ag 107.8682(4)	48 Cd 112.411(8)	49 In 114.818(8)	50 Sn 118.710(3)	51 Sb 121.757(1)	52 Te 127.6(3)	53 I 126.90545(3)	54 Xe 131.29(4)				
55 Cs 132.9054519(6)	56 Ba 137.327(2)	57-70 * Lanthanoids	71 Lu 174.967(1)	72 Hf 178.49(3)	73 Ta 180.94788(1)	74 W 183.84(1)	75 Re 186.207(1)	76 Os 190.23(3)	77 Ir 192.222(1)	78 Pt 195.078(2)	79 Au 196.966569(4)	80 Hg 200.59(2)	81 Tl 204.387(3)	82 Pb 207.2(1)	83 Bi 208.980388(4)	84 Po 209	85 At 210	86 Rn 222			
87 Fr 223	88 Ra 226	89-102 ** Actinoids	103 Lr 260	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 264	108 Hs 265	109 Mt 266	110 Ds 271	111 Uub 272	112 Uuq 277									

*lanthanoids	57 La 138.90547(7)	58 Ce 140.12(1)	59 Pr 140.90766(2)	60 Nd 144.24(1)	61 Pm 145	62 Sm 150.36(2)	63 Eu 151.964(1)	64 Gd 157.25(3)	65 Tb 158.92534(6)	66 Dy 162.50015(3)	67 Ho 164.93032(2)	68 Er 167.259(4)	69 Tm 168.93047(3)	70 Yb 173.0469(3)
**actinoids	89 Ac 227	90 Th 232.0377(2)	91 Pa 231.036887(2)	92 U 238.02891(3)	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259

Element symbols and names, symbols, names, and weights are from recommendations by IUPAC (http://www.iupac.org). Also containing the names of elements 101-110 are now confirmed (June 4, April, Chem., 1997, 26, 2471-2475). Names have yet to be proposed for the elements 111-112, and 114. These and 116 are IUPAC's temporary systematic names (Pure & Appl. Chem., 1979, 51, 265-284), in the IUPAC and some other sources, the symbols lanthanum and cerium are written with the lower spelling is capital. Atomic weights shown relative masses. Most data for lanthanoid elements, those are IUPAC 2003 values (Pure & Appl. Chem., 2003, 75, 823-835). Elements with relative mass in brackets have no stable nuclides and are represented by the highest value for the longest-lived isotope. The elements thulium, promethium, and ununseptium have characteristic relative abundances and have the relative masses. The best available figure of each value is considered reliable to at least one more uncertainty than is given in parentheses. Periodic table organization for a justification of the position of the elements La, Ac, U, and Lu in the WebElements periodic table see W.D. Jenkins. "The position of lanthanum, actinium and lutetium (revisions) in the periodic table", J. Chem., 56, 1982, 54, 459-476. Group labels: the s-block (1-2) used here is the IUPAC nomenclature, for a discussion of this and other nomenclature systems see IUPAC, Mendeleev and IUPAC, "Guidelines to the periodic table of the elements", J. Chem., 65, 1993, 85, 529-536. ©2003 Dr. Mark J. Winter WebElements Ltd and University of Sheffield. All rights reserved. For updates to this table see <http://www.webelements.com/aboutus/updates/updates.html>. Version date: 17 March 2003.

Electronegativity values of the elements

H 2.1																	He				
Li 1.0	Be 1.5															B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne
Na 0.9	Mg 1.2															Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	Ar
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.9	Ni 1.9	Cu 1.9	Zn 1.8	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr				
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe				
Cs 0.7	Ba 0.9	La 1.1	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.9	Bi 1.9	Po 2.0	At 2.2	Rn				