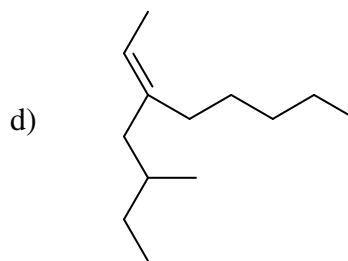
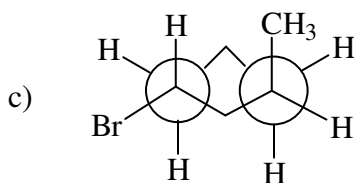
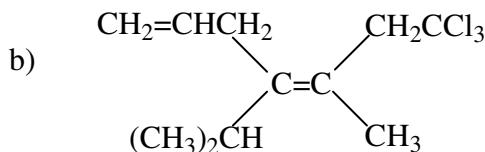
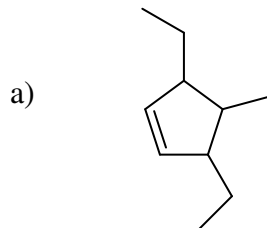


1.(16) Name the following compounds using I.U.P.A.C. nomenclature. Be sure to denote stereochemistry (*Z*, *trans* etc.) when appropriate.

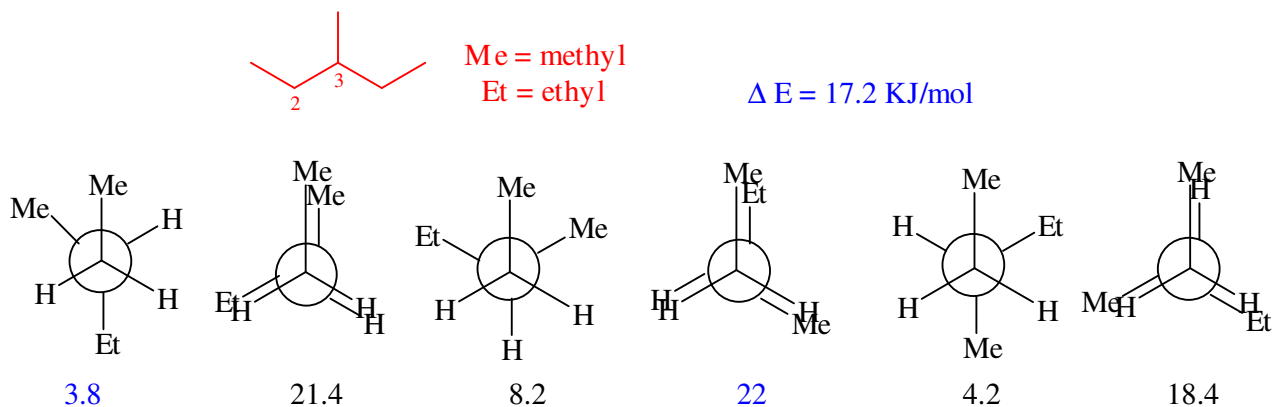


- a) 3,5-diethyl-4-methylcyclopentene
 b) (E) 7,7,7-trichloro-4-isopropyl-5-methyl-1,4-heptadiene
 c) *Trans* 1-bromo-3-methylcyclohexane
 d) (E) 3-(2-methylbutyl)-2-octene

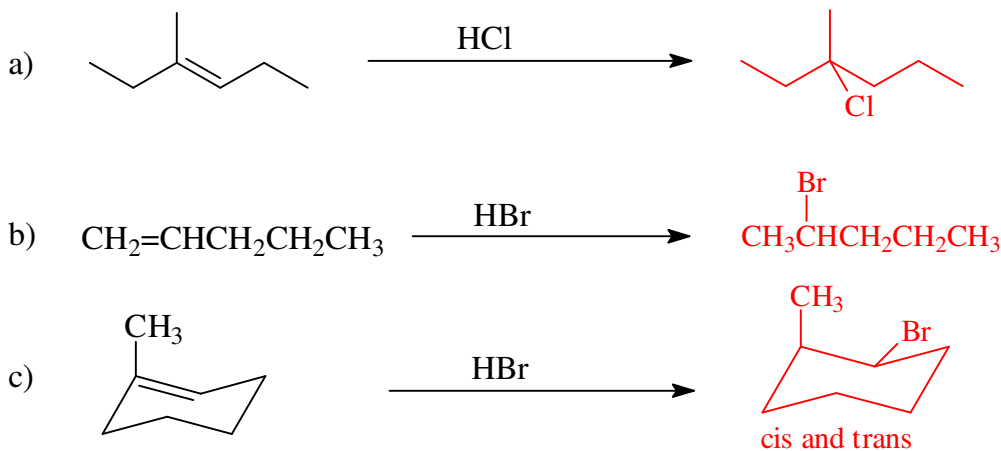
2.(16) Consider the molecule **3-methylpentane** citing along **C₂-C₃**. Construct all six rotational conformers using Newman projections. **Also**, identify the *highest* and *lowest* energy conformations and determine the energy difference (KJ/mol) between the two. *Please be sure to draw the correct molecule! The original exam had different values; use these.*

Interaction	Energy cost (KJ/mol)
methyl-methyl <i>gauche</i>	3.8
methyl-ethyl <i>gauche</i>	4.2
methyl-H <i>eclipse</i>	6.0
ethyl-H <i>eclipse</i>	6.4
methyl-methyl <i>eclipse</i>	11.0
methyl-ethyl <i>eclipse</i>	12.0
H-H <i>eclipse</i>	4.0

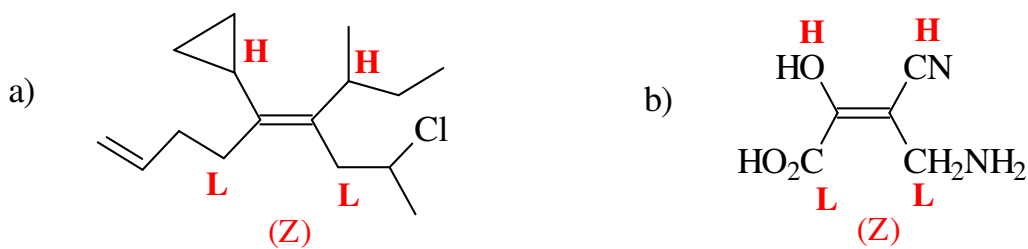
For my structures, I held the front carbon (C-2) still and rotated the rear carbon (C-3) clockwise.



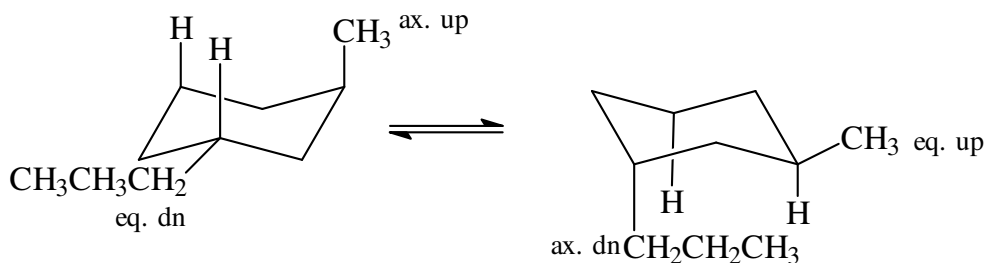
3.(12) Give the major product for the following reactions:



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



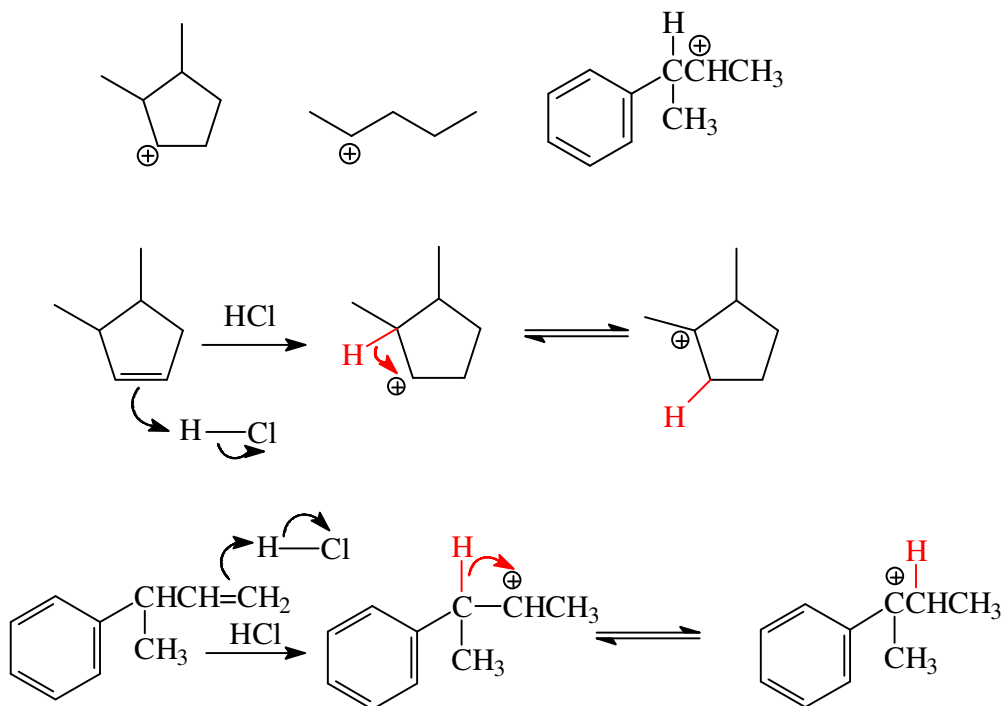
5.(14) The molecule ***trans*-1-methyl-3-propylcyclohexane** can exist in two conformations that have a **difference in energy of only 1.0 KJ/mol**. Draw the two chair conformations of this molecule and **label the alkyl groups** as axial-up, axial-down, equatorial-up, or equatorial-down. If the energy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



$2 \times 3.8 \text{ KJ/mol} = 7.6 \text{ KJ/mol}$

8.6 KJ/mol (given)
ergo each Pr-H 1,3 diaxial is **4.3 KJ/mol**

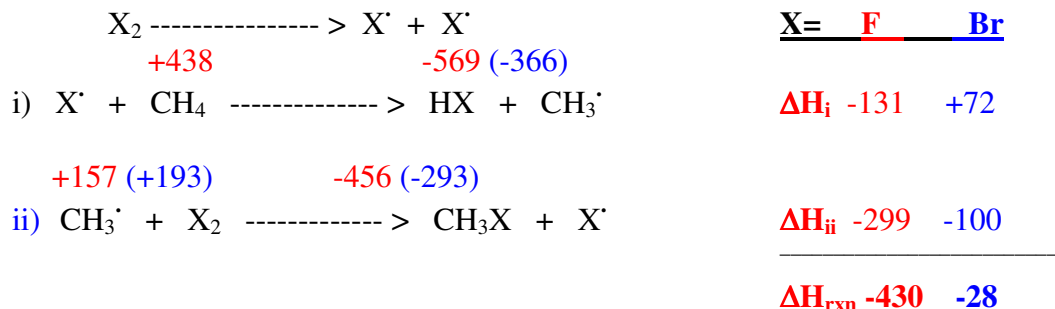
6.(10) Carbocations tend to undergo 1,2-hydride shifts or 1,2-methide shifts in order to achieve greater stability. From the carbocations below, identify the *two* species that you would expect to undergo a rearrangement and draw the rearranged cation below it.



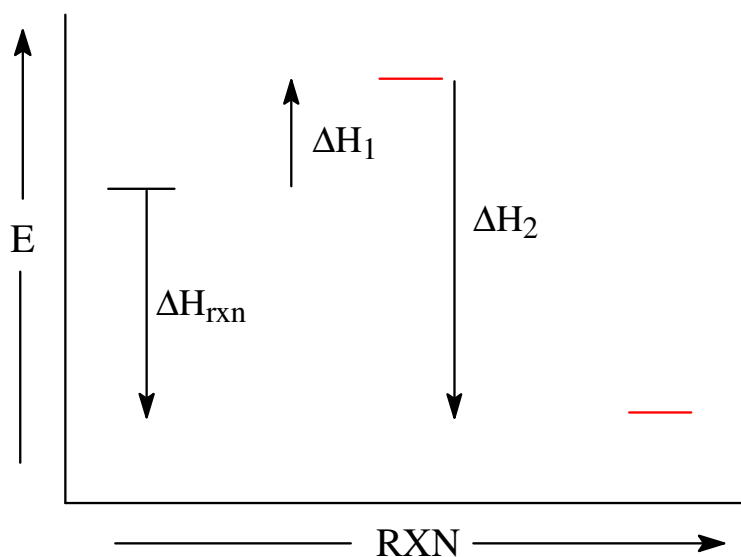
7.(12) Give the structures of the alkenes that would most likely give rise to the above carbocations (question #6) as the major intermediate upon protonation with HCl.
See above.

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. $CH_4 + X_2 \rightarrow CH_3X + HX$

All values are in KJ/mol



- Using the two propagation steps shown above (i and ii), calculate ΔH_i and ΔH_{ii} and ΔH_{rxn} for the reaction with both F_2 and Br_2 (see BDE values on next page).
- Are the reactions endo- or exothermic overall? **exothermic**
- Which step is the rate determining step in the **bromination** reaction?
Step i) It has a higher Energy of activation
- Which reaction is likely *not* a safe reaction to carry out in the lab? Why?
Fluorination. The rate determining step is exothermic and the overall ΔH is extremely negative.
- On the axes below, construct a reaction profile for the **bromination** propagation steps. Keep your profile roughly to scale. With vertical arrows, **Label ΔH°** for step i, ii, and for the overall reaction. **(Connect each step with curved line).**



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