Alkanes
Family: Alkanes

- Alkanes: Hydrocarbons (compounds with only hydrogen and carbons) that contain only single bonds
- Simplest alkane is methane.
- Except in the case of methane, each C must be bound to another C.
- Can be open-chain or cyclic. If open-chain (general formula $C_n H_{2n+2}$), can be straight-chain or branched-chain.
Isomers

- **Isomers**: Compounds that have the same molecular formula but different arrangement of atoms in space

- There are several different types of isomers.
Constitutional Isomers: same molecular formula, but different atom-atom connections

$\text{C}_4\text{H}_{10}$

$4 -\text{C}- + 10 \text{H} \quad \text{gives}$

- Completely different compounds, with different structures, physical properties (melting pt, boiling pt)
Constitutional Isomers

\[ \text{C}_5\text{H}_{12} \]

\[ 5 \overset{\text{C}}{\text{C}} + 12 \overset{\text{H}}{\text{H}} \quad \text{gives} \]

- Straight chain
- Branched chain
- Branched chain

Ex Probs
Conformational Isomers (Conformers): same molecular formula and same atom-atom connections, but different 3D geometries due to rotation about a bond.

- Identical compound with same physical properties; can’t be separated
- Most molecules in the sample have the least crowded, extended conformation.
Different Types of Structural Formulas

1. Full
   - All atoms and bonds are shown.

2. Condensed
   - C-C and C-H bonds are not shown (unless branched).

3. Line
   - Each C-C bond is represented as a line. Every vertex and open end represents a C. Cs and Hs are not shown. (Any atoms other than C or H must be shown.)
1. IUPAC System (International Union of Pure and Applied Chemistry)
2. Common
IUPAC Nomenclature for Alkanes

Refer to Handout: Naming Organic Molecules.

1. **Name parent+suffix**: longest carbon chain + family suffix (-ane).

2. **Number carbons** in parent chain: Begin numbering from end that meets specified criteria (Begin at end nearer to branch point. Then give smallest #s possible to substituents).

3. **Name prefix**: substituent position #s and names (group repeated substituents together using di-, tri-, etc).

4. **Write full name**, listing substituents in alphabetical order (ignore di-, tetra- in alphabetizing).

   **Name Format**: #–substituent–#–substituentparentsuffix
# Names of Parent Alkanes

## Table 12.2 Names of Straight-Chain Alkanes

<table>
<thead>
<tr>
<th>Number of Carbons</th>
<th>Structure</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH₄</td>
<td>Methane</td>
</tr>
<tr>
<td>2</td>
<td>CH₃CH₃</td>
<td>Ethane</td>
</tr>
<tr>
<td>3</td>
<td>CH₃CH₂CH₃</td>
<td>Propane</td>
</tr>
<tr>
<td>4</td>
<td>CH₃CH₂CH₂CH₃</td>
<td>Butane</td>
</tr>
<tr>
<td>5</td>
<td>CH₃CH₂CH₂CH₂CH₃</td>
<td>Pentane</td>
</tr>
<tr>
<td>6</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₃</td>
<td>Hexane</td>
</tr>
<tr>
<td>7</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₃</td>
<td>Heptane</td>
</tr>
<tr>
<td>8</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
<td>Octane</td>
</tr>
<tr>
<td>9</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
<td>Nonane</td>
</tr>
<tr>
<td>10</td>
<td>CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₃</td>
<td>Decane</td>
</tr>
</tbody>
</table>
Names of Alkyl Substituents

• Substituent: An atom or group of atoms attached to a parent compound

• Alkyl substituent: An alkane-derived substituent (To name, change \(-ane\) to \(-yl\)).

Some Common Alkyl Groups*

- CH₃ — Methyl
- CH₃CH₂ — Ethyl
- CH₃CH₂CH₂ — n-Propyl
- CH₃CH₂CH₂CH₂ — n-Butyl
- CH₃CHCH₂CH₃ — sec-Butyl
- CH₃CHCH₂ — Isobutyl
- CH₃CCH₃ — tert-Butyl

*The red bond shows the connection to the rest of the molecule.
Four Substitution Patterns of Carbon

*Primary* carbon (1°) has one other carbon attached.

*Secondary* carbon (2°) has two other carbons attached.

*Tertiary* carbon (3°) has three other carbons attached.

*Quaternary* carbon (4°) has four other carbons attached.

Ex Probs