Chem 2321  
Problem-Solving Skills  
Chapters 3 and 4

**Naming examples from pages 4-5 of the lecture notes:**

1. **Example:** (compare #3.30, page 103) Draw and name all of the dichloro derivatives of butane, \( \text{C}_4\text{H}_8\text{Cl}_2 \).

2. **From a previous test:** What is the IUPAC name of the compound below

\[
\text{CH}_3\text{C(CH}_3\text{)}_2\text{CH(CH}_2\text{CH}_2\text{CH}_3\text{)C(CH}_2\text{CH}_3\text{)}_3
\]

3. **From a previous test:** What is the correct IUPAC name of the compound below?

- a) 4-isopropyl-1,1,3-trimethylhexane
- b) 5-isopropyl-2,4-dimethylheptane
- c) 3-isopropyl-4,6-dimethylheptane
- d) 3-ethyl-2,2,4,6-tetramethylheptane
- e) 3-isopropyl-4,6,6-trimethylhexane

4. **From a previous test:** Consider the two structures shown below:

What is the relationship between these two molecules?

- a) identical
- b) constitutional isomer
- c) stereoisomers
- d) conformers
- e) different compounds with different molecular formulas

5. **From a previous test:** Draw and name all the monochloro derivatives of 2,3-dimethylpentane, \( \text{C}_7\text{H}_{15}\text{Cl} \).

6. **From a previous test:** What is the IUPAC name of this compound?

More naming examples:

7. Draw the skeletal structures and give the IUPAC names of all of the isomers, both constitutional isomers and stereoisomers, which have the formula \( \text{C}_8\text{H}_{11}\text{Cl} \) and which contain a cyclopentane ring.
8. Give the complete IUPAC name of the compound shown below.

![Compound](image1)

9. Give the complete IUPAC name of the compound shown below.

![Compound](image2)

10. What is the IUPAC name of the compound shown?

   \[ \text{CH(CH}_3)_2\text{CH(CH}_3)_2\text{C(CH}_3)_3 \]

11. What is the IUPAC name of the compound shown?

![Compound](image3)

**Functional Groups:**

12. Circle and name the functional group(s) in the two compounds below.

   a) \( \text{HC=CCH}_2\text{CH}_2\text{CHO} \)

   ![Functional Group](image4)

   b) 

   ![Functional Group](image5)

13. Draw the skeletal structures of all ketones having the formula \( \text{C}_3\text{H}_{10}\text{O} \). (Do not name these compounds.)
**Conformational Analysis:**

\[
\begin{align*}
&\text{CH}_3 \leftrightarrow \text{H} & 1, 3 \text{ diaxial interaction} & 3.8 \text{ kJ/mol} \\
&\text{H} \leftrightarrow \text{H} & \text{eclipsed} & 4.0 \text{ kJ/mol} \\
&\text{H} \leftrightarrow \text{CH}_3 & \text{eclipsed} & 6.0 \text{ kJ/mol} \\
&\text{CH}_3 \leftrightarrow \text{CH}_3 & \text{eclipsed} & 11 \text{ kJ/mol} \\
&\text{CH}_3 \leftrightarrow \text{CH}_3 & \text{gauche} & 3.8 \text{ kJ/mol}
\end{align*}
\]

14. Consider the following compound: 2,3-dimethylbutane.  
Sighting along the C2-C3 axis, draw a Newman projection of the most stable conformation of this compound, and draw a Newman projection of the least stable conformation of this compound. Use the data in the table above to calculate the total strain energy of each structure, and calculate the energy difference between the two structures.

15. Consider the molecule 2-methylbutane. Sighting along the C2-C3 axis, draw Newman projections of the two staggered conformations of this molecule. Use the data in the table above to calculate the total strain energy of each structure, determine the difference in energy between the two structures, and indicate which conformation is more stable.

16. Consider the following two compounds:  
2,2,3-trimethylbutane
2,3-dimethylbutane  
Sighting along the C2-C3 axis, draw Newman projections of the most stable conformation of each compound. Use the data in the table above to calculate the total strain energy of each structure.

17. Consider the following two compounds:  
\textit{trans}-1,2-dimethylcyclohexane  
\textit{cis}-1,3-dimethylcyclohexane  
Draw the most stable conformation of each molecule. Use the data in the table above to calculate the total strain energy of each structure. Indicate which, if either, is more stable, and calculate the energy difference between the two structures.

18. Consider the following two molecules:  
\textit{cis}-1,2-dimethylcyclohexane  
\textit{trans}-1,3-dimethylcyclohexane  
Draw the more stable conformation of each molecule. Use the data in the table above to calculate the total strain energy of each structure. Indicate which, if either, is more stable, and calculate the energy difference between the two structures.

19. Consider the following two compounds:  
\textit{trans}-1,2-dimethylcyclohexane  
\textit{cis}-1,4-dimethylcyclohexane  
Draw the most stable conformation of each molecule. Use the data in the table above to calculate the total strain energy of each structure. Indicate which, if either, is more stable, and calculate the energy difference between the two structures.

20. Consider the conformation of cyclopentane in which all carbon atoms are in the same plane.  
a) How many H↔H eclipsing interactions would be present of cyclopentane were planar?  
b) How much torsional strain would planar cyclopentane have?  
c) Since the measured total strain of cyclopentane is 26 kJ/mol, how much torsional strain is relieved by puckering?

**Miscellaneous questions**

21. Which compound is expected to have the highest boiling point?  
a) 2-methylpropane  
b) butane  
c) 2,3-dimethylbutane  
d) pentane  
e) hexane

22. Which term best describes the relationship between \textit{cis}-1,2-dimethylcyclohexane and \textit{trans}-1,3-dimethylcyclohexane?  
a) constitutional isomers  
b) stereoisomers  
c) conformers  
d) identical  
e) different compounds with different molecular formulas.