

1. Dichloromethane is larger and has a larger dipole moment than water, yet water has a higher boiling point than dichloromethane. **(a. 4 pts.)** List the intermolecular forces that dichloromethane molecules use to interact with each other. **(b. 4 pts.)** List the intermolecular forces that water molecules use to interact with each other. **(c. 4 pts.)** Briefly explain why water has a higher boiling point than dichloromethane.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

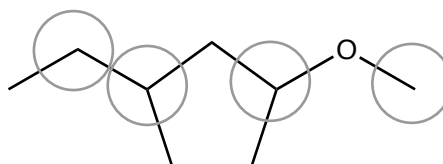
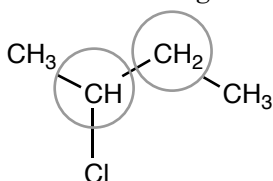
5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

8. \_\_\_\_\_

2. (12 pts.) Determine the degree of substitution (methyl, 1°, 2°, 3°, or 4°) for the circled C atoms.

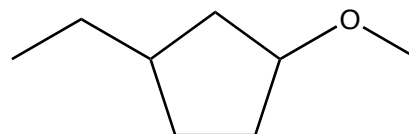
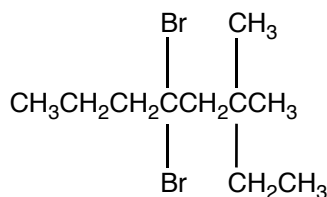


9. \_\_\_\_\_

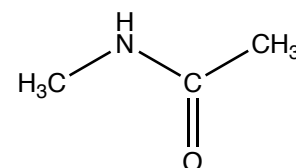
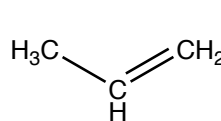
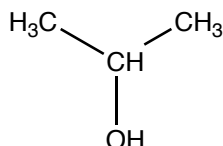
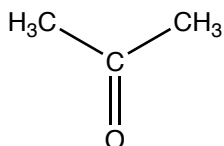
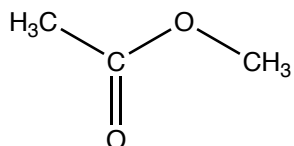
10. \_\_\_\_\_

11. \_\_\_\_\_

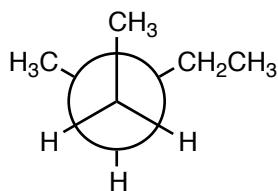
3. (16 pts.) Provide IUPAC names for the following molecules.



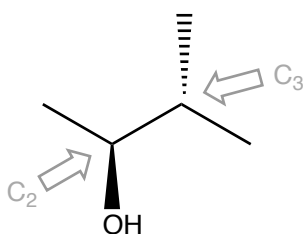
4. (10 pts.) Identify/name the functional groups in the following structures.



5. (a. 6 pts.) Circle any groups or atoms experiencing gauche interactions on the Newman projection drawn below. Draw Newman projections showing the (b. 6 pts.) lowest and (c. 6 pts.) the highest energy conformations of the view of the molecule drawn below.



6. (8 pts.) Draw a Newman projection along the C<sub>2</sub> to C<sub>3</sub> bond of the conformation of 3-methyl-2-butanol drawn below.



7. The so-called C to C banana bonds in cyclopropane are much more reactive than C to C bonds in acyclic alkanes. (a. 3 pts.) Draw cyclopropane. (b. 3 pts.) Determine the hybridization of the C atoms in cyclopropane, and (c. 6 pts.) using valence bond theory briefly explain why these bonds are more reactive.

8. (10 pts.) Mark the following true or false.

\_\_\_\_\_ In a disubstituted cyclohexane, a ring flip will change the *cis/trans* relationship between the substituents.

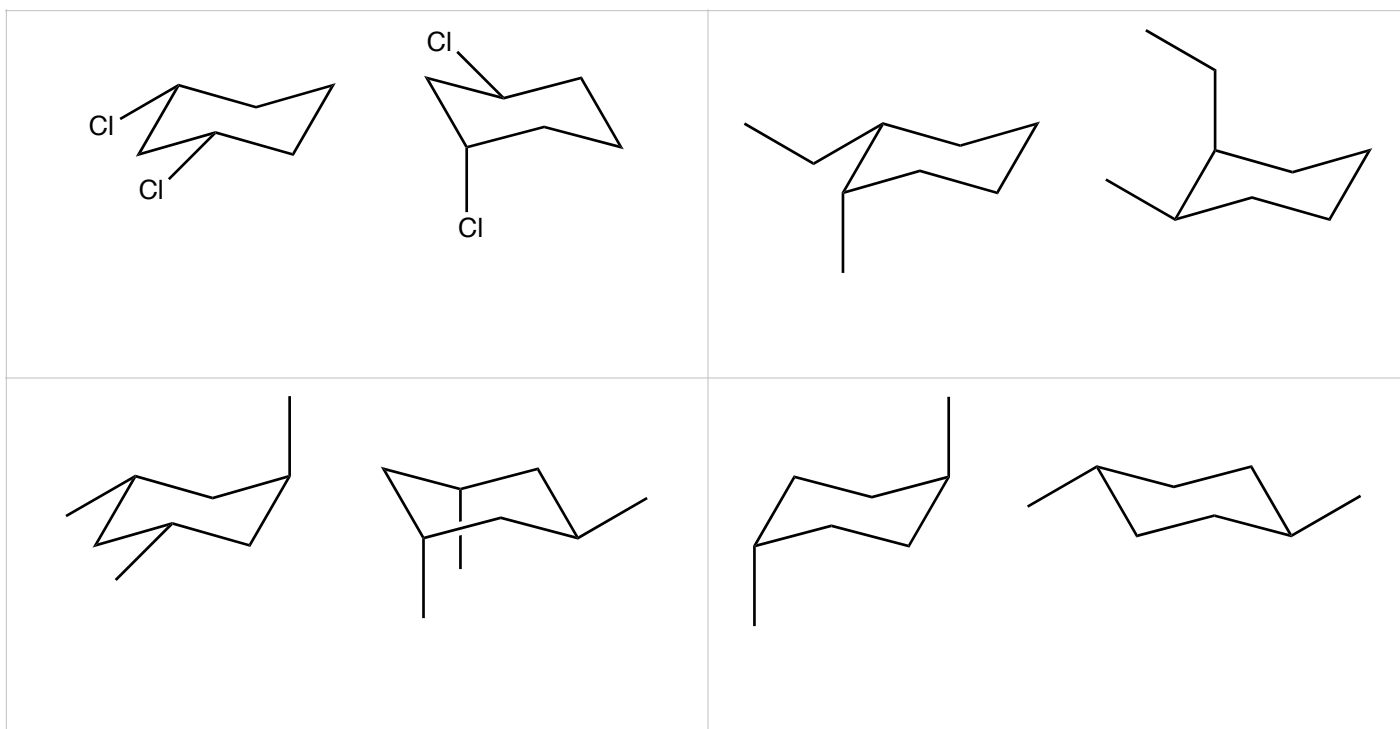
\_\_\_\_\_ In a disubstituted cyclohexane, a ring flip will change the axial positions to equatorial positions and vice versa.

9. (8 pts.) Draw the lowest energy conformation of a *cis*-1,2-dimethylcyclohexane molecule.

10. Four pairs of substituted cyclohexane rings are drawn below.

a. (8 pts.) If the two structures in a given pair can be interconverted by a so-called ring flip write "yes" under the pair; if not write "no". When examining the structures you should assume that the molecules themselves have not been rotated in space.

b. (4 pts.) For each pair, circle the structure that would be lower in energy.



11. (12 pts.) Place a star (\*) next to the chirality centers on the following molecules.

