Alkane Nomenclature and Structural Formulas

1. Write the structural formulas for the following compounds:
   a. 2-methylpentane
   b. 2,3-dimethybutane
   c. 4-ethyl-2,2-dimethylhexane
   d. 2-chloro-4-methylpentane
   e. 1,1-dichlorocyclobutane

2. Write expanded formulas for the following alkanes and name them using the IUPAC system:
   a. $(CH_3)_3CCH_2CH_2CH_3$
   b. $CH_3(CH_2)_2CH_3$
   c. $(CH_3)_2CHCH_2CH_2CH_3$
   d. $CH_3CCl_2CBr_3$
   e. $(CH_2)_4$

3. Give both common and IUPAC names for the following alkanes:
   a. CH_3Br
   b. CH_3CH_2I
   c. CH_2Cl_2
   d. $(CH_3)_2CHI$

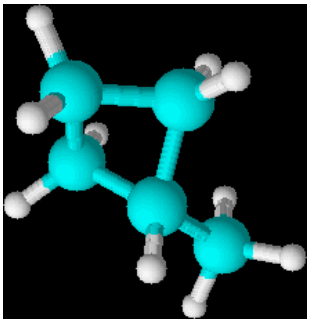
4. Write a structure for each of the compounds listed. Explain why the name given here is incorrect, and give a correct IUPAC name in each case.
   a. 2,3-dibromopropane
   b. 1-methylbutane
   c. 2-ethylbutane

5. Chemical substances used for communication in nature are called pheromones. The pheromone used by the female tiger moth to attract the male is the 18-carbon-atom alkane 2-methylheptadecane. Write its structural formula.

6. Write the structural formulas for all isomers of each of the following compounds, and name each isomer by the IUPAC system. The number of isomers is indicated in parentheses.
   a. C_4H_{10} (2)
   b. $C_3H_6Br_2$ (4)
   c. $C_2H_2ClF_3$ (3)

7. Write structural formulas and names for all possible **cycloalkanes** having the following molecular formula: C_6H_{12} (16). Be sure to include *cis-trans* isomers when appropriate. The number of isomers is indicated in parentheses☺

8. Write a correct IUPAC name for the following structure:

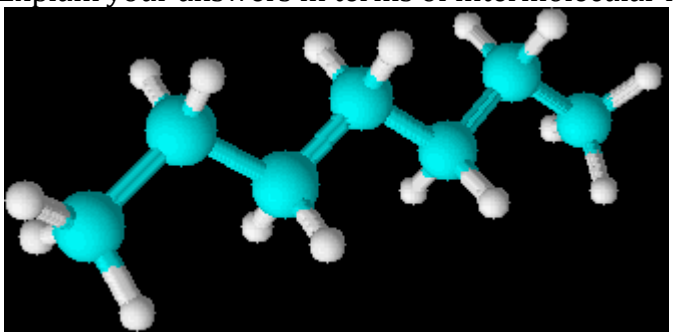


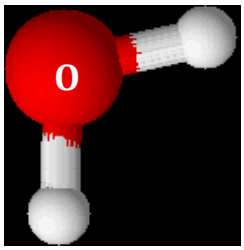
Alkane Properties and Intermolecular Interactions

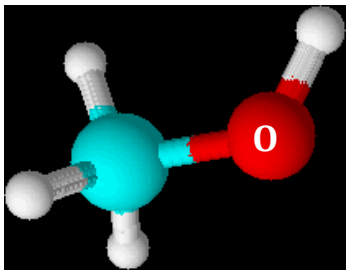
9. Without referring to tables, arrange the following five hydrocarbons in order of increasing boiling point. Explain your answers in terms of intermolecular interactions. (*Hint: Draw structures or make models of the five hydrocarbons to see their shapes and sizes.)*

a. 2-methyhexane
b. heptane
c. 3,3-dimethylpentane
d. hexane
e. 2-methylpentane

10. Arrange the following liquids in order from least soluble in hexane to most soluble in hexane. Explain your answers in terms of intermolecular interactions.

a. 

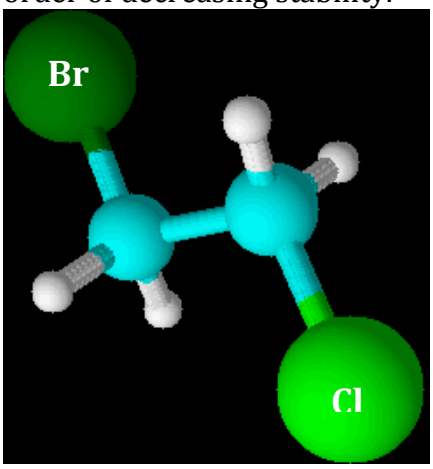
b. 

c. 

Conformations of Alkanes

11. Draw Newman projections for two different *staggered* conformations of butane (looking end-on at the bond between carbo-2 and carbon-3). Then, draw Newman projections for two different *eclipsed* conformations of butane. Arrange these four conformations in order of decreasing stability.

12. Draw the four possible staggered and eclipsed conformations of 1-bromo-2-chloroethane (ball and stick model below), using Newman projections. Under each, draw the corresponding "dash-wedge" and "sawhorse" structures. Rank the conformations in order of decreasing stability.



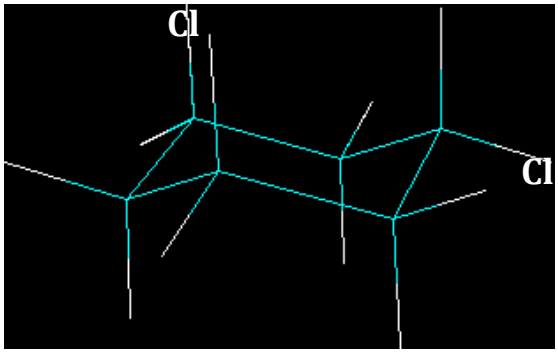
<u>Conformations of Cycloalkanes: *Cis-Trans* Isomerism (Stereoisomerism)</u>

13. Draw the formula for the preferred conformation of:
    a. bromocyclohexane
    b. *trans*-1,4-dimethylcyclohexane

14. Name the following *cis-trans* pair:

a.

b.

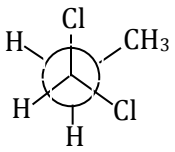


15. Explain with the aid of conformational structures why *cis*-1,3-dimethylcyclohexane is more stable than *trans*-1,3-dimethylcyclohexane. (*Constructing models will help you.*)

16. Which will be more stable, *cis*- or *trans*-1,4-di-*tert*-butylcyclohexane? Explain you answer by drawing conformational structures for each compound.

17. Examine the relationships of isomers as described in class. Then classify each of the following pairs of isomers as structural, conformational, configurational, or identical structures.

a. the pair of compounds in #14

b. 

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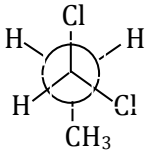
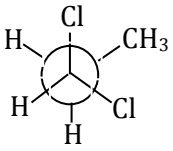


c. 

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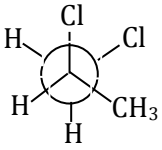
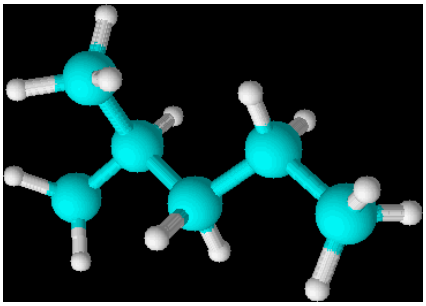
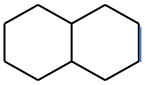


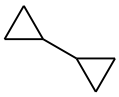
d. 
and


18. Draw structural formulas for the seven possible dichlorocyclohexanes and name them. Include *cis-trans* isomers.

<u>Reactions of Alkanes: Combustion & Halogenation</u>

19. Draw the monochlorination products' structural isomers (you do not have to do stereoisomers) that can be obtained from each of the following polycyclic alkanes:

a. 

b. 

20. Using structural formulas, write equations for each of the following combustion reactions:

a. the complete combustion of propane
b. the complete combustions of pentane

21. Using structural formulas, write equations for each of the following halogenation reactions:

a. the monobromination of propane
b. the monochlorination of cyclobutane

22. From the dichlorination of propane, four isomeric products with the formula, $C_3H_6Cl_2$ were isolated and designated A, B, C, and D. Each was separated and further chlorinated to give one or more trichloropropanes, $C_3H_5Cl_3$. A and B gave three trichlro- compounds; C gave one; and D gave two. Deduce the structures of C and D. One of the products from A was identical to the product from C. Deduce the structures for A and B. (*Hint: Start by drawing the structures of all four dichlorinated propane isomers.)*

23. Write all of the steps (initiation, propagation, termination) in the free-radical chain mechanism for the monochlorination of ethane. What trace by-products would you expect to be formed as a consequence of the chain-terminating step?

$CH_3CH_3 + Cl_2 \rightarrow CH_3CH_2Cl + HCl$