BASIC NOMENCLATURE

A STUDENT SHOULD BE ABLE TO:

1. Give examples of, and recognize when given the structure, representatives of the following classes of compounds.
   - Alkyl halides (1°, 2°, 3°)
   - Alcohols (1°, 2°, 3°), ethers
   - Amines (1°, 2°, 3°), amides, nitriles

2. Classify carbons and hydrogens attached to sp^3 carbon as 1°, 2°, or 3°.

3. Give the IUPAC names of open-chain alkanes, alkenes (including cis and trans), alkynes, alkyl halides, and alcohols having a longest chain of ten carbons or less when given the structure, and draw the structure given the name. The unbranched alkanes whose names are the basis of this are:

   - methane (1 carbon)  hexane (6 C’s)
   - ethane (2 C’s)      heptane (7 C’s)
   - propane (3 C’s)     octane (8 C’s)
   - butane (4 C’s)      nonane (9 C’s)
   - pentane (5 C’s)     decane (10 C’s)

   The names of the groups you must be able to recognize and draw are:

   - methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl (the unbranched groups)
   - isopropyl
   - isobutyl, sec-butyl, tert-butyl
   - neopentyl
   - vinyl and allyl

4. Give the IUPAC name when given the structure, and give the structure given the IUPAC name, of monocyclic alkanes, alkenes, alkynes, alcohols, and alkyl halides having rings containing 3-10 carbons. These compounds may also contain halogen atoms and side chains.

5. Give the IUPAC name when given the structure, and draw the structure given the name, of bicyclic alkanes. These alkanes may have alkyl groups or halogen atoms as substituents.

6. Give the common name when given the structure, and give the structure when given the common name, of simple alcohols and alkyl halides. In the system used here compounds are named by first naming the alkyl group and then naming the functional group (e. g. ethyl alcohol, neopentyl bromide).
7. Give the common name when given the structure, and draw the structure when given the common name, of unsubstituted monocyclic alcohols and alkyl halides (e.g. cyclobutyl alcohol).

8. Draw the structure when given any of the following common names: ethylene, propylene, isobutylene, acetylene, and alkylacetylenes including any of the alkyl groups named in #3 above. Also, give the name when given the structure of any of these compounds.

9. Know the priority of various functional groups in nomenclature

<table>
<thead>
<tr>
<th>HIGHEST priority</th>
<th>If the group is a substituent, it is called:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carboxylic acid</td>
<td></td>
</tr>
<tr>
<td>Ester</td>
<td></td>
</tr>
<tr>
<td>Acid halide</td>
<td></td>
</tr>
<tr>
<td>Amide</td>
<td></td>
</tr>
<tr>
<td>Nitrile</td>
<td>cyano</td>
</tr>
<tr>
<td>Aldehyde</td>
<td>formyl, oxo</td>
</tr>
<tr>
<td>Ketone</td>
<td>oxo</td>
</tr>
<tr>
<td>Alcohol</td>
<td>hydroxy</td>
</tr>
<tr>
<td>Amine</td>
<td>amino</td>
</tr>
<tr>
<td>Alkyne/alkene</td>
<td>even priority; only if numbering tie, priority to alkene</td>
</tr>
<tr>
<td></td>
<td>Alkyl, halo, alkoxy, phenyl/benzyl</td>
</tr>
</tbody>
</table>
Note: there is no specific chapter on Nomenclature in your textbook as it is introduced in different chapters for particular classes of compounds. Explore on your own for Skill Builder problems in the textbook.

A STUDENT WHO HAS MASTERED THE OBJECTIVES PREVIOUSLY LISTED SHOULD BE ABLE TO SOLVE THE FOLLOWING PROBLEMS AND RELATED ONES:

1.1 Draw the structure of an example of each of the following classes of compounds. Do not use the symbol R.
   a) 2° amine  b) 3° alcohol  c) 1° alkyl halide

1.2 Name the functional group(s) present in each of the following molecules. Indicate 1°, 2°, or 3° when appropriate.
   a) CH₃CH₂OH  b) \[
   \begin{array}{c}
   \text{N} \\
   \text{H}
   \end{array}
   \]  c) \[
   \begin{array}{c}
   \text{OH} \\
   \text{N}
   \end{array}
   \]
   d) CH₃CHClCH₃  b) \[
   \begin{array}{c}
   \text{NH₂}
   \end{array}
   \]
   c) \[
   \begin{array}{c}
   \text{OH}
   \end{array}
   \]

2.1 How many 1°, 2°, and 3° hydrogens are present in each of the following molecules?
   a) (CH₃)₂CHCH₂CH₃  b) \[
   \begin{array}{c}
   \text{CH₂}
   \end{array}
   \]
   c) \[
   \begin{array}{c}
   \text{CH₂CH₃}
   \end{array}
   \]

3.1 Give the IUPAC name of each of the compounds shown.
   a) CH₃CH₂CH₂CH₂CH₃  b) CHCl₃  c) CH₃CH₂CHCH₃
   d) CH₃CH₂CHCH₂CH₃  e) (CH₃)₂CHCHBrCH₂CH₃
   f) (C₂H₅)₂CH(CH₂)₂CH₃  g) \[
   \begin{array}{c}
   \text{CH₃} \\
   \text{CH₃}
   \end{array}
   \]
   \[
   \begin{array}{c}
   \text{CH₃CH₂CHCH₂CHCHCH₃} \\
   \text{CH₃CH₂CHCH₃} \\
   \text{CH₂CH₂CH₃}
   \end{array}
   \]
   h) CH₃CBr₂CH₂CCl₃  i) CH₃CH₂CHCH₂CH₂CH₃
3.2 Draw the structure of each of the compounds named below.

a) 2,2-dimethylbutane  
b) 3,3-dimethyl-1-butanol  
c) 4-ethyl-2,2-dimethylhexane  
d) 1,2-dibromo-2-methylpropane  
e) 4-methyl-2-pentyne  
f) cis-1-bromo-2-pentene

4.1 Give the IUPAC name of each of the compounds shown.

a)  
b) (CH₃)₂CH-  
c)  
d) Cl-Cl

4.2 Draw the structure of each of the compounds named.

a) 1,3-dimethylcyclobutane  
b) 4-neopentylcyclohexanol  
c) 4-isopropylcyclohexene

5.1 Give the name of each of the compounds shown.

a)  
b)  
c) Cl-  
d)
5.2 Draw the structure of each of these compounds.
   a) bicyclo[2.2.0]hexane
   b) 2-isopropylbicyclo[1.1.0]butane
   c) 1,5-diethylbicyclo[3.3.0]octane

6.1 Give the common name of each of the compounds shown.
   a) CH₃CH₂OH     b) CH₃CH₂CH₂Cl     c) (CH₃)₂C-CH₂OH     d) FC(CH₃)₃

6.2 Draw the structure of each of the compounds named.
   a) methyl iodide      b) isobutyl alcohol
   c) isopropyl alcohol   d) sec-butyl bromide

7.1 Give the common name of each of the following compounds.
   a) \[
   \begin{tikzpicture}
   \draw (0,0) circle (0.5cm);
   \draw (0,0) -- (0,0.5cm);
   \draw (0,0) -- (0,-0.5cm);
   \draw (0,0) -- (0.5,0);
   \node at (0,0) {OH};
   \end{tikzpicture}
   \]
   b) \[
   \begin{tikzpicture}
   \draw (0,0) circle (0.5cm);
   \draw (0,0) -- (0,0.5cm);
   \draw (0,0) -- (0,-0.5cm);
   \draw (0,0) -- (0.5,0);
   \draw (0,0) -- (-0.5,0);
   \node at (0,0) {OH};
   \end{tikzpicture}
   \]
   c) \[
   \begin{tikzpicture}
   \draw (0,0) circle (0.5cm);
   \draw (0,0) -- (0,0.5cm);
   \draw (0,0) -- (0,-0.5cm);
   \draw (0,0) -- (0.5,0);
   \draw (0,0) -- (-0.5,0);
   \draw (0.5,0) -- (0.5,0.5);
   \draw (-0.5,0) -- (-0.5,0.5);
   \node at (0,0) {Br};
   \end{tikzpicture}
   \]

7.2 Draw the structures of the following compounds.
   a) cyclopropyl chloride      b) cyclohexyl iodide

8.1 Draw the structures of each of the following compounds.
   a) propylene      b) acetylene      c) ethylacetylene      d) ethylene
SOLUTIONS TO SAMPLE PROBLEMS:

1.1

a) \( \text{NH} \)  

b) \( \text{OH} \)  

c) \( \text{Cl} \)  

1.2

a) 1° alcohol    

b) 2° amine      

c) 2° alcohol    

d) 2° alkyl halide 

e) 1° amine      

f) 3° amine

2.1

a) 9 1°H’s, 2 2°H’s, and 1 3°H’s 

b) 6 1° H’s, 10 2° H’s, and 2 3°H’s 

c) 3 1°H’s, 10 2°H’s, and 1 3°H’s

3.1

a) pentane  

b) trichloromethane  

c) 2-butanol  

d) 3-methylpentane  

e) 3-bromo-2-methylpentane  

f) 3-ethylhexane  

g) 5-isopropyl-3-methyloctane  

h) 3,3-dibromo-1,1,1-trichlorobutane  

i) 2-ethyl-1-pentanol  

j) 2,5-dimethyl-1-hexene  

k) 2,5,5-trimethyl-3-heptyne  

l) trans-1,2-dibromo-1-butene  

m) 2-ethyl-1-butene

3.2

a) 2,2-dimethylbutane 

b) 3,3-dimethyl-1-butanol  

\[ \text{CH}_3 \text{CH}_3 \]

\[ \text{CH}_3 \text{CCH}_2\text{CH}_3 \]

\[ \text{CH}_3 \]

\[ \text{HOCH}_2\text{CH}_2\text{CCH}_3 \]

\[ \text{CH}_3 \]

c) 4-ethyl-2,2-dimethylhexane  

d) 1,2-dibromo-2-methylpropane  

\[ \text{CH}_3 \text{CH}_2\text{CH}_3 \]

\[ \text{CH}_3 \]

\[ \text{CH}_3 \text{CCH}_2\text{CHCH}_2\text{CH}_3 \]

\[ \text{CH}_3 \]

\[ \text{CH}_2\text{CCH}_3 \]

\[ \text{Br} \text{Br} \]

e) 4-methyl-2-pentyne  

f) cis-1-bromo-2-pentene  

\[ \text{CH}_3\text{C}=\text{CCHCH}_3 \]

\[ \text{CH}_3 \]

\[ \text{BrCH}_2 \text{CH}_2\text{CH}_3 \]

\[ \text{C}=\text{C} \text{H} \text{H} \]

4.1

a) cycloheptane   

b) isopropylcyclopentane  

c) 2-methylcyclobutanol  

d) 1,4-dichlorocyclohexene
4.2  a) 1,3-dimethylcyclobutane  b) 4-neopentylcyclohexanol  c) 4-isopropylcyclohexene

\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
& \quad \text{HO-CH}_2\text{C-CH}_3 \\
& \quad \text{CH}_3
\end{align*}
\]

5.1  a) bicyclo[4.3.0]nonane  b) bicyclo[3.2.1]octane  
      c) 7-chlorobicyclo[4.1.1]octane  d) 1,6-dimethylbicyclo[3.2.0]heptane

5.2  The structures are:

\[
\begin{align*}
\text{a)} & \quad \text{b)} & \quad \text{c)} \\
\text{CH}_2\text{CH}_3 & \quad \text{CH}_2\text{C-CH}_3 & \quad \text{CH}_2\text{C-CH}\text{CH}_3
\end{align*}
\]

6.1  a) ethyl alcohol  b) propyl chloride  c) neopentyl alcohol  d) tert-butyl fluoride

6.2  a) methyl iodide  b) isobutyl alcohol  c) isopropyl alcohol  d) sec-butyl bromide

\[
\begin{align*}
\text{CH}_3\text{I} & \quad (\text{CH}_3)\text{CHCH}_2\text{OH} & \quad (\text{CH}_3)\text{CHOH} & \quad \text{CH}_3\text{CHBrCH}_2\text{CH}_3
\end{align*}
\]

7.1  a) cyclopentyl alcohol  b) cyclohexyl alcohol  c) cyclobutyl bromide

7.2  a) cyclopropyl chloride  b) cyclohexyl iodide

\[
\begin{align*}
\text{Cl} & \quad \text{I}
\end{align*}
\]

8.1  a) propylene  b) acetylene  c) ethylacetylene  d) ethylene

\[
\begin{align*}
\text{CH}_3\text{CH}=&\text{CH}_2 & \quad \text{H-C}=\text{C-H} & \quad \text{CH}_3\text{CH}_2\text{C}=\text{C-H} & \quad \text{H}_2\text{C}=\text{CH}_2
\end{align*}
\]
1. Name the functional group in each of the following compounds, indicating 1°, 2°, or 3° if appropriate.

   a) CH₃CHOHCH₂CH₃  
   b)  
   c)  
   d)  

2. Give specific examples (don’t use R) for each of the following types of compounds.

   a) 3° alcohol  
   b) 2° alkyl iodide  
   c) 3° amine

3. Name Cl₃CCH₂Cl

4. Name (CH₃)₂CH(CH₂)₃CH(CH₃)₂

5. Draw neopentylcyclohexane

6. Draw 2,4-dibromo-3-ethylhexane

7. Name BrCHCH₂CH₂CHCH₃CH₃

   |CH₂|CHOH
   |CH₃|   |

8. Draw 3,3-dimethylcyclobutanol

9. Name:

10. Name:
11. Name

12. Draw cyclopentyl fluoride

![Cyclopentyl fluoride structure](attachment:structure.png)

13. Name

14. Give a structure for: propylacetylene

![Propylacetylene structure](attachment:structure2.png)

15. Name:

16. Give a structure for:
4-methyl-1-neopentylbicyclo[3.2.1]octane

![Structure of 4-methyl-1-neopentylbicyclo[3.2.1]octane](attachment:structure3.png)

17. Give a structure for: allyl alcohol
1. Draw the structure of an example (do not use R) of each of the following classes of compounds.
   a) primary alcohol  
   b) amide  
   c) 2° alkyl bromide

2. What family does each of the compounds shown belong to? Be specific; indicate 1°, 2°, or 3° if appropriate.
   a)  
   b)  
   c) CH₃NHCH₃

3. Name:  

4. Give a structure for:  
   1,3-di-tert-butylcyclohexene

5. Name:  

6. Give a structure for: vinyl chloride

7. Name BrCH₂CH₂CHBr₂  

8. Give a structure for: 2,3-dimethylpentane
9. Name:  
![Structure](image1.png)

10. Give a structure for:  
2,2-dimethylbicyclo[3.2.1]octane

11. Name: BrCHCH\_2CHCH\_3  
\[\text{\[CH\_2\]} \quad \text{\[CHOH\]} \quad \text{\[CH\_2I\]} \quad \text{\[CH\_2Cl\]} \]

12. Give a structure for:  
4-\textit{tert}-butyl-4-ethylcyclohexanol

13. Name:  
![Structure](image2.png)

14. Give a structure for:  
3,5-dichloro-4-iodononane

15. Name:  
![Structure](image3.png)

16. Give a structure for:  
\textit{sec}-butyl alcohol

17. Name:  
![Structure](image4.png)