1. Name the following molecules:

2. Circle all the chiral carbons in question 1.

3. Suppose you were performing an esterification reaction with acetic acid and 2-butanol.
   (a) What is the name of the ester produced?

   (b) What catalyst is needed to speed up this reaction?

   (c) List ALL the things you could do to the equilibrium to favor the production of more ester.
4. Complete the following reactions:

\[
\begin{align*}
\text{\[\text{alkane}\]} & \xrightarrow{\text{base}} \text{\[\text{alkane \Cl}\]} \\
\text{\[\text{alkane}\]} & \xrightarrow{\Delta} \text{\[\text{alkene}\]} \\
\text{\[\text{cyclopentene}\]} & \xrightarrow{\text{H}_2\text{O}} \\
\text{\[\text{acid}\]} & \xrightarrow{\text{KMnO}_4} \text{\[\text{alkene}\]}
\end{align*}
\]

5. Suppose you had a large carboxylic acid mixed with some neutral junk impurities, neither of which were soluble in water. Suggest a method for separating out the carboxylic acid from the undesirable impurities.

6. Explain in general terms how a racemic mixture is resolved.
1. Name the following molecules:

- 2,6,7-trichloro-4-isopropyl-3-methyl-1-octene
- 1,6-dibromo-5,5-dimethyl-3-heptene
- 5-chloro-2-isopropyl benzoic acid
- 2-tetrahydro-3-ethyl pentanoic acid
- trans-5,6,7-trimethyl 2-nonene
- Cyclohexyl phenyl ether
- 2,7-dibromo-6-ethyl-7,9-dimethyl-4-decyn
- 3,4-dimethyl propionic acid

2. Circle all the chiral carbons in question 1.

3. Suppose you were performing an esterification reaction with acetic acid and 2-butanol.
   
   (a) What is the name of the ester produced?

   sec-butyl acetate (sec-butyl ethanoate)

   (b) What catalyst is needed to speed up this reaction?

   H+ (acid)

   (c) List ALL the things you could do to the equilibrium to favor the production of more ester.

   - Add more of a reactant
   - Remove a product
   - Heat if endo, cool if exo
4. Complete the following reactions:

\[
\begin{align*}
\text{H} & \quad \xrightarrow{\text{Cl}_2, \text{uv light}} \quad \text{H} \text{Cl} \\
\text{X} & \quad \xrightarrow{\text{base, } \Delta} \quad \text{Y} \\
\text{C} & \quad \xrightarrow{\text{H}_2\text{O, } \text{acid}} \quad \text{C} \text{OH} \\
\text{Z} & \quad \xrightarrow{\text{excess } \text{KMnO}_4} \quad \text{Z} \text{CO}_2
\end{align*}
\]

5. Suppose you had a large carboxylic acid mixed with some neutral junk impurities, neither of which were soluble in water. Suggest a method for separating out the carboxylic acid from the undesirable impurities.

Add a base like NaOH. The carboxylic acid will dissolve but not the neutral junk (filter off and discard). Then add acid (like HCl) to precipitate the carboxylic acid. Filter + Keep!

6. Explain in general terms how a racemic mixture is resolved.

Add another chiral compound (R* for example) to form diastereomers. Now separate according to the most convenient physical properties. Lastly, remove the R* that you added to get back to the original enantiomers.
1. Name the following:

2. For all the molecules in question 1, indicate the number of chiral carbons.
3. Complete the following reactions:

\[ \text{HBr} \rightarrow \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (-0.5,1) -- (-0.5,0) -- (-1,0);
    \draw (0.5,1) -- (0.5,0) -- (1,0);
    \draw (0,0) -- (0,-1);
    \end{tikzpicture}} \]

\[ \text{NH}_\text{OH} \rightarrow \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (-0.5,1) -- (-0.5,0) -- (-1,0);
    \draw (0.5,1) -- (0.5,0) -- (1,0);
    \draw (0,0) -- (0,-1);
    \draw (1,0) -- (1,-1);
    \end{tikzpicture}} \]

\[ \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (0,0) -- (0,1);
    \draw (0,0) -- (1,0);
    \draw (0,0) -- (-1,0);
    \end{tikzpicture}} \rightarrow \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (0,0) -- (0,1);
    \draw (0,0) -- (1,0);
    \draw (0,0) -- (-1,0);
    \draw (1,0) -- (1,-1);
    \draw (-1,0) -- (-1,-1);
    \end{tikzpicture}} \]

\[ \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (0,0) -- (0,1);
    \draw (0,0) -- (1,0);
    \draw (0,0) -- (-1,0);
    \draw (0,0) -- (0,-1);
    \end{tikzpicture}} \rightarrow \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (0,0) -- (0,1);
    \draw (0,0) -- (1,0);
    \draw (0,0) -- (-1,0);
    \draw (0,0) -- (0,-1);
    \draw (0,0) -- (0,1);
    \draw (1,0) -- (1,-1);
    \draw (-1,0) -- (-1,-1);
    \end{tikzpicture}} \]

4. Consider the molecule ethyl methyl amine.
   (a) Draw an isomer that is more basic:

   \[ \text{\begin{tikzpicture}
    
    \draw (0,0) circle (0.5cm);
    \draw (0,0) -- (0,1);
    \draw (0,0) -- (1,0);
    \draw (0,0) -- (-1,0);
    \draw (0,0) -- (0,-1);
    \draw (0,0) -- (0,1);
    \draw (1,0) -- (1,-1);
    \draw (-1,0) -- (-1,-1);
    \end{tikzpicture}} \]

   (b) Draw an isomer that is less basic.

5. Consider the molecule 3-chloropropanoic acid.
   (a) Draw an isomer that is more acidic.

   (b) Draw an isomer that is less acidic.

6. What is the difference between...
   (a) Constitutional isomers and stereoisomers

   (b) Enantiomers and diastereomers

   (c) Enthalpy (\(\Delta H\)) and activation energy
1. Name the following:

- 4-chloro-3,3-dimethyl cyclohexanone
- 2-tert-butyl-6-chloro-4-nitro aniline
- Cyclohexyl phenyl ether
- 3-sec-buty1-5-chloro-4-methyl-1-heptyne
- 4,4-dichloro-7-ethyl-5-indole-8-methyl naphthalene
- N,N-diethyl-3-methyl-N-propyl pentamidine
- di-isopropyl propyl quinine

2. For all the molecules in question 1, indicate the number of chiral carbons:

```
1 0 0
0 4 2
2 0 0 0
```
3. Complete the following reactions:

\[
\begin{align*}
\text{pentane} & \xrightarrow{\text{HBr}} \quad \text{br} \\
\text{methylamine} & \xrightarrow{2\text{KOH}} \quad \text{carboxylic acid} \\
\text{propylene} & \xrightarrow{\text{H}_2\text{O}} \quad \text{alcohol} \\
\text{acrylonitrile} & + \text{HOY} \xrightarrow{\text{H}^+} \quad \text{ester} \\
\text{X-Y} & \xrightarrow{\text{Cl}_2} \quad \text{XY-Cl} \\
\text{alkane} & \xrightarrow{\text{LiAIH}_4} \quad \text{amine} + \text{RX}
\end{align*}
\]

4. Consider the molecule ethyl methyl amine.
   (a) Draw an isomer that is more basic:

   \[
   \begin{align*}
   \text{ethyl methyl amine} & \\
   \text{more basic isomer}
   \end{align*}
   \]

   (b) Draw an isomer that is less basic.

   \[
   \begin{align*}
   \text{less basic isomer}
   \end{align*}
   \]

5. Consider the molecule 3-chloropropanoic acid.
   (a) Draw an isomer that is more acidic.

   \[
   \begin{align*}
   \text{3-chloropropanoic acid} & \\
   \text{more acidic isomer}
   \end{align*}
   \]

   (b) Draw an isomer that is less acidic.

   \[
   \begin{align*}
   \text{less acidic isomer}
   \end{align*}
   \]

6. What is the difference between...
   (a) Constitutional isomers and stereoisomers

   \[
   \begin{align*}
   \text{constitutionally different} & \quad \text{same chemical structure} \\
   \text{stereoisomers} & \quad \text{same chemical structure, different spatial arrangement}
   \end{align*}
   \]

   (b) Enantiomers and diastereomers

   \[
   \begin{align*}
   \text{perfect mirror images} & \quad \text{mirror images, not the same}
   \end{align*}
   \]

   (c) Enthalpy (\(\Delta H\)) and activation energy

   \[
   \begin{align*}
   \text{energy difference between products and reactants} & \quad \text{energy required to "start" a reaction}
   \end{align*}
   \]
1. Name the following:

\[
\begin{align*}
\text{CH}_3 & \quad \text{NO}_2 \quad \text{O} \\
\text{Cl} & \quad \text{Br} \\
\text{O} & \quad \text{N} \\
\text{C}_5H_11 & \quad \text{N} \\
\text{O} & \quad \text{C}_5H_11 \\
\text{Cl} & \quad \text{Br} \\
\text{Cl} & \quad \text{Cl} \\
\end{align*}
\]

2. For the molecules in question 1, indicate the number of chiral carbons.
3. Complete the following reactions:

\[
\text{2kNO}_3 \rightarrow \text{Cyclic \ compound}
\]

\[
\text{Cyclic \ compound} \rightarrow \text{Cyclic \ compound with \ OH}
\]

\[
\text{OH} \rightarrow \text{Cyclic \ compound with \ OH}
\]

\[
\text{Cyclic \ compound with \ OH} \rightarrow \text{Cyclic \ compound}
\]

4. Imagine a molecule that had four chiral carbons adopted the RRSR configuration.
   (a) What is the enantiomer?
   (b) List ALL the diastereomers of this molecule.

5. Enantiomers generally have identical properties, with what two exceptions?

6. How are oxidation and reduction defined in organic chemistry?

7. Isomers are broadly split into two categories. What are they? One of these categories is further split into two more categories. What are they?
1. Name the following:

- \( \text{N}-\text{ethyl-N,N-dimethylheptanamide} \)
- \( \text{5-bromo-2-methyl-2-nitrobenzoic acid} \)
- \( \text{Benzyl bromide ether} \)
- \( \text{Cyclopropyl octanoate} \)
- \( \text{Secthyl ethyl isopropyl quinone} \)
- \( \text{6-ethyl-3,7-dimethylnonanone} \)
- \( \text{4-chloro-3,3-dimethyl cyclopentene} \)
- \( \text{5-buty1-3,4-dichloro-2,2-dimethylcyclopentanone} \)
- \( \text{5-bromo-3,3,4-trimethyl-1-ptyne} \)
- \( \text{trans-7-chloro-6,6-dimethyl-3-heptone} \)
- \( \text{4-tert-butyl-5-chloro-3-methyl heptanone} \)

2. For the molecules in question 1, indicate the number of chiral carbons.

\[
\begin{array}{c}
3 & 0 & 0 \\
0 & 1 & 3 \\
3 & 1 & 0 & 3
\end{array}
\]
3. Complete the following reactions:

\[
\begin{align*}
\text{OH} & \quad \xrightarrow{2\text{KOH}} \quad \text{OH} \\
\text{H}_2\text{O} & \quad \xrightarrow{\text{ac.}} \quad \text{OH} \\
\text{OH} & \quad \xrightarrow{\text{LiAIH}_4} \quad \text{N. R} \text{Sn} \\
\text{OH} & \quad \xrightarrow{2\text{LiAIH}_4} \quad \text{OH} \\
\end{align*}
\]

4. Imagine a molecule that had four chiral carbons adopted the RRSR configuration.
   (a) What is the enantiomer? SSSR
   (b) List ALL the diastereomers of this molecule.
   
   \[
   \begin{array}{cccc}
   \text{RRRR} & \text{RRSS} & \text{SSSR} & \text{RRSS} \\
   \text{RRSR} & \text{RRSS} & \text{SSSR} & \text{SSRR} \\
   \text{SSRR} & \text{SSRS} & \text{SSRR} & \text{SSSS} \\
   \end{array}
   \]

5. Enantiomers generally have identical properties, with what two exceptions?
   - Rotation of plane-polarized light
   - Intraclass of other chiral molecule

6. How are oxidation and reduction defined in organic chemistry?

\[
\begin{align*}
\xrightarrow{\text{O}} & \quad \text{H} \quad \xleftarrow{\text{O}} & \quad \text{OH} \quad \text{or} \quad \text{H} \\
\end{align*}
\]

7. Isomers are broadly split into two categories. What are they? One of these categories is further split into two more categories. What are they?

\[
\begin{array}{c}
\text{Isomer} \\
\text{Constitutional} \\
\text{Stereoisomer} \\
\text{Optical}
\end{array}
\]