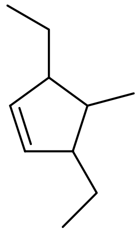
CHM 201 – Organic Chemistry I Name________________________

Hour Exam II

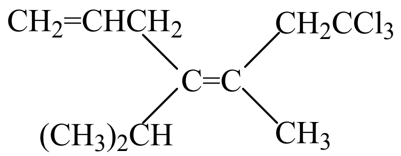
14 October 2002

1.(16) Name the following compounds using I.U.P.A.C. nomenclature. Be sure to denote stereochemistry (*Z*, *trans* etc.) when appropriate.

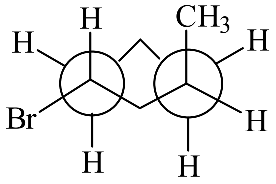
a)



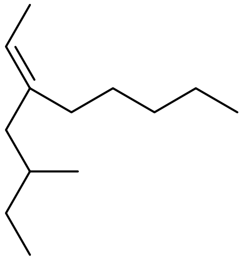
b)



c)



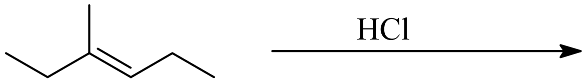
d)



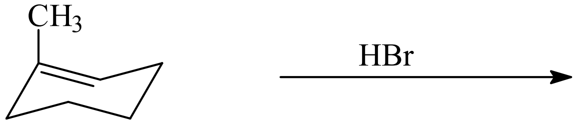
2.(16) Consider the molecule **3-methylpentane** citing along **$C_2$-$C_3$**. Construct all six rotational conformers using Newman projections. **Also**, identify the *highest* and *lowest* energy conformations and determine the energy difference (KJ/mol) between the two. *Please be sure to draw the correct molecule!*

| **Interaction** | **Energy cost (KJ/mol)** |
|---|---|
| methyl-methyl *gauche* | 3.8 |
| methyl-ethyl *gauche* | 4.2 |
| methyl-H *eclipse* | 4.0 |
| ethyl-H *eclipse* | 4.2 |
| methyl-methyl *eclipse* | 11.0 |
| methyl-ethyl *eclipse* | 12.0 |

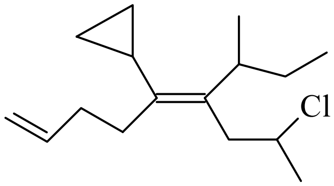
3.(12) Give the major product for the following reactions:

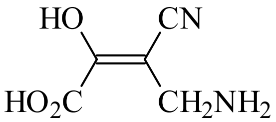
a) 

b) $CH_2{=}CHCH_2CH_2CH_3 \xrightarrow{HBr}$

c) 

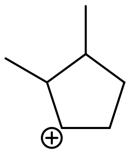
4.(10) Identify the high and low priority substituents and assign (*E*) or (*Z*) in the following molecules:

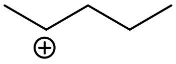
a) 

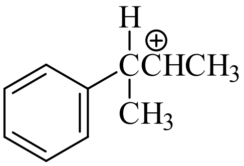
b) 

5.(14) The molecule ***trans*1-methyl-3-propylcyclohexane** can exist in two conformations that have a **difference in energy of only 1.0 KJ/mol**. Draw the two chair conformations of this molecule and **label the alkyl groups** as axial-up, axial-down, equatorial-up, or equatorial-down. If the energy value of a 1,3-diaxial interaction between a methyl group and a hydrogen is 3.8 KJ/mol, what is the value of a 1,3-diaxial interaction between a propyl group and a hydrogen.

6.(10) Carbocations tend to undergo 1,2-hydride shifts or 1,2,-methide shifts in order to achieve greater stability. From the carbocations below, identify the *two* species that you would expect to undergo a rearrangement and draw the rearranged cation below it.







7.(12) Give the structures of the alkenes that would most likely give rise to the above carbocations (question #6) as the major intermediate upon protononation with HCl.

8.(16) Consider the free radical halogenation ($X_2$) of **methane** with both **fluorine ($F_2$)** and **bromine ($Br_2$)**. Use the information below and the data table provided to answer the following questions. $CH_4 + X_2$ --------------→ $CH_3X + HX$

$X_2$ ----------------> $X^{\cdot} + X^{\cdot}$

i) $X^{\cdot} + CH_4$ --------------> $HX + CH_3^{\cdot}$

ii) $CH_3^{\cdot} + X_2$ -------------> $CH_3X + X^{\cdot}$

| **X=** | **F** | **Br** |
|---|---|---|
| $\Delta H_i$ | _____ | _____ |
| $\Delta H_{ii}$ | _____ | _____ |
| $\Delta H_{rxn}$ | _____ | _____ |

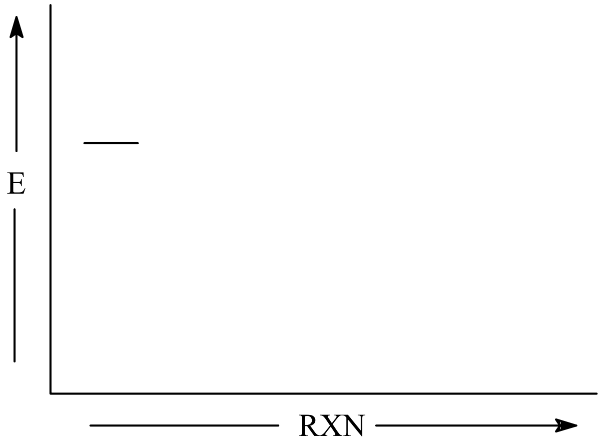
a) Using the two propagation steps shown above (i and ii), calculate $\Delta H_i$ and $\Delta H_{ii}$. and $\Delta H_{rxn}$ for the reaction with both $F_2$ and $Br_2$ (see BDE values on next page).

b) Are the reactions endo- or exothermic overall? ____________

c) Which step is the rate determining step in the **bromination** reaction?

d) Which reaction is likely *not* a safe reaction to carry out in the lab? Why?

e) On the axes below, construct a reaction profile for the **bromination** propagation steps. Keep your profile roughly to scale. With vertical arrows, **Label $\Delta H^o$** for step i, ii, and for the overall reaction.



| **Bond** | **Bond Dissociation Energy (KJ/mol)** |
|---|---|
| $CH_3$-H | 438 |
| $CH_3$-Br | 293 |
| $CH_3$-F | 456 |
| H-Br | 366 |
| H-F | 569 |
| Br-Br | 193 |
| F-F | 157 |