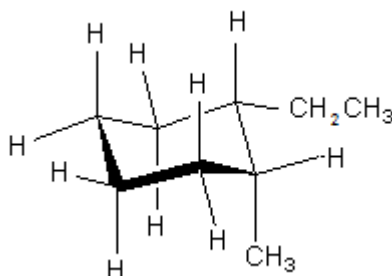
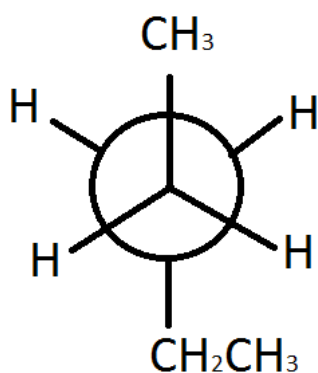


1.) Draw the **most stable** conformation of *cis*-1-ethyl-2-methylcyclohexane in chair conformation. You do not need to draw in the H's. Be very clear about your positioning! (12 pts)



2.) Draw the Newman projection for the **lowest energy, most stable** conformation of pentane, looking down the C₂-C₃ bond. Is it eclipsed or staggered? Anti or gauche? (12 pts)



Staggered, anti

3.) Consider the following three molecules: trimethylamine, ethylmethanamine, and isopropanol. (20 pts)

a.) Arrange the above by **increasing** boiling point, starting with the **lowest**. (Hint: draw out the structures!)

trimethylamine < ethylmethanamine < isopropanol

b.) Explain your reasoning in (a), including reference to the intermolecular forces present in each.

Trimethylamine is a **tertiary amine** so has **no hydrogen bonding**, only dipole-dipole interactions and dispersion forces (weaker intermolecular forces)

Ethylmethanamine is a **secondary amine** so has dispersion, dipole-dipole, and hydrogen bonding, but the **N-H bond is less polar** than the O-H bond, causing weaker hydrogen bonding.

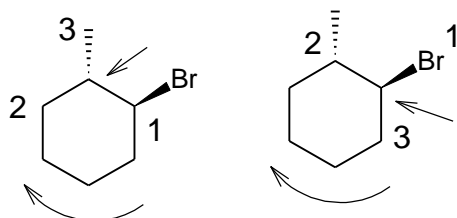
Isopropanol has dispersion, dipole-dipole, and hydrogen bonding, so has the **strongest intermolecular forces** causing the highest boiling point.

4.) Consider the following molecule. (28 pts)

a.) Name the molecule appropriately. **trans-1-bromo-2-methylcyclohexane**

b.) Circle the asymmetric center(s).

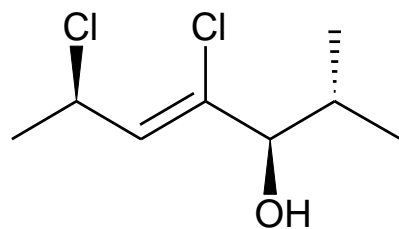
c.) Assign correct stereochemistry to each asymmetric center.



Around methyl: clockwise, but reversed—**S-isomer**

Around bromine: counterclockwise—**S-isomer**

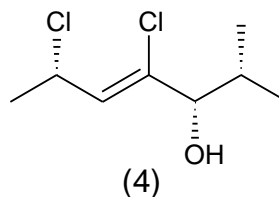
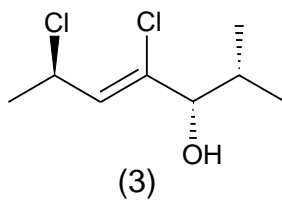
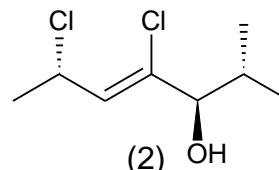
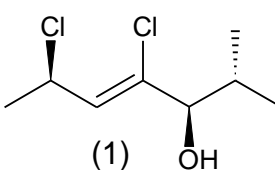
5.) Consider the following molecule. (28 pts)



a.) Is it chiral or achiral? **chiral**

b.) What is its maximum number of stereoisomers? $2^2 = 4$

c.) Draw all possible unique stereoisomers for this compound.

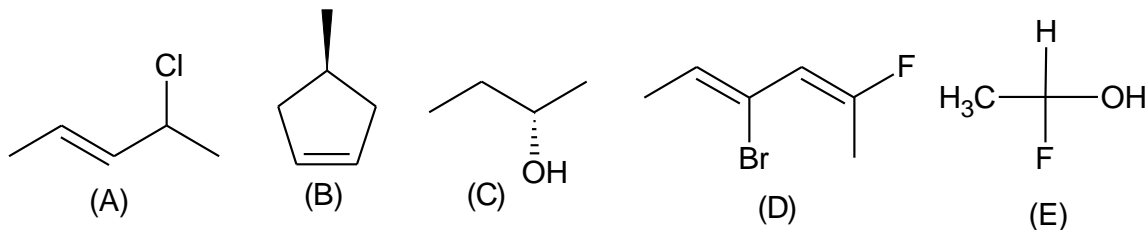


6.) Why is cis-trans isomerization seen in **alkenes**, but not in **alkanes**? (8 pts)

Alkanes have **only single (sigma) bonds** that are allowed **free rotation** at room temperature.

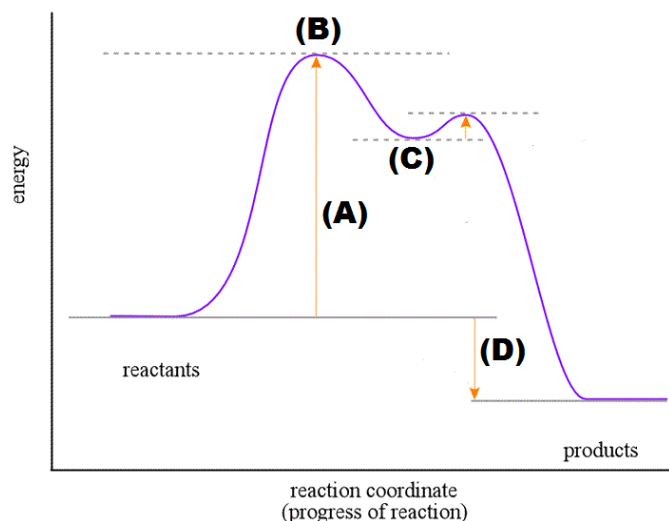
Alkenes include C=C double (sigma and **pi**) bonds that **restrict all rotation**.

7.) Give the appropriate IUPAC names for the following compounds, including stereochemistry where applicable. (35 pts, 7 pts ea)



- (A) (2E)-4-chloro-2-pentene
- (B) 4-methylcyclopentene
- (C) (2S)-2-butanol
- (D) (2E,4Z)-4-bromo-2-fluoro-2,4-hexadiene
- (E) (1S)-1-fluoro-1-ethanol

8.) Consider the following reaction coordinate diagram for a hypothetical reaction. Identify each of the following features on the graph correctly. (22 pts)



- (A) activation energy
- (B) transition state
- (C) intermediate
- (D) ΔG_{rxn}

- a.) Is the reaction **exergonic** or **endergonic**? exergonic ($-\Delta G$)
- b.) Is it **spontaneous**? yes ($-\Delta G$)
- c.) How many steps are in this reaction? 2 (two transition states)
- d.) The addition of a **catalyst** will change which value (A-D) on the graph? (A)
- e.) If ΔS is **negative**, is the reaction **endothermic** or **exothermic**? exothermic ($-\Delta H$)