Name: ______________________

**Naming Alkanes**

**PART A: Basic Naming**

Learning how to name compounds in Organic Chemistry does not have to be a difficult task. There are some basic rules that can get you started. The rules for naming are governed by IUPAC and are updated frequently. Although many older, common names are still used, it is a good idea to try to learn the most recent IUPAC nomenclature rules.

Look at the table below. These are the names of the first ten straight-chain alkanes. An alkane is a hydrocarbon made entirely of single bonds. These will help you with naming along the way.

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of Carbon Atoms</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>1</td>
<td>CH₄</td>
</tr>
<tr>
<td>Ethane</td>
<td>2</td>
<td>CH₃CH₃</td>
</tr>
<tr>
<td>Propane</td>
<td>3</td>
<td>CH₃CH₂CH₃</td>
</tr>
<tr>
<td>Butane</td>
<td>4</td>
<td>CH₃CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Pentane</td>
<td>5</td>
<td>CH₃CH₂CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Hexane</td>
<td>6</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Heptane</td>
<td>7</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Octane</td>
<td>8</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Nonane</td>
<td>9</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
</tr>
<tr>
<td>Decane</td>
<td>10</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
</tr>
</tbody>
</table>

**Questions**

1. What is the name for a two-carbon chain?

2. What is the name for a seven-carbon chain?

3. You should memorize these ten names. Can you think of a good way to memorize them?

4. Can you come up with a “formula” that represents the number of hydrogen atoms that will be found in a straight chain alkane?

5. Now take a look at the names of the following “substituted alkanes”:
PART B: IUPAC Rules for Naming

RULE 1
The base or parent name for an alkane is determined by the longest chain of carbon atoms in the formula.
- The longest chain may bend and twist, it is seldom horizontal.
- Any carbon groups not part of the base chain are called branches or substituents.
- These carbon groups are also called alkyl groups.

1. Find the longest carbon chain in the following molecules, circle it in each example:

<table>
<thead>
<tr>
<th>Molecular Structure</th>
<th>Name</th>
</tr>
</thead>
</table>
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3
\end{align*}
\] | 3-methylpentane |
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3 \text{CH}_3
\end{align*}
\] | 3-methylhexane |
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3 \text{CH}_3 \text{CH}_3
\end{align*}
\] | 3-ethylhexane |
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3
\end{align*}
\] | 5-ethyl-2-methylheptane |
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3
\end{align*}
\] | 4-ethylheptane |
| \[
\begin{align*}
\text{CH}_3 & \text{-CH}_2 \text{-CH}_2 \text{-CH}_3 \\
\text{CH}_3 & \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{CH}_3
\end{align*}
\] | 2,3-dimethylhexane |

2. Explain the relationship (in your own words) between the molecular structure—(referencing both the longest chain, and the substituents)—and the name provided.
RULE 2
Number the carbon atoms in the chain starting from the end with the first branch
- If both branches are equally from the ends, continue until a point of difference occurs

3. Number the longest carbon chain in each of the following molecules:

RULE 3
Write each of the branches/substituents in alphabetical order before the base/stem name (longest chain)
- An alkyl group is substituent that contains only carbon and hydrogen. They are named the same way as the parent carbon chain, but their name ends in -yl.
  o Methyl -CH₃
  o Ethyl -CH₂CH₃
  o Propyl -CH₂CH₂CH₃
  o Butyl -CH₂CH₂CH₂CH₃
  o Pentyl -CH₂CH₂CH₂CH₂CH₃
  o Hexyl -CH₂CH₂CH₂CH₂CH₂CH₃
  o Heptyl -CH₂CH₂CH₂CH₂CH₂CH₂CH₃
  o Octyl -CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃
  o Nonyl -CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃
  o Decyl -CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃
- Halogens usually come first
  o Alkylhalide - Alkanes bearing halogen substituents.
    o F = fluoro,  Br = bromo,  Cl = chloro,  I = iodo
- Indicate the position of the branch on the main chain by prefixing its name with the carbon number to which it is attached
- Separate numbers and letters with a hyphen
- Separate two or more numbers with commas

4. Number the longest carbon chain in the following molecule, circle the substituent groups, and determine each of their names. Then use the information to try to determine the name of the entire molecule:

\[
\begin{align*}
\text{CH}_3 & \\
\text{CH}_2 & \text{CH}_3 \\
\text{CH}_3&-\text{CH}_2-\text{CH}-\text{CH}_2-\text{CH}-\text{CH}_3
\end{align*}
\]
RULE 4
When the same type of branch/substituent occurs more than once:
• Prefix the name (depending on how many times it occurs) with:
  o di
  o tri
  o tetra
• List the number of the carbon branch for that substituent to the name with a separate number for each occurrence
• Separate numbers with commas
• e.g., 3,4-dimethyl or 4,4,6-triethyl

5. Use your knowledge and the information in rule 4 to try to determine the name of the molecule below:

![Molecule](image)

PART C: Practice Naming
a. Given the structures below, name each of the compounds. The structures are drawn in a variety of ways. Remember, carbon always makes four bonds.

1  
![Structure 1](image)

2  
![Structure 2](image)

3  
![Structure 3](image)

4  
![Structure 4](image)
b. Given the names, draw the structural formulas for each:

1. 4 ethyl-2,3-dimethylheptane

2. 2,3-dimethylpentane

3. 2-methylbutane

4. 2-methylhexane
5. 3-methylheptane

6. 4-ethyl-2-methylhexane

7. 3-ethyl-3-methylhexane

8. 2,3-dimethylbutane

9. 2,3,4-trimethylpentane

10. 2,2,4,4-tetramethylpentane

11. 2,3,5-trimethyl-4-propylheptane

12. chloroethane

13. 1-fluoropropane

14. 2-bromopropane

15. 2-chloro-3-methylpentane

16. 2-chloro-4-methylpentane
Part D: Ball and Stick Models
Walk around the room and look at the structures. Using your knowledge of organic naming, write the names of each structure in the space provided below:

1. ______________________________________________________

2. ______________________________________________________

3. ______________________________________________________

4. ______________________________________________________

5. ______________________________________________________